AGRA DEVELOPMENT AUTHORITY

Ratan Muni Road, Jaipur House Colony, Agra-282010.
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REQUEST FOR PROPOSAL

For

Selection of Contractor for Integrated Infrastructure Development Works, in Atal Puram Township at Gwalior Road Agra in the State of Uttar Pradesh on EPC basis

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PRESS NOTICE

AGRA DEVELOPMENT AUTHORITY, AGRA

NOTICE INVITING e-TENDER

NIT No:. **Tender/……./……/** **Date: XX-XX-2025**

The undersigned, on behalf of Agra Development Authority, invites online bids for the Survey, Investigation and Collect all primary and secondary data to undertake Detailed Engineering, Procurement, Construction, Testing and Commissioning of All Components of Atal Puram Township in Agra which include, Road, Minor Bridge, Culvert, Road Side Plantation & Arboriculture, Storm Water Drainage, Potable Water Supply & Recycle Water System, Waste Water System, Power Infrastructure, Smart Street Lighting System, Utility Ducts, Solid Waste Management, Site Grading & Levelling, Rain Water Harvesting, Security & Surveillance, landscape for parks and boundary wall in Atal Puram Township at Agra in the State of Uttar Pradesh on Design, Engineering, Procurement and Construction (EPC) basis, followed by 3 years of Defect Liability, 5 years of operation and maintenance for Roads, footpath, tracks, arboriculture, street lights, ICT, Parks, plazas and gardens, networks of water, sewer, recycled water, storm drain and rain water harvesting and 10 years of operation and maintenance of WTP and STP after commissioning. The power system network and substation operation and maintenance are excluded from eligible Bidders through e- tendering in two Bid System for the following work:-

Name and Description of Work	Estimated cost	Construction Period of Work	Last date to fill/upload the Bid through e-tendering	Bid Document Cost	Bid Processing Fee	EMD Amount
Selection of Contractor for Integrated Infrastructure Development Works, in Atal Puram Township at Agra in the State of Uttar Pradesh on EPC basis	Rs. 413.15 /- Cr. (Rupees Four Hundred Thirteen Crore & Fifteen Lakh) only including O&M	30 Months plus 5 years Operation & Maintenance including Three years of Defect Liability Period (except Power Infrastructure) and 10 years of operation and maintenance of WTP and STP after commissioning	24-03-2025 upto 05:00 PM	Rs 1,25,000/- (Rupees One Lakhs Twenty-Five thousand) only + 18% GST (Non-Refundable) = Rs 1,47,500/- (Rupees One Lakhs Forty-Seven Thousand Five hundred) only.	Rs. 4,13,000/- + 18% GST = Rs. 4,87,000/- (Rupees Four Lakhs Eighty-Seven Thousand) only.	Rs 4.13/- Cr (Rupees Four Crore Thirteen Lakh) only.

- The Bid document shall be available online on *https://etender.up.nic.in, etenders.gov.in, eprocure.gov.in* from 21/02/2025 at 12 PM to 24/03/2025 upto 05:00 PM & the last date of submission of Bid document shall be 24/03/2025 upto 05:00 PM (Online). Opening of Technical Bid shall be at 25/03/2025 at 11:00 AM.

- For submission & other tender details, please refer detailed NIT available on websites e-tender portal https://www.etender.up.nic.in. Other details are also available on *etenders.gov.in, eprocure.gov.* and Corrigendum/amendments etcetera, if any, will be notified on these websites only and separate advertisement will not be made for the same.
- Agra Development Authority (ADA) reserves the right to accept or reject any application without assigning any reason or incurring any liability whatsoever.
- Pre bid meeting for this project will be held on 06/03/2025 at 11:30 AM.

s/d
Chief Engineer
AGRA DEVELOPMENT AUTHORITY
Ratan Muni Road, Jaipur House Colony,
Agra-282010, Uttar Pradesh, India

Agra Development Authority (ADA)

Ratan Muni Road, Jaipur House Colony, Agra-282010, Uttar Pradesh

e - Procurement Notice

NOTICE INVITING E-TENDERS (NIT) IN EPC MODE

NIT No:. **Tender/……./……/** **Date: XX-XX-2025**

Atal Puram Townships being developed at Kakua, Bhandai Village, Agra under the Agra Development Authority.

The undersigned, on behalf of Agra Development Authority, invites online bids for the work mentioned in table below through e- procurement from eligible contractors having national and/ or international experience in Infrastructural Development Works. In the event bidder is a Joint Venture, the Joint Venture shall have to get themselves registered with the Agra Development Authority, Agra in case the project is awarded to them within two months from the date of award. The bid shall be submitted online in the website http://Uttar Pradeshtenders.gov.in. The bidder(s) should have necessary portal enrolment with their own DSC.:

Name and Description of work	Selection of Contractor for Integrated Infrastructure Development Works, in Atal Puram Township at Agra in the State of Uttar Pradesh on EPC basis
Estimated cost	Rs. 413.15 /- Cr. (Rupees Four Hundred Thirteen Crore & Fifteen Lakh) only including O&M
Completion period of Work	30 months + 5 years of O&M for all components except power and 10 years O&M for WTP & STP including DLP of 3 years
Date of availability of Bid document Online	21/02/2025 at 12:00 PM
Date & time of pre- Bid meeting	06/03/2025 at 11:30 AM
Last date to fill/ upload the Bid through e-tendering	24/03/2025 upto 05:00 PM
Date of opening of Technical Bids	25/03/2025 at 11:00 AM
Date of opening of Financial Bids	To be communicated later to the Technically Qualified Bidders only
Bid Document Cost	Rs 1,25,000/- (Rupees One Lakhs Twenty-Five thousand) only + 18% GST (Non-Refundable) = Rs 1,47,500/- (Rupees One Lakhs Forty-Seven Thousand Five Hundred)
Bid Processing Fee	Rs. 4,13,000/- + 18% GST = Rs. 4,87,000/- (Rupees Four lakhs eighty-seven thousand only including GST)
EMD amount (Rs.)	Rs 4.13/- Cr (Rupees Four Crore Thirteen Lakh) only.

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- The Bid document shall be available online on *https://etender.up.nic.in, etenders.gov.in, eprocure.gov.in* from 21/02/2025 at 12 PM to 24/03/2025 upto 05:00 PM
- The Bidders would be required to register at https://www.etender.up.nic.in. The Bid document will be available online as per schedule above for submission of the Bids. The intended applicants are advised to procure digital signature certificate (Class-III) from UP Electronics Corporation Ltd Lucknow, to participate in e-tender process. Last date of submission of Bid document 24/03/2025 upto 5:00 PM (Online). Opening of Technical Bid shall be 25/03/2025 11:00 AM.
- The documents to be uploaded online are listed at Annexure I of the NIT & ITB (Vol. 1). The complete set of Tender Documents comprising seven Volumes I, II, III, IV, V, VI, VII shall be made available, as per schedule, on e-tender portal www.etender.up.nic.in. Other details are also available on *etenders.gov.in, eprocure.gov.in* and Corrigendum/amendments etcetera, if any, will be notified on these websites only and separate advertisement will not be made for the same.
- NIC registration is compulsory to submit bid documents on above mentioned website.
- Pre bid meeting for this project will be held on 06/03/2025 at 11:30 AM at the Agra Development Authority (ADA) office.
- The queries can be sent to mailID- ceadaagra12@gmail.com. The Bidders shall have to send the queries in both pdf format as well as word format.
- Agra Development Authority (ADA) reserves the right to accept or reject any application without assigning any reason or incurring any liability whatsoever.
- Prospective Bidders are advised to regularly scan through website *https://etender.up.nic.in, etenders.gov.in, eprocure.gov.in* e-tender portal, as corrigendum/amendments etcetera, if any, will be notified on this portal only and separate advertisement will not be made for the same. The Bids shall remain valid for acceptance for a period of 180 days from the date of opening of Technical Bids.
- Any Bidder who is having criminal record is not allowed to participate in the Bidding process.
- Any Bidder who is registered with the State Bar Council is not allowed to participate in the Bidding process.
- 1% labour cess will be deducted from the Contractor's Bill.
- The Qualified Bidder shall have to register all the laborers employed in the project with the labour department. The associated/ sub-contractors have also to comply accordingly.
- Conditional bids shall be rejected
- Bids submitted with Discrepancies shall be rejected (clarifications will not be sorted from the bidders). ADA will inform about the discrepancies for rejection on the portal.
- **Original MM-11 forms proof of royalty shall have to be produced at time of every running bill in accordance to G.O. no. 115(1)/86-2020 dated 15-01-2020 for all the materials procured from the quarries.**

s/d
Chief Engineer
AGRA DEVELOPMENT AUTHORITY
Ratan Muni Road, Jaipur House Colony,
Agra-282010, Uttar Pradesh, India

DISCLAIMER

This document has been prepared by Agra Development Authority, as Executing Agency for the Project. The information is provided to prospective Bidders, who are interested to Bid for "Survey, Investigation and Collect all primary and secondary data to undertake Detailed Engineering, Procurement, Construction, Testing and Commissioning of All Components of Atal Puram Township in Agra which include, Road, Minor Bridge, Culvert, Road Side Plantation & Arboriculture, Storm Water Drainage, Potable Water Supply & Recycle Water System, Waste Water System, Power Infrastructure, Smart Street Lighting System, Utility Ducts, Solid Waste Management, Site Grading & Levelling, Rain Water Harvesting, Security & Surveillance, landscape for parks and boundary wall in Atal Puram Township at Agra in the State of Uttar Pradesh on Design, Engineering, Procurement and Construction (EPC) basis, followed by 3 years of Defect Liability, 5 years of operation and maintenance for Roads, footpath, tracks, arboriculture, street lights, ICT, Parks, plazas and gardens, networks of water, sewer, recycled water, storm drain and rain water harvesting and 10 years of operation and maintenance of WTP and STP after commissioning. The power system network and substation operation and maintenance are excluded.".

This document is neither an agreement, nor an offer or invitation to perform work of any kind to any party.

The purpose of this document is to provide interested parties with information to assist the preparation of their Bid. While due care has been taken in the preparation of the information contained herein, and believe it to be complete and accurate, neither any of their authorities or agencies nor any of their respective officers, employees, agents or advisors give any warranty or make any representations, expressed or implied as to the completeness or accuracy of the information contained in this document or any information which may be provided in association with it.

Further, Agra Development Authority (ADA) does not claim that the information is exhaustive. Interested parties are required to make their own inquiry/ survey and will be required to confirm, in writing, that they have done so and they did not rely solely on the information given herein and indemnifies Agra Development Authority from any loss/es, damages happening due to use of information in this document.

Agra Development Authority (ADA) reserve the right not to proceed with the Project or to change the configuration of the Project, to alter the timetable reflected in this document or to change the process or procedure to be applied. It also reserves the right to decline to discuss the Project further with any interested party.

No reimbursement of cost of any type or on any account will be made to persons or entities submitting their Bid.

DEFINITION

1. **"Application"** shall mean the response submitted by interested parties.

2. **"Project"** shall mean Survey, Investigation and Collect all primary and secondary data to undertake Detailed Engineering, Procurement, Construction, Testing and Commissioning of All Components of Atal Puram Township in Agra which include, Road, Minor Bridge, Culvert, Road Side Plantation & Arboriculture, Storm Water Drainage, Potable Water Supply & Recycle Water System, Waste Water System, Power Infrastructure, Smart Street Lighting System, Utility Ducts, Solid Waste Management, Site Grading & Levelling, Rain Water Harvesting, Security & Surveillance, landscape for parks and boundary wall in Atal Puram Township at Agra in the State of Uttar Pradesh on Design, Engineering, Procurement and Construction (EPC) basis, followed by 3 years of Defect Liability, 5 years of operation and maintenance for roads, footpath, tracks, arboriculture, street lights, ICT, Parks, plazas and gardens, networks of water, sewer, recycled water, storm drain and rain water harvesting and 10 years of operation and maintenance of WTP and STP after commissioning. The power system network and substation operation and maintenance are excluded.

3. **"Site"** shall mean the place where the works under the Project are to be carried out and the details of which are provided in this document.

4. **"BID/Tender"** shall mean documents issued by ADA to the prospective Bidder. The word "**Tender**" is synonymous with "**Bid**".

5. **"Bid Security/ Earnest Money"** shall mean the amount to be deposited by the Bidder with the Tender.

6. **"Bid Validity"** shall mean the period for which the Bids shall remain valid.

7. **"Bidder"** shall mean the individual, proprietary firm, firm in partnership, limited company, private or public or corporation participating in the tendering process pursuant to and in accordance with the terms of this document. The word "**Tenderer**" is synonymous with "**Bidder**".

8. **"ADA"** shall mean The Vice Chairman ADA or their nominee/ assignee.

9. **"ADAs Representative"** shall mean the the person named by the ADA in the Contract or appointed from time to time by the ADA who acts on behalf of the ADA

10. **"PMC"** shall mean the name of the consultancy firm to assist the Engineer-in – charge.

11. **"Engineer-in-charge"** shall mean the **Executive Engineer, Engineering Division, ADA**

12. **"Contract Agreement"** shall mean the agreement to be signed between the Successful Tenderer and the competent authority for and on behalf of ADA or their authorized representative.

13. **"Contract Price"** shall mean the negotiated financial Bid of the Successful Tenderer as accepted by ADA.

14. **"Date of commencement of work"** shall mean the date of Start as specified in the **Schedule "F"** or the date of handing over of the site, whichever is later as indicated in the tender document.

15. **"Defects Liability Period"** means the period after completion with commissioning and handover of the Project during which ADA or its authorized representative / Engineer-in-charge that will notify to the Contractor any defect noticed in the work and the Contractor is liable for rectification of such defects. Proof of dispatch of letter notifying the defect/ intimating the representative of Contractor at site on the last date of Defect liability period will make the Contractor liable for rectify all such defects.

16. **"Evaluation Committee"** shall mean the committee for the evaluation of the Bids as constituted by ADA for evaluation of bid.
17. **"EPC"** shall mean Engineering, Procurement and Construction, here includes Commissioning Operations and Maintenance.
18. **"DLP"** shall mean Defect Liability period.
19. **"U.P."** shall mean Uttar Pradesh.
20. **"Successful Tenderer"** shall mean the Tenderer declared technically and financially successful for the Project and with whom, the Contract Agreement shall be signed.
21. **"Letter of Award (LOA)"** shall mean the letter issued by ADA to the Successful Tenderer inviting him to sign the Contract Agreement.
22. **"Performance Bank Guarantee"** shall mean the amount to be paid by the Successful Tenderer as per relevant clause mentioned elsewhere.
23. **"Processing Fee**" shall mean the amount to be paid by the Bidders/Tenderers in consideration of cost of Bid document.
24. "**Similar Works**" shall mean the work as defined in eligibility criteria.
25. **"Nationalised banks"** mean **"Nationalised Commercial Banks operational in Agra**"
26. **"NIT"** means **Notice Inviting e-Tender.** The word "**Notice Inviting e- Tender**" is synonymous with "**Notice Inviting Bids**".
27. **"ITB"** means **Instructions to Bidders**
28. **"YEAR"** means "Financial Year" unless stated otherwise.
29. **"GST"** shall mean Goods and Service Tax.
30. **"ADA"** shall mean Agra Development Authority.
31. **"Authority"** shall mean Agra Development Authority.
32. **"FEED"** Front End Engineering Design

SECTION -I

INVITATION FOR BID (IFB)

1. The Agra Development Authority (herein called "ADA") executes the Site Grading & Levelling, Road, Minor Bridge, Culvert, Underpass, Storm Water Drainage Network, Rain Water Harvesting System, Potable Water Supply & Recycled Water Supply Network, Waste Water System, Power Infrastructure, Smart Street Lighting System, Utility Ducts, Solid Waste Management, Security & Surveillance including carrying out detailed survey & investigation for all works and utilizing both primary & secondary data collected in this regard; getting approved the so prepared designs and drawings; carrying out construction of all the works mentioned above in two and half years' time and thereafter carrying out operation and maintenance of all these works,. There will be a Defect Liability Period (DLP) of 3 years commencing from the date of Completion Certificate in which the bidder is supposed to carry out all type of rectification to the satisfaction of the Owner. The successful bidder shall be responsible for the Operation & Maintenance of the Project for period of five years commencing from the date of Completion Certificate for all components except Power, STP and WTP. The O&M for STP & WTP will be 10 years after commissioning and the power system network and substation operation and maintenance are excluded. The responsibility of work as stated above sanctioned under budgetary provisions of ADA and their maintenance, is also with the Authority. ADA invites on-line Bids on Design, Engineering, Procurement and Construction (EPC) including Operation & Maintenance basis from Eligible Bidders, in two Bid system, through e-tendering.

   1.1. The estimated cost of work is as given in Table – I below. The below Table-1 will deal with all the matters relating to invitation of tenders. Any clarification shall be sought from Chief Engineer, Agra Development Authority, ADA, Agra. The NIT and other details are available on the website of e-tender portal *https://etender.up.nic.in, etenders.gov.in, eprocure.gov.in*

Table -1

Name and Description of work	Selection of Contractor for Integrated Infrastructure Development Works, in Atal Puram Township at Agra in the State of Uttar Pradesh on EPC basis.
Estimated cost	Rs. 413.15 /- Cr. (Rupees Four Hundred Thirteen Crore & Fifteen Lakh) only including O&M
Completion period of Work	30 months + 5 years of O&M for all components except power and 10 years O&M for WTP & STP including DLP of 3 years
Date of availability of Bid document Online	21/02/2025 at 12:00 PM
Date & time of pre- Bid meeting	06/03/2025 at 11:30 AM
Last date to fill/ upload the Bid through e-tendering	24/03/2025 upto 05:00 PM
Date of opening of Technical Bids	25/03/2025 at 11:00 AM
Date of opening of Financial Bids	To be communicated later to the Technically Qualified Bidders only
Bid Document Cost	Rs 1,25,000/- (Rupees One Lakhs Twenty-Five thousand) only + 18% GST (Non-Refundable) = Rs 1,47,500/- (Rupees One Lakhs

	Forty-Seven thousand Five hundred)
Bid Processing Fee	Rs. 4,13,000/- + 18% GST = Rs. 4,87,000/- (Rupees Four lakhs eighty-seven thousand only including GST)
EMD amount (Rs.)	Rs 4.13/- Cr. (Rupees Four Crore Thirteen Lakh) only.

1.2. General Information: -

Pre-Bid conference shall be held on date 06/03/2025 at 11:30 am in the Agra Development Authority Office The queries can be sent to mail ID- ceadaagra12@gmail.com by 10/03/2025 upto 5:00 PM. The Bidders shall have to send the queries in both pdf format as well as word format.

Representatives (2 nos. maximum) of each prospective Bidder shall be allowed to participate on production of authorisation letter from the Bidder. During the course of Pre- Bid meeting, the Bidders will be free to seek clarifications and make suggestions for consideration. The Agra Development Authority shall endeavour to provide clarifications and such further information as it may, in its sole discretion, consider appropriate for facilitating a fair, transparent and competitive Bidding process.

Bidders are hereby informed that it is mandatory to submit the bids with proper indexing, page numbers and signatures along with the official stamp.

1.3. The intending Bidder must read the terms and conditions of Notice Inviting e- tender and the Bid Documents carefully. He should only submit his Bid if he considers himself eligible and he is in possession of all the documents required. Intending Bidder is eligible to submit the Bid provided he has definite proof from the appropriate authority, which shall be to the satisfaction of the competent authority of the respective department, of having satisfactorily completed the works given in the Eligibility Criteria specified below:

1.4. Bids (Two Bid system – (a) Technical Bid and (b) Financial Bid) are invited on behalf of Agra Development Authority from eligible contractors working in any central/state departments or government/semi government undertakings. The Bidders, individual proprietorship firm, company, meeting the following minimum eligibility criteria shall be eligible to apply.

a) If e- Tender Fee / Processing Fee and or EMD submitted by any Bidder is not as per e-tender terms and conditions, his Bid will be rejected and will not be considered for further stages of evaluation.
b) If the Bidder or any JV in which he has participated has ever been blacklisted or debarred & currently in force by any state Government, Central Government or any Public Sector Unit of either Central Government or State government, his Bid will be rejected and will not be considered for further stages of evaluation.
c) Experience should be in the name of the Bidding company and not in subsidiary/ associate company/ Group Company/ parent company etcetera. Also, the work should not have been Sublette by the Bidder on back-to-back basis in full.
d) Valid Class A approved Electrical licences from any State Government/ Government of India for executing the electrical works shall be submitted, otherwise bid shall be rejected.

Experience of having successfully completed works during the last 7 years ending the previous day to the last date of submission of tender. For this purpose, cost of work shall mean gross value of the completed work including cost of material supplied by the respective Owner but excluding those supplied by the Owner free of cost.

1.5. Eligible Bidders

This invitation for bid is open to bidders possessing either national and/ or international experience in Infrastructure Development related works as mentioned in the qualification of the bidder.

All bidders shall provide Qualification Information and other forms, a statement that the bidder or any person proposed by him as Project Manager for the works/ contract are neither associated, nor have been associated, directly or indirectly, with the Consultant or any other entity that has prepared the design, specifications and other documents for this Project.

1.6. Qualification of the Bidder

i. The Bidder may be a single entity or a group of entities (the "Joint Venture"), coming together to implement the Project. However, a Bidder, applying individually or as a member of a Joint Venture, as the case may be, cannot be member of another group of entity. The term Bidder used herein would apply to both a single entity and a Joint Venture.

ii. A Bidder shall be a company incorporated under the Indian Companies Act 2013 or a combination of companies with a formal intent to enter into a Joint Venture agreement. A Joint Venture shall be eligible for consideration subject to the conditions set out in Clause 1.7 below.

iii. All bidders shall provide Qualification Information and other forms a preliminary description of the proposed work method and schedule, including drawings and charts, as necessary. The proposed methodology should include programme of construction backed with procurement of equipment, material and resources planning and deployment, duly supported with broad calculations and quality assurance procedures proposed to be adopted justifying their capability of execution and completion of work as per scope of work and technical specifications, within stipulated completion time of 30 months.

iv. Even though the bidder meets all the qualifying criteria given herein, he is subject to be disqualified, if he has made a misleading or false representation(s) in the forms, statement and attachments submitted in proof of the qualifying requirements. Further such bidder shall be blacklisted.

v. All bidders shall include the following information and documents with their bids:

a) Scanned Copies of original documents defining the constitution or legal status, place of registration, and principal place of business; written power of attorney of the signatory of the Bid to commit the Bidder.

b) Total monetary value of construction work in the field of Infrastructure Development performed for each of the last Five years.

c) Experience in works of a similar nature for each of the last seven years, and details of works underway or contractually committed in next two years and clients who may be contacted for further information on these contracts;

d) Major items of construction equipment proposed to carry out the Contract;

e) Qualifications and experience of key site management and technical personnel proposed for the Contract;

f) Reports on the financial standing of the Bidder, such as profit and loss statements and auditor’s reports for the past five years;

g) Authority to seek references from the Bidder’s banker(s);

h) Self-attested copy of information regarding any litigation, current or during the last seven years, in which the Bidder is involved, the parties' concerned, and disputed amount;

i) Proposal for subcontracting components of the works amounting to more than 10% of the Bid Price shall not be permitted;

j) The proposed methodology and programme of construction, backed with planning of procurement of equipment, material and resources and their deployment, duly supported with broad calculations and quality control procedures proposed to be adopted, justifying their capability of execution and completion of the work as per technical specifications within the stipulated period of completion as per milestones.

k) Should not have been blacklisted by any public agency, Central / State Government Department/Autonomous Body/PSU in last five years from the original last date of submission of the Bid. The Bidder shall submit duly notarized affidavit to this effect, as per prescribed format (Form "G").

1.7. Joint Venture

iv. A joint venture of more than one contactor can also participate in the present bid. Joint Venture partners would be limited to three (including the lead partner)

v. Subject to the provisions of clause (1.6) above, the Bid should contain the information required for each Member of the Joint Venture;

vi. Out of the members of the Consortium, the member with the highest shareholding in the SPV shall be appointed as the lead member ("Lead Member") who shall have an equity share holding of at least 51% (fifty-one per cent) of the paid up and subscribed equity of the SPV. Additionally, the Lead Member shall have the project experience of Category I of Technical Eligibility Criteria as per Clause 1.8. Other members of the consortium shall hold a minimum of 10% of the paid up and subscribed equity of the SPV. The members of the Consortium shall sign a power of attorney in favour of the Lead Member, as per the format at Appendix-Form E.

iv. One of the partners, who is responsible for performing the key role under the contract (Lead Partner of the JV) management or is executing a major component of the proposed contract, shall be nominated as being in charge during Bidding periods and in the event of successful Bid, during contract execution. The partner in charge shall be authorized to incur liabilities and receive instructions for and on behalf of the partner(s) of the Joint Venture. This authorization shall be evidenced by submitting a notarised power of attorney signed by legally authorized signatories of all partners.

v. All the partners of Joint Ventures shall be, jointly and severally liable, during the Bidding process and for the execution of the contract in accordance with the contract terms, and a statement of this affect shall be included in the authorization. The Bid shall be signed so as to legally bind all the partners, jointly and separately. Bid security and Performance Bank Guarantee, as required, will be furnished by the lead partner and Joint Venture/ Consortium partner(s) out of their accounts in proportion to their participation in Joint Venture.

vi. The Threshold Technical Capacity and Financial Capacity of all the Members of Joint Venture would be taken into account for satisfying the above conditions of eligibility. Further, Lead Member shall meet at least 51% requirements of Technical and

Financial Capacity required as per Clause 1.8. For avoidance of doubt, it is further clarified that the Joint Venture must collectively satisfy the complete (100%) qualification criteria.

vii. The Bid should include a brief description of the roles and responsibilities of individual members, particularly with reference to financial, technical and defects liability obligations.

viii. An individual Bidder cannot at the same time be member of a Joint Venture submitting for bid. Further, a member of a particular Bidder Joint Venture cannot be member of any other Bidder Joint Venture submitting for bid;

ix. Except as provided under this RFQ cum RFP and the Bidding Documents, there shall not be any amendment to the Joint Bidding Agreement without the prior written consent of the Employer;

x. The composition of the JV shall not be allowed to change during the contract period. However, in exceptional circumstances such as bankruptcy, M&A etc, any change in members or composition shall be only allowed after approval from the Authority.

xi. Joint Venture Agreement shall contain a Clause to the effect that there shall be a separate JV Bank Account (distinct from the Bank Account of the individual partners) to which the individual partner shall contribute their share / or working capital. In case of successful Bid being accepted by Authority the payments under the contract will only be made to the JV Bank Account not to the individual partner(s).

xii. Joint Venture Agreement shall also contain a Clause to the effect that the financial obligations of the JV shall be discharged through the said JV Bank Account only and also all the payments received or paid by the Authority to the JV shall be through that Account alone.

xiii. Qualifying criteria for Joint Venture:

xiv. Any Bidder including any Member should, in the last 3 (three) years, have neither failed to perform on any contract, as evidenced by imposition of a penalty by an arbitral or judicial Employer or a judicial pronouncement or arbitration award against the Bidder or Member, as the case may be, nor has been expelled from any project or contract by any public entity nor have had any contract terminated by any Public entity for breach by such Bid der or Member.

  i. The Bidder including any Member may provide details of all their on-going projects along with stage of litigation, if so, against the Employer / Governments.
  ii. The Bidder including any member may also provide details of on-going process of blacklisting if so, under any contract with Employer / Government.
  iii. The Employer reserves the right to reject an otherwise eligible bidder on the basis of the information provided under this clause. The decision of the Employer in this case shall be final.

xv. A copy of the Joint Venture Agreement (JVA) entered into between the partners shall be submitted with the application. Alternatively, a binding letter of Intent to execute a JVA in the event the joint venture is declared as the successful Bidder shall be signed

by all partner(s) and submitted with the application together with a copy of the proposed agreement. The JVA shall include among other things a Joint Venture's objectives and proposed management structure, the contribution of each partner to the Joint Venture operation, the commitment of the partner to Joint Venture in the event of the default or withdrawal of any partner an arrangement for providing the required indemnities:

- Stepping into the shoes of the existing partner(s) of JV with all liabilities of the existing partners from the beginning of the contract.
- With the prior approval of the Authority.
- Notwithstanding demarcation or allotment of work between two JV partner(s), the Lead Partner shall be liable for non-performance of the whole contract irrespective of their demarcation or shared of work.

1.8. Technical and Financial Qualification

I. To qualify for award of the contract, each bidder in its name should have similar works in the last seven years as referred below.

Similar Works means:
Construction of Integrated Infrastructure Development Project such as Townships / Industrial parks / SEZs/ IT parks in urban areas including roads, potable and recycle water supply system, sewerage system, storm drainage, power and streetlighting, ICT and parks & gardens for Government & Private Projects.

II. The bidder is required to demonstrate required technical experience in each of the following categories:

Category 1: Civil Works

- Three similar completed works with minimum area of 20% of Proposed Atal Puram Township each costing not less than the amount equal to 165 Cr (40% of Estimated Cost Value (ECV), i.e. 413 Crore of the proposed work);
  Or
- Two similar completed works with minimum area of 30% of Proposed Atal Puram Township each costing not less than the amount equal to 247 Cr (60% of Estimated Cost Value (ECV), i.e. 413 Crore of the proposed work);
  Or
- One similar completed work with minimum area of 50% of Proposed Atal Puram Township costing not less than the amount equal to 330.0 Cr (80% of Estimated Cost Value (ECV), i.e. 413 Crore of the proposed work).

Category 2: Water/waste infrastructure Works

- Two similar completed works of
  - Potable Water/ recycle water supply network not less than 15 Km each
  - Water Treatment Plat (WTP) not less than 4 MLD each
  - Sewerage network not less than 12 Km each
  - Sewerage Treatment Plant not less than 7 MLD each

  Or
- One similar completed work of
  - Potable water/ recycle water supply network not less than 20 Km each

- Water Treatment Plat (WTP) not less than 6 MLD each
- Sewerage network not less than 18 Km each
- Sewerage Treatment Plant not less than 10 MLD each

Category 3: Power Infrastructure Works

- Two similar completed works of
  - Power supply distribution network not less than 15 Km each
  - One number 33/11 KV substation each

  Or
- One similar completed work of
  - Power supply distribution network not less than 22 Km each
  - Two number 33/11 KV substation each

Note:

- The value of executed works (excluding O&M) shall be brought to current costing level by enhancing the actual value of work at simple rate of 7% per annum; calculated from the date of completion to the previous day of last date of submission of tenders.

- The works submitted for evaluation in all the three categories must be satisfactorily executed under one contract during the last 07 financial years from 2018-19 to 2023-2024

- Experience as subcontractor/Nodal agency/Project Management Consultant shall not be considered. The Bidder should have procured & executed the project on his own. Own works / work under the same management / own certification of the Bidder shall not be considered.

- If the bidder has worked for renowned Developers like Hiranandani, Ansals, DLF, ELDICO etc. and fulfils Clause 1.8; they can be eligible with submission of certificates from the Director (DIN has to be mentioned in the Certificate) of the Developer Company.

a) Average Annual turnover:

Shall have at least Average Annual Financial Turnover of 50% of ECV in Civil Construction works during the last 03 financial years ending 31st March 2024. The balance sheets, Statement of Profit & Loss Account and Notes to Accounts should be duly audited and certified by a Chartered Accountant with his seal / signatures, firm registration number and UDIN number. The year in which no turnover is shown, would also be considered for working out the average. The average annual turnover should be of the Bidding Company and not for Group Company or subsidiary company etc

b) Net Profit:

Net profit (after deducting tax, depreciation and interest) shall be positive in more than two financial years during the last 05 financial years ending 31st March 2024. An attested certificate by Statutory Chartered Accountant in this regard shall be uploaded.

c) The Contractor shall possess required valid A Class approved electrical license from any State Government/ Government of India for executing the electrical works.

d) **Solvency Certificate**: The Bidder should have a Solvency equal to or more than 40% of the Estimated Cost Value (ECV) of the proposed work certified by his bankers for this work. Banker's certificates should be on letter head of the Bank, self-attested and should have been issued within three months from the last date of submission of the Bid.

Proof of solvency of the bidder will consist of a fixed assets certificate signed by the District Magistrate and Solvency Certificate signed by Manager of the bank regarding the cash assets of the bidder.

e) The bidder (any member of the JV/consortium) should be financially sound and should have not applied for Corporate Debt Restructuring (CDR) during last 5 (five) years.

f) Evidence of access to line(s) of credit and availability of other financial resources facilities (10% of contract value), certified by the Bankers (not more than 3 months old).

g) Undertaking that the bidder will invest a minimum amount up to 25% of contract value exclusively for this work, during implementation.

III. Each bidder should further demonstrate

a) Availability (either owned or leased) of key and critical equipment for this work given in specification and infrastructure parameters.
b) Availability of personnel for this work with adequate experience as required and listed in specification and infrastructure parameters.
"While the above are not basis for evaluation these are mandatory requirement for completion of work in 30 months' time."

IV. To qualify for a package of contracts made up of this and other contracts for which bids are invited in the IFB, the bidder must demonstrate having experience and resources sufficient to meet the aggregate of the qualifying criteria for the individual contracts.

1.9. Sub-contractors' experience and resources (which are limited to 10% only) shall not be taken into account in determining the bidder's compliance with the qualifying criteria.

1.10. Bidders who meet the minimum qualification criteria will be qualified only if their available bid capacity is more than the total bid value. The available bid capacity will be calculated as follows:

Available Bid Capacity = (AxNx2 - B)

Where,

A = Maximum value of civil engineering works executed in any one year during the last Five years between 2019-20 to 2023-2024 (updated to the price level of the year indicated in Appendix to ITB) taking into account the completed as well as works in progress.
N = Number of years prescribed for completion of the works for which bids are invited.

B = Value (updated to the price level of the year indicated in Appendix) of existing commitments and ongoing works to be completed during the next 2.0 years (period of completion of the works for which bids are invited)

Note:

The statements showing the value of existing commitments and on- going works as well as the stipulate period of completion remaining for each of the works listed should be countersigned by the engineer in charge, not below the rank of an Executive Engineer or equivalent for State Government / Central Government / PSU projects.

The Bidder shall submit the calculation sheet of tendering capacity as per above formula.

1.11. Even though the bidder meets the above qualifying criteria, they are subject to be disqualified if they have:

- Been debarred/ Blacklisted from Record of poor performance such as abandoning the works, not properly completing the contract, inordinate delays in completion, litigation history, or financial failures etc.;
- Submitted conditional bid.

1.12. Deleted.

1.13. The Bidder shall have In-house design capabilities to provide the required services as per the scope of work. In case, the in-house design capabilities are not available, then the Bidder shall enter into in an agreement with a design consultant who has requisite credentials as mentioned in the Specific Conditions of Contract. The Bidder, shall submit details of such in house design capabilities or details of the design consultant proposed to be engaged along with requisite credentials along with the bid.

1.14. The Bid documents consisting of Notice Inviting e-Tenders (NIT) & Instructions to Bidders (ITB), General Conditions of Contract, Specific Conditions of Contract, Design Basis Report, Technical Specifications, Tender Drawings, Financial Bid and other necessary documents (if any) are available online at e-tender portal https://etender.up.nic.in/

1.15. Last date to fill/upload the e-tender through e-Tendering is as per Table-I at Clause 1.1 above.

1.16. The intending Bidder must have Class-III digital signatures to submit the Bid. After submission of Bid the contractor can re-submit revised Bid any number of times but before the last time and the date of submission of Bid as notified. While submitting the revised Bid, the contractor can revise the rate of one or more item(s) any number of times (he need not re-enter rate of all the items) but before the last time of date of submission of Bids as notified.

1.17. E-Tender Fee/ Processing Fee and Earnest Money Deposit (EMD)

i. **E-Tender Fee/ Processing Fee:** The Bid can be submitted online only after paying the Processing & Document Fee which is non-refundable. The amount shall be paid online through payment gateway Net banking/RTGS on e-tender portal i.e. **www.etender.up.nic.in**. Interested applicants are informed that tender submission process will not move onward if the above amount is not paid through e-tender portal. E-tender Fee / Processing Fee is non–refundable.

ii. **Earnest Money Deposit (EMD):** The amount shall be paid online through the payment Gateway by Net banking/RTGS on **https://induscollect.indusind.com/pay/** Interested applicants are informed that

tender submission process will not move onward if the Earnest money is not paid through https://induscollect.indusind.com/pay

Micro and Small Enterprises registered with the National small Industries Corporation Limited, New Delhi (NSIC) and in respect of which competency certificates are issued by the NSIC are also need to furnish earnest money.

iii. Online Bid Documents submitted by intending Bidders shall be opened only of those Bidders, e-tender Fee/Processing Fee submission is verified vide (UTR) no provided by them in online submission.

1.18. The Bid submitted shall become invalid and Bid Document cost Tender processing fee shall not be refunded if:

i. The bidder is found ineligible.

ii. The bidder does not upload all the required documents as stipulated in the bid document.

iii. If any discrepancy is noticed between in the uploaded bid documents.

1.19.

a. The Technical Package and Financial Package as detailed in clause 2.3.6 of Section-II ITB shall be submitted online, and will be opened as per the schedule at Table-I above. Technical Package Part-II" of only those tenderer(s), whose Earnest money & e-Tender Fee/Processing Fee is found to be in order, shall be opened.

b. Deleted

1.20. The Technical Bid shall be opened first, on due date and time as mentioned at Table- I above. The time and date of opening of Financial Bid of Bidders qualifying the Technical Bid shall be communicated to them at a later date through portal

1.21. The Bidder, whose tender is accepted, will be required to furnish performance bank guarantee, of the amount and within the period, specified in Schedule F. This guarantee shall be in the form of Bank Guarantee of any Nationalised commercial bank based in India, with branch in Agra in favour of "Agra Development Authority" as per Form C. Performance Bank Guarantee to be valid up to 18 months beyond the stipulated date of completion or the extended period, thereof.

1.22. In case the Bidder fails to deposit the said performance bank guarantee within the period as indicated in schedule 'F', including the extended period if any, the earnest money deposited by the contractor shall be forfeited automatically without any notice to the Bidder.

1.23. The Bidder whose Bid is accepted will also be required to furnish either copy of applicable licenses / registration or proof of having made application for obtaining labour licenses, registration with EPFO, ESIC and BOCW, Welfare Board including Provident Fund Code No., if applicable and also ensure the compliance of aforesaid provisions by the sub-agencies, if any engaged by the Contractor for the said work and Programme Chart (time and progress) within the period specified in Schedule 'F' of GCC.

1.24. Performance Evaluation: Performance Evaluation of the Bidders for eligibility shall be done by ADA. If required, the works executed by the Bidders who otherwise qualify may be got inspected by ADA.

1.25. Bidders are advised to inspect and examine the site and its surroundings and satisfy themselves before submitting their tenders as to the nature of the ground and sub- soil, the form and nature of the site, the means of access to the site, the accommodation they may require and in general shall themselves obtain all necessary information as to risks, contingencies and other circumstances which may influence or affect their tender. A

Bidder shall be deemed to have full knowledge of the site whether he inspects it or not and no extra charges consequent on any misunderstanding or otherwise shall be allowed. The Bidder shall be responsible for arranging and maintaining at its own cost all materials, tools & plants, water, electricity, access, facilities for workers and all other services required for executing the work unless otherwise specifically provided for in the contract documents. Submission of a tender by a Bidder implies that he has read this notice and all other contract documents and has made himself aware of the scope and specifications of the work to be done and other conditions, factors etcetera having a bearing on the execution of the work.

1.26. The Agra Development Authority does not bind itself to accept the lowest or any other tender and reserves to itself the authority to reject any or all the tenders received without the assignment of any reason. All tenders in which any of the prescribed condition is not fulfilled or any condition including that of conditional rebate is put forth by the Bidder shall be summarily rejected.

1.27. Canvassing, whether directly or indirectly, in connection with tenders is strictly prohibited and the tenders submitted by the contractors who resort to canvassing will be liable to rejection.

1.28. The Agra Development Authority reserves to itself the right of accepting the whole or any part of the tender and the Bidder shall be bound to perform the same at the rate quoted by him for the same.

1.29. The Bidder shall not be permitted to tender for works in case his near relative is Gazetted officer in the office of ADA/ /Law UP or in the Managerial Cadres of ADA and is directly dealing with the Project. Any breach of this condition by the contractor would disqualify him from participation and consideration in the tender process.

1.30. No Engineer of Gazetted rank or other Gazetted officer employed in Engineering or Administrative duties in an Engineering Department of the Government of Uttar Pradesh/is allowed to work as a contractor for a period of two years after his retirement from Government service, without the prior permission of the Government of Uttar Pradesh in writing. This contract is liable to be cancelled if either the contractor or any of his employees is found any time to be such a person who had not obtained the permission of the Government of India as aforesaid before submission of the tender or engagement in the contractor's service.

1.31. The tender for the works shall remain open for acceptance for a period of 180 (One Hundred and Eighty) days from the last date of submission of Bid or any extension thereto. If any Bidder withdraws his ADA, then ADA shall, without prejudice to any other right or remedy, be at liberty to forfeit 100% of the said earnest money as aforesaid. Further the Bidder shall not be allowed to participate in the re– tendering process of the work.

1.32. Deleted

1.33. Registration/ Licence: The Bidder should have their registration for GST, PF, ESIC, Building Cess Registration etcetera, with the appropriate Authorities. In case the Bidder is not registered for PF, ESIC, Building Cess Registration (except GST) etcetera, with the appropriate Authorities at the time of submission of Bid, they will submit an undertaking that they will get themselves registered with the concerned authorities in case they are awarded the work and prior to raising their first tax invoice to ADA for this project.

1.34. The Bidder will indemnify ADA, as the case may be, against all penal action that may be levied/effected by any concerned authority for default in any labour regulation/PF/ESI and other statutory requirements of the relevant Acts/Laws related to the work of the contractor and will bear the legal charges, if any, and will pay the legal charges/dues

directly to the concerned authority. An undertaking in this regard is required to be submitted by applicant along with their Bid.

1.35. GST or any other tax applicable in respect of inputs procured by the contractor for this contract shall be payable by the Contractor and ADA will not entertain any claim, whatsoever in respect of the same. However, component of GST at time of supply of service (as provided in CGST Act) provided by the contract shall be varied if different from that applicable on the last date of receipt of tender including extension if any.

1.36. This Notice Inviting e-Tender shall form a part of the contract document. The successful Bidder, on acceptance of his e-tender by ADA, shall, within 30 days from the stipulated date of start of the work, sign the contract consisting of the Notice Inviting Bids, all the documents including General Conditions of the Contract, Specific Conditions of Contract, Specifications, Bill of Quantities and drawings, if any, forming the e- tender as issued at the time of invitation of tender and acceptance thereof together with any correspondence leading thereto including amendments, corrigendum etcetera, if any.

1.37. Following shall also be part of the contract:

Standard forms as mentioned in Schedule “F” consisting of:

i. Various standard clauses with corrections upto the date stipulated in Schedule F along with annexures thereto.

ii. Safety Code.

iii. Rules for protection of health, sanitary arrangements for workers employed by ADA or its contractors.

iv. Contractor Labour regulations.

v. List of Acts and Omissions for which fines can be imposed.

1.38. Bid document consists of:

I. **Volume – 1 (Notice Inviting e-Tenders (NIT) & Instructions to Bidders (ITB)**

II. **Volume – 2 (General Conditions of Contract)**

III. **Volume - 3 (Specific Conditions of Contract)**

IV. **Volume – 4 (Front End Engineering Design) (FEED)**

V. **Volume – 5 (Technical Specifications)**

VI. **Volume– 6 (Tender Drawings)**

VII. **Volume – 7 (Financial Bid)**

VIII. **All amendments(s)/ corrigendum, if any.**

ADA reserves the right to accept or reject any or all the tenders without assigning any reason, No Bidder shall have any cause of action or claim against ADA for rejection of his/ all e-tender (s).

1.39. The Work Order shall be issued by Agra Development Authority for this bid after the Land use changed in the Master Plan of the Atal Puram Township by the Government of Uttar Pradesh.

Chief Engineer

AGRA DEVELOPMENT AUTHORITY

Ratan Muni Road, Jaipur House Colony,
Agra-282010, Uttar Pradesh, India

SECTION-II

INSTRUCTIONS TO BIDDERS (ITB)

2. INTRODUCTION:

2.1. Brief Particulars of the Work

The scope of work includes Survey, Investigation and Collect all primary and secondary data to undertake Detailed Engineering, Procurement, Construction, Testing and Commissioning of All Components of Atal Puram Township in Agra which include, Road, Minor Bridge, Culvert, Road Side Plantation & Arboriculture, Storm Water Drainage, Potable Water Supply & Recycle Water System, Waste Water System, Power Infrastructure, Smart Street Lighting System, Utility Ducts, Solid Waste Management, Site Grading & Levelling, Rain Water Harvesting, Security & Surveillance, landscape for parks and boundary wall in Atal Puram Township at Agra in the State of Uttar Pradesh on Design, Engineering, Procurement and Construction (EPC) basis, followed by 3 years of Defect Liability, 5 years of operation and maintenance for roads, footpath, tracks, arboriculture, street lights, ICT, Parks, plazas and gardens, networks of water, sewer, recycled water, storm drain and rain water harvesting and 10 years of operation and maintenance of WTP and STP after commissioning. The power system network and substation operation and maintenance are excluded. The details of scope of work are at Section III of the Document.

2.2. Eligibility Criteria & Disqualification

The eligibility Criteria is as at Section I (Notice inviting e-Tender). It may be noted that even if a Bidder meets the eligibility criteria, the ADA may, at their discretion and at any stage during the selection process or execution of the Project, on discovering the facts & figures & finding that the information provided by the Contractor is Contrary to Integrity pact, ADA shall order disqualification of the contractor, if the Contractor has been blacklisted by any Central/State Government Department/ Autonomous Body/ PSU, even after Bids have been opened and/or work awarded.

2.3. BID Documents:

2.3.1. Contents of BID Documents

BID Document shall consist of the documents listed in this document along with any schedules, addendum or corrigendum etcetera issued by ADA for the purpose.

2.3.2. Pre-Bid Meeting

The purpose of the meeting will be to clarify issues and to answer questions on any matter that may arise at this stage. ADA shall conduct pre-Bid meeting(s) at the time and venue mentioned in Notice Inviting e-Tender to answer any queries / provide clarifications that the Bidders may have in connection with the Project and to give them relevant information regarding the same. Representatives (2 nos. maximum) of each prospective Bidder shall be allowed to participate on production of authority letter from the Bidder. During the course of Pre-Bid meeting, the Bidders will be free to seek clarifications and make suggestions for consideration. The ADA shall endeavour to provide clarifications and such further information as it may, in its sole discretion, consider appropriate for facilitating a fair, transparent and competitive Bidding Process. Bidders are requested to bring authorization letter, letterhead and stamp/seal of the company at the time of pre – Bid meeting. Only written queries shall be accepted from those present in the pre- Bid meeting. No other queries shall be entertained or replied to. If prospective Bidders / their authorized representatives wish to raise any queries, then they need to be present in the pre- Bid meeting. ADA

response (including an explanation on the query but without identifying the source of the inquiry) will be uploaded on the websites *https://etender.up.nic.in, etenders.gov.in, eprocure.gov.in*.

2.3.3. Clarifications

A prospective Bidder requiring any clarification with regards to the BID document may notify in writing at the mailing address indicated in Notice Inviting Bid or e-mail at ceadaagra12@gmail.com. Chief Engineer, ADA will respond any request for clarification which is received within seven days from the date of availability of Tender document on-line. ADA's responses (including an explanation on the query but without identifying the source of the inquiry) upload on the website of e-tender portal *https://etender.up.nic.in, etenders.gov.in, eprocure.gov.in* only written communication/clarification shall be considered as valid.

2.3.4. Amendment to BID Document

i. At any time prior to the deadline for the submission of Bids, ADA, may, for any reason, whether at its own initiative or in response to a clarification or query raised by prospective Bidders, modify the BID document by an amendment(s)/ addendum(s)/corrigendum(s).

ii. The said amendments in the form of the addendum/corrigendum will be made available on website *https://etender.up.nic.in, etenders.gov.in, eprocure.gov.in* at-least three (3) days prior to the last date of the original or extended deadline for the submission of the Bids. The uploading of the said amendment(s)/ addendum(s)/corrigendum(s) shall be binding on the Bidders. The Bidders are advised to regularly visit above mentioned website to ensure that they are aware of the amendment(s)/ addendum(s)/corrigendum(s). The amendment(s)/ addendum(s)/ corrigendum(s) issued will form part of the BID documents.

iii. In order to provide prospective Bidders, reasonable time for preparing their Bids after taking into account such amendments, addendum (s)/ corrigendum(s) the, ADA may, at its discretion, extend the deadline for the submission of Bids.

2.3.5. Preparation of Bid

a) Bidder's responsibility

i. The Bidder is solely responsible for the details of his Bid and the preparation of Bids.

ii. The Bidder is expected to examine carefully all the contents of BID document as mentioned in Notice Inviting e-Tender including instructions, conditions, forms, terms, etcetera. and take them fully into account before submitting his offer. Bids, which do not satisfy all the requirements, as detailed in these documents, are liable to be rejected as being non - responsive.

iii. The Bidder shall be deemed to have inspected the Site and its surroundings and taken into account all relevant factors pertaining to the Site, while preparing and submitting the Bid.

b) Project Inspection and Site Visit

Any Site information including the site survey, soil investigation report etcetera, given in this Bid Document is for guidance only. The Bidder is advised to visit and examine the Site of works and its surroundings at his/their cost and get/ obtain at his/their own responsibility, any information that may consider necessary including conducting site survey, soil

investigations, availability of electricity, water and drainage, as applicable for preparing the Bid. ADA shall not be liable for such costs, regardless the outcome of the selection process. The Bidder has to obtain a Site Visit Certificate from the respective ADA Authorized Personnel and submit it along with the Bid but non-submission of the same shall not form the ground for disqualification.

c) Documents Comprising the Bid

The Bidder shall submit their bids online only.

d) Alternative Proposal by Bidders

Bidders shall submit offers that comply with the requirement of the Tender. Any Alternative Proposal(s) shall not be considered.

e) Method of Application

i. If the Bidder is an individual, the application shall be signed by him above his/her full type written name and current address.

ii. If the Bidder is a proprietary firm; the application shall be signed by the proprietor above his/her full type written name and the full name of his firm with its current address.

iii. If the Bidder is a firm in partnership, the application shall be signed by all the partners of the firm above their full type written names and current addresses or alternatively by a partner holding power of attorney for the firm. In the later case a certified copy of the Power of Attorney should accompany the application. In both the cases a certified copy of the partnership deed and current address of all the partners of the firm should accompany the application.

iv. If the Bidder is a Limited company or a corporation, the Bid shall be signed by a duly authorized person holding Power of Attorney for signing the application and certified copy of such power of attorney shall also be furnished. The Bidder should also furnish a copy of memorandum of articles of association duly attested by a Public Notary.

v. If the Bidders are in Joint Venture, all the partners of Joint Ventures shall be, jointly and severally liable, during the Bidding process and for the execution of the contract in accordance with the contract terms, and a statement of this affect shall be included in the authorization. The Bid shall be signed so as to legally bind all the partners, jointly and separately. Bid security and Performance Bank Guarantee, as required, will be furnished by the lead partner and Joint Venture/ Consortium partner(s) out of their accounts in proportion to their participation in Joint Venture. (Refer Section I, Clause 1.7)

f) Bid documentation

i. All information called for in the enclosed forms should be furnished against the relevant columns in the forms. If for any reason, information is furnished on a separate sheet, this fact should be mentioned against the relevant column. Even, if no information is to be provided in a column, a 'Nil' or 'no such case' entry should be made in that column. If any particulars/query is not applicable in case of the Bidder, it should be stated as 'Not applicable'. The Bidders are cautioned that not giving complete information called for in the application forms or not giving it in clear terms or making any change in the prescribed forms (or) deliberately

suppressing the information may result in the Bid being summarily disqualified. Bid made by telegram or telex and those received late will not be entertained.

ii. The Bid should be type written. The Bidder should sign each page of application, forms and documents before scanning & uploading.

iii. Over writing should be avoided. Corrections if any should be made by neatly crossing out, initialing, dating and rewriting. Pages of the eligibility criteria document are numbered. Additional Sheets if any added by the Bidder should also be numbered by him. They should be submitted as a package with signed letter of transmittal.

iv. References, information and certificate from the respective Govt. departments / PSU certifying technical knowledge or capability of the Bidder etcetera should be signed by an officer not below the rank of Executive Engineer or equivalent. If any bidder has worked for renowned developers such as but not limited to Hiranandani, DLF, Ansals, Eldeco and so on; fulfilling Clause 1.8; can be eligible with submission of certificates from the Director (DIN has to be mentioned in the certificate) of the Developer Company

v. The Bidder may furnish any additional information, which he thinks is necessary to establish his capabilities to successfully complete envisaged work. He is, however advised not to furnish superfluous information. No information shall be entertained after submission of eligibility criteria document unless it is called for by ADA.

vi. If private works are shown in support of eligibility, certified copy of the tax deducted at source certificate (TDS) shall be submitted along with the experience certificate and the TDS amount shall tally with the actual amount of work done.

2.3.6. Contents of Packages (Bid Submission)

The tender/ Bid shall be submitted in two packages i.e. Technical Package & Financial Package.

2.3.6.1. Technical Package

The technical package, clearly labelled as “TECHNICAL PACKAGE”, is to be submitted in two parts.

A. Technical Package, Part-1: Bid Document Fee / Bid Processing Fee & EMD (Form-I).
This part shall consist of following: -

I. Non – Refundable Bid Document Fee : - as per Table- I, only on the online mode through payment gateway available on e- portal- https://etender.up.nic.in. The Bid Document Fee is non– refundable. Any physical submission of e-Tender Fee / Processing Fee will be rejected.

II. Non – Refundable Bid Processing Fee : - as per Table- I, only on the online mode through payment gateway available on e- portal- https://etender.up.nic.in. The Bid Processing Fee is non– refundable. Any physical submission of e-Tender Fee / Processing Fee will be rejected.

III. **Earnest Money Deposit: -** as per Table- I, only on the online mode through payment gateway available on e-portal- https://www.etender.up.nic.in. The EMD Fee is refundable. Any physical submission of the Earnest Money will be rejected.

~~a) Deleted.~~

b) The Earnest Money of Unsuccessful Bidders shall be discharged/ returned by ADA after signing of Contract by the successful bidder.

c) The Earnest Money shall be forfeited if a Bidder withdraws his Bid during the period of Bid validity or in the case of the Successful Bidder, if he fails to submit the necessary performance bank guarantee or fails to enter into the Contract within time limit specified in Schedule 'F'.

d) The Bid Security of the Successful Bidder shall be returned after receipt of Performance Bank Guarantee.

B. Technical Package, Part-2: Should be submitted in original with scanned copy of documents to be uploaded online (Bidder should be able to produce the original when asked by ADA)

a) Form A: Form of Bid along with Appendix to be typed on the letter head and duly signed and stamped by authorized person having power of attorney from the Board of the Company (BoC). In case of JV from BoC and JV partners.

b) Form E: Format for Power of Attorney for signing of proposal. In case Bid is signed by Managing Director/Partners/Proprietor himself, Power of Attorney is not required. It is mandatory to mention on letterhead that the Bid is duly signed and stamped by Managing Director / Partner / Proprietor. However, proof of appointment as Managing Director/Partners/Proprietor to be provided.

c) Indemnity/ Undertaking/ Affidavits as per requirements (Form-F, H)

d) Form G: Original Affidavit as per format at Form'G'

e) Form 'T-1'(Financial Information) – Annual Audited Financial Statements for the last five years (Audited balance sheets and Statement of Profit & Loss Account along with notes to accounts duly signed by Chartered Accountant shall be attached with this form for last five financial years.

f) Form "T-2" (List of all works successfully completed during the last seven years)

g) Form "T-3" (Performance Report of Similar Works)

h) Form "T-4" (Structure and Organization)

i) Form "T-6" (GST Registration Details)

j) Form "T-7" (JV Information Sheet)

k) Form "T-8" (Declaration by Bidder/JV)

l) Form "T-9" (JV Agreement)

m) Copies of GST Registration or undertaking / EPF Registration/ PAN Number

n) Integrity Pact and Agreement duly signed by the person authorized to sign the Bid on behalf of the Bidder. (Asper Performa given in GCC, Vol-2).

o) All pages of the entire Corrigendum/ addendum (if any)/ pre-Bid clarifications (if any) signed by the authorized person of the Bidder/Bidder

p) Form T1 – B: Self Attested Bank Solvency Certificate from a Nationalized bank or Scheduled Bank as per format at "Form T1- B".

q) Form "T-5" (TDS Details for Private Sector Projects for the works executed in India)

r) The Class A Electrical License from the relevant government department.

s) Any other relevant document which form a part of the technical bid submission.

t)

2.3.6.2. Financial Package

The financial package **(VOLUME 7 –FINANCIAL BID)** should be submitted **ONLINE** only. Physical submission of Financial Bid will not be accepted and e-tender shall be rejected. The quoted rates should include all costs associated with the Project including any out of pocket / mobilization expenses. Quoted rates shall include all prevailing taxes except Goods and Services Tax, Building and other Construction Workers welfare Cess and any other applicable statutory taxes, levies till the last stipulated date for the receipt of tender including extensions if any. In case Government levies/modifies any tax subsequently, the same will be adjusted plus/minus as the case may be.

The Bidder must ensure to fill up rate against each item of Financial Bid. If any cell is left blank then value of that cell shall be treated as “0” (ZERO). In event no rate has been quoted for any item (s), it will be presumed that the contractor has included the cost of this/these items(s) in other items and rate for such item(s) will be considered as zero and work will be required to be executed accordingly.

The complete Bid shall be without alterations, overwriting, interlineations or erasures except those to accord with instructions issued by ADA, or as necessary to correct errors made by the Bidder. All amendments/corrections shall be initiated by the person or persons signing the Bid.

2.3.7. Language of Bid

The Bid and all related correspondence and documents relating to the Project shall be in English language only.

2.3.8. Currency of Bid

Bid prices shall be quoted in Indian Rupees only. The amount mentioned elsewhere in the Bid document will also deemed to be in Indian Rupees unless otherwise mentioned.

2.3.9. Extension of Bid Validity

Prior to the expiry of the original Bid Validity Period, ADA may, at its discretion, request Bidders to extend the Bid Validity Period for a specified additional period.

2.3.10. Format and Signing of Bid

a) Bid documents (Technical package and Financial package) shall be digital signed by a person duly authorized to sign the Bid documents. The Bidder shall also submit a Power of Attorney authorizing the person signing the documents.

b) Entries to be filled in by the Bidder shall be typed or written in indelible ink.

c) All witnesses and sureties shall be persons of status and probity and their full names, occupations and addresses shall be written below their signatures.

2.3.11. Sealing and Marking of Bids

a) The Bid shall be submitted along with documents and mode of submission mentioned at Clause 2.3.6 mentioned above at Section-II (ITB) and also mentioned in the Checklist at Annexure - I in Volume I of the document.

b) Please note that the price should not be indicated in any of the documents enclosed in Technical package. Non-compliance shall entail rejection of the Bid.

2.3.12. Submission of Bids

a) The last date for submission of completed Bids is given in Notice Inviting e-Tender. ADA may, at their discretion, extend this date, in which case all rights and obligations of the ADA and the Bidder shall thereafter be subjected to the new deadline as extended. If such nominated date for submission of Bid is subsequently declared as a public holiday, the next official working day shall be deemed as the date for submission of Bid.

2.3.13. Modifications/ Substitution/ Withdrawal of Bids

a) No modification or substitution of the submitted Bid shall be allowed after last date of submission of Bids.

b) A Bidder may withdraw its submitted Bid, provided that written notice of the withdrawal is received by Chief Engineer, ADA, Agra, before the last date for submission of Bids.

c) Only a single copy of the withdrawal notice shall be prepared and each page of the notice shall be signed and stamped by the authorized signatory. The notice shall be duly marked “WITHDRAWAL”. This withdrawal notice will be opened at the time of opening of Bid and not earlier. The signature of GPA (General Power of Attorney) holder will be verified and withdrawal shall be considered only in case both are same.

2.3.14. Bid Due Date

a) The Technical Bid to be submitted online & List of documents to be scanned & uploaded as per Clause 2.3.6, on or before the stipulated/extended time and date as specified in Notice Inviting Bids

b) The Financial Bid to be submitted online & List of documents to be scanned & uploaded as per Clause 2.3.6, on or before the stipulated/extended time and date as specified in Notice Inviting Bids.

c) ADA may, in exceptional circumstances, and at its sole discretion, extend the Bid due date by issuing an addendum only.

2.3.15. Late Bids

Any Bid received at the address mentioned above after the deadline prescribed for submission of Bids in Notice Inviting e-Tender/extended date as the case may be, herein will not be considered and will be returned unopened to the Bidder.

2.3.16. Power of Attorney:

Bidders shall submit, along with Technical Package, a Power of Attorney, on a stamp paper of Rs 100/- only, in favour of the person signing the Bid documents authorizing him to sign the Bid documents, make corrections/ modifications thereto and interacting with ADA and act as the contact person. The format for the power of attorney shall be as per Form E of Bid Document Volume-I. In case Bids are signed by Managing Director/Partner/Proprietor himself, Power of Attorney is not required. However, proof of his appointment by the board has to be provided.

In the event of tender being submitted by a firm, it must be signed separately by each partner thereof or in the event of the absence of any partner, it must be signed on his behalf by a person holding a Power of Attorney authorizing him to do so, such power of attorney to be produced with the tender, and it must disclose that the firm is duly registered under the Indian Partnership Act 1932.

In the event of tender being submitted by a Limited company or a corporation, it must be signed by a duly authorized person holding power of attorney for signing the application and certified copy of such power of attorney shall also be furnished. The Bidder should also furnish a copy of memorandum of articles of association duly attested by a Public Notary.

2.4. Bid Opening and Evaluation:

2.4.1. Bid opening

i. The Bids will be opened in the presence of prospective Bidders or their authorized representatives who may choose to attend on date & time as mentioned in Notice Inviting e-Tender.

ii. If such nominated date for opening of Bid is subsequently declared as a public holiday, the next official working day shall be deemed as the date of opening of the Bid.

iii. Bids for which an acceptable notice of withdrawal has been submitted shall not be opened.

iv. Bids which have not complied with one or more of the foregoing instructions may not be considered.

v. On opening of the Bid, it will be checked if the Bid Document Fee & Bid processing fee and EMD has been submitted online as detailed above.

vi. Technical Package –will be opened first. These will be checked for completeness and confirmation of submission of the requisite Bid Document Fee / Bid Processing Fee & EMD/Bid Security declaration form. Thereafter Technical Package – Part 2 will be opened. If the documents do not meet the requirements of the e-Tender, a note will be recorded.

vii. The Bidders name, the presence or absence of the requisite Bid Security and any other details as ADA or their authorized representative, may consider appropriate will be announced at the time of Bid opening.

viii. Technical evaluation shall be as per Section IV, Evaluation Process.

ix. Financial Package of all Bidders whose Bids are found responsive after technical evaluation will be opened at a later date.

2.4.2. Determination of Responsiveness

i. Prior to the detailed evaluation of Bids, ADA will determine whether each Bid is responsive to the requirements of the tender.

ii. For the purpose of this clause, a responsive Bid is one which:

a) have digital signature

b) is accompanied by the Power(s) of Attorney,

c) if required contains all the information as requested in the Bid Document

d) contains information in formats same/similar as those specified in this Bid Document

e) mentions the validity period of the Bid

f) is accompanied by the Bid Security/ EMD,

g) Conforms to all the terms, conditions and specifications of Tender without material deviation or reservation. "Deviation" may include exceptions and

exclusions. A material deviation or reservation is one which affects, in any substantial way, the scope, quality, performance or administration of the works to be undertaken by the Bidder under the Contract, or which limits in any substantial way, ADA's rights or the Bidder's obligations under the Contract as provided for in Bid and/or is of an essential condition, the rectification of which would affect unfairly the competitive position of other Bidders presenting substantially responsive Bids at reasonable price.

iii. If a Bid is not substantially responsive to the requirements of Bid, it will be rejected by ADA. The decision of the ADA in this regard shall be final and binding. The financial Packages of non-responsive Bidders shall not be opened.

2.4.3. Evaluation of Bids

i. ADA would examine and evaluate responsive Bids, as per the criteria set out in this document at Section IV Evaluation Process

ii. ADA reserves the right to reject any Bid if:

a) At any time, a material misrepresentation is made or uncovered;

or

b) The Bidder does not respond within the stipulated time to requests for supplemental information/ clarifications required and sought by ADA for the evaluation of the Bid;

or

c) It is found that the information provided is not true or incorrect or facts/ material for the evaluation have been suppressed.

iii. The ADA reserves the right, without being liable for any damages or obligation to inform the Bidder to:

a) Amend the scope and value of contract.

b) Reject any or all the applications without assigning any reason.

2.4.4. Clarification of Bids

i. Evaluation of Technical Bids submitted by Bidders shall be undertaken based on details submitted therein only. Bidder shall not be allowed to submit on their own, additional information or material subsequent to the date of submission and such material / information, if submitted, will be disregarded. It is therefore essential that all details are submitted by the Bidder comprehensively, accurately and specifically in their Technical Bid, avoiding vague answers. However, Evaluation Committee, if it so desires, reserves the right to seek any clarification from the Bidders on the information provided in the Bid. The request for clarifications and the response shall be in writing, or by e-mail at ceadaagra12@gmail.com

ii. No change / addition in the information or substance of the Bid shall be sought, offered or permitted.

iii. To assist in the examination, evaluation and comparison of the Financial Bid, Evaluation Committee may ask Bidders individually for clarifications. The request for clarification and the response shall be in writing or by e- mail at ceadaagra12@gmail.com

2.4.5. Process to be Confidential

i. Except the public opening of the Bids, information relating to the examination, clarification, evaluation and comparison of Bids and recommendations concerning the award of Contract shall not be disclosed to Bidders or other persons not officially concerned with such process.

ii. Any effort by a Bidder to influence ADA Evaluation Committee in the process of examination, clarification, evaluation and comparison of Bids and in decisions concerning award of Contract, shall result in the rejection of their Bid.

2.4.6. Award of Contract

i. Award Criteria

The project will be awarded to the successful bidder in two stages.

Stage I- Letter of Award (LOA)

ADA will declare the Bidder ranked L1 as Successful Bidder considering the total Bid as mentioned in the NIT. ADA reserves the right to proceed and award the work and issue Letter of Award (LOA) on these basis as per the procedure mentioned in the Bid Document and terms and conditions set out in this Bid document.

Stage II – Letter of Appointment

ADA will issue the letter of appointment only after the change of land use in the Agra Master Plan 2031 for the Atal Puram site is approved by the Government of Uttar Pradesh. Site will be handed over to the contractor after the letter of appointment is issued.

Notification of Award

a) Prior to the expiry of the period of Bid Validity, ADA will issue the Letter of Award to the Successful Bidder, notifying him of being declared successful and the intent to sign the Contract Agreement with him. This letter (hereinafter and in the Conditions of Contract called 'the Letter of Award') shall mention the amount which ADA, will pay to the Contractor in consideration of the completion and guarantee of the work to be performed by them, as prescribed therein (hereinafter and in the conditions of Contract called 'the Contract Price'). No correspondence will be entertained by ADA from the unsuccessful Bidders.

b) The Letter of Award shall constitute a part of the Contract.

ii. Signing of Agreement

a) ADA shall prepare the Contract Agreement in the Proforma (Form D) included in this document, duly incorporating all the terms of agreement between the two parties within thirty days from the date of issue of the Letter of Award the Successful Bidder will be required to execute the Contract Agreement.

b) Prior to the signing of the Contract Agreement, the Successful Bidder shall submit Performance Bank Guarantee.

c) The contractor whose Bid is accepted will also be required to furnish either copy of applicable licenses/registrations or proof of applying for obtaining of labour licenses, registration with EPFO, ESIC and BOCW Welfare Board and Programme Chart (Time and Progress) within the period specified in schedule “F” given in Volume –II, GCC.

d) The Contract Agreement shall be duly signed by the ADA and the

e) contractor through their authorized signatories.

f) In case the Successful Bidder does not sign the Contract Agreement, ADA reserves the right to cancel the selection process, forfeit any Bid Security and/or Performance Bank Guarantee, as the case may be, submitted by the Successful Bidder and either re-Bid or proceed in any manner that it may deem fit.

iii. Refund of Earnest Money

a) The Earnest Money will be refunded to the Unsuccessful Bidders on finalization of the award or on rejection of a Bid or at the expiry of the validity period of the tender (unless extended by the Bidder), whichever is earlier. Earnest Money Deposit submitted by contractors except the first and second lowest Bidders may be returned within 30 days from the date of opening of the price Bids.

b) Earnest Money will be refunded without waiting for any application or request from Unsuccessful Bidders.

****

SECTION-III

SCOPE OF WORK

3. Bids are Invited for the following Scope of Work

The scope of work includes Survey, Investigation and Collect all primary and secondary data to undertake Detailed Engineering, Procurement, Construction, Testing and Commissioning of All Components of Atal Puram Township in Agra which include, Road, Minor Bridge, Culvert, Road Side Plantation & Arboriculture, Storm Water Drainage, Potable Water Supply & Recycle Water System, Waste Water System, Power Infrastructure, Smart Street Lighting System, Utility Ducts, Solid Waste Management, Site Grading & Levelling, Rain Water Harvesting, Security & Surveillance, landscape for parks and boundary wall in Atal Puram Township at Agra in the State of Uttar Pradesh on Design, Engineering, Procurement and Construction (EPC) basis, followed by 3 years of Defect Liability, 5 years of operation and maintenance for roads, footpath, tracks, arboriculture, street lights, ICT, Parks, plazas and gardens, networks of water, sewer, recycled water, storm drain and rain water harvesting and 10 years of operation and maintenance of WTP and STP after commissioning. The power system network and substation operation and maintenance are excluded. The total time for completion of the above mention scope shall be 30 months from the project start date.

- Land: - A contiguous land parcel of approximate 140.5 Ha has been acquired by ADA for the project in the Kakua Bhandai village area.
- Access: - The approach road to the site is from the Agra Gwalior Road located on the eastern side which provides optimal accessibility for through movement of traffic from Agra. The Site has direct access to the Agra bypass road from the southern side. Additionally, there is an egress point on to Agra Bypass Road which facilitates the movement towards Agra city through the proposed LVUP.
- The contractor shall refer the Front-End Engineering Design (FEED) for undertaking all detailed engineering works.
- Good For Construction (GFC) Drawings: - The EPC contractor shall prepare their designs & good for construction drawings based on the FEED provided in the tender document. Design

  The FEED provided to the contractor is to ensure a clear understanding of the design standards and other associated parameters that the Authority wishes to achieve for different components of the project. Whilst the Authority is keen to see innovation, but the required standards of design must be achieved. Contractors shall outline the means by which they will ensure design quality and the design objectives, which have influenced their scheme. This shall include details of how the Authority's objectives are to be achieved.

  The Contractor shall undertake the following works in conformity with the Front-End Engineering Design and other standards set forth in the contract document subject to applicable statutory bye-laws/ regulations.

  1. Planning, designing and laying Flexible Pavement Roads
  2. Planning, designing and construction of Minor Bridges, LVUP
  3. Planning, designing and construction of footpath and tracks
  4. Planning, designing, supplying and laying of pumping main pipeline for potable water supply
  5. Planning, designing, supplying and laying of Pipe for sewerage

6. Planning, designing, construction & commissioning of STP
7. Planning, designing, construction & commissioning of WTP
8. Planning, designing, supply & installation / laying of underground MV & LV cables (including Testing & Commissioning)
9. Planning, designing, installation, testing & commissioning of Indoor substation, Distribution Transformer substation, street lighting
10. Planning, designing, supplying & Laying of DWC and HDPE Cable Duct for Power/ ICT
11. Planning, designing and construction of RCC Utility Duct for
12. Planning, designing and installing SCADA system
    i. Control Valves Bulk & Water flow metres
    ii. Level /Pressure Transmitters
    iii. Digital Panel Meter
    iv. Server with Interface switches
    v. Storage & Security device
    vi. Switches & Routers
    vii. Control & Instrumentation
    viii. RTUs
    ix. PLC System with SCADA Software.
    x. Web application
    xi. Smart Controller for Individual light fixture control & monitoring System.
13. Planning, designing and development of parks, main gate (2nos), arboriculture and external boundary wall (1192 running meter) along with supply and installation of items mentioned in the indicative BoQ.

- Vetting of design & drawings: - The contractor shall ensure vetting of designs and drawings from IIT/NITs, after approval of the design, drawings by Engineer-in-Charge.

- General Standards

The facilities shall be completed to high standards of construction and specification. The facilities shall be technically sound and functionally suitable in line with the provisions given in the FEED and to meet the Authority 's objectives:

- Statutory, Industry and Local Standards:

  The following standards shall apply unless otherwise stated:
  i. CPHEEO Manuals
  ii. Standards set out in National Building Code of India 2016
  iii. Standards set out in latest IRC Codes & MoRTH Manual
  iv. Standards set out in I,S. Codes
  v. Relevant Development Control Rules/Planning Act/Development Act/ Municipal Act/ any other applicable statutes and local bye-laws
  vi. National Electrical Code,1985
  vii. Indian Electricity Act2003
  viii. Requirements of the local Water Supply Company, Electricity Supply Company/Department
  ix. Requirements of the Pollution Control Board, Fire Department, Aviation authorities and other statutory authorities, as applicable
  x. Requirements of UP building bye laws as applicable.
  xi. Requirements of the Agra Development Authority
  xii. Requirements of any other relevant codes and standards

- Statutory Approvals

The Contractor shall obtain all required statutory approvals including pre- construction from Municipal and other local bodies, Water supply agencies concerned, Electric Supply and Inspectorate Agencies concerned, Police and Security Agencies, Environmental Agencies, Chief Controller of Explosives, Fire Department, Civil Aviation Department, in accordance to prevailing rules, Building Bye-Laws, tree replantation etcetera, as the case may be with related to/ required for Construction/ Completion. If required then the contractor shall also assist and liaison for obtaining EIA approval. These approvals shall include: -

i. Obtaining consent to establish
ii. Obtaining consent to operate
iii. Obtaining approval of all the competent authorities and other statutory bodies like Air Force, civil aviation, railways and local development bodies etcetera as applicable necessary according to the local Acts, Laws, Regulations, etcetera and make any changes desired by such authorities at no extra cost.
iv. Obtaining NOCs (No Objection Certificates) from Fire Department, Storm water drainage & sewerage department, Municipal Corporation / Local Bodies, Civil Aviation, any other statutory body on completion and / or occupancy certificates etcetera
v. Obtaining approval of electrical drawings from Central/State Electrical Inspectorate, as applicable.
vi. Any other approval required from the appropriate Statutory Authorities/Local Bodies.
vii. The original documents of approval/certificates etcetera shall be submitted to the Authority.

Refer Volume-3 Specific Conditions of Contract for detailed scope of work.

SECTION-IV

EVALUATION PROCESS

4. Evaluation Process:

The Bids will be evaluated in the following stages:

i. Stage 1-Preliminary & Technical Evaluation
ii. Stage2- Financial Evaluation

E-tender will be evaluated at each and every stage of evaluation process. The Bids will be evaluated in the following stages:

Stage 1: Preliminary &Technical Evaluation

4.1.1. Preliminary Evaluation

In Preliminary Stage, e-Tender Fee/Processing Fee & EMD will be opened online first and Envelope No. 1 containing proof of submission of e-Tender Fee / Processing Fee and EMD. Online Bids of only those Bidders will be opened who have submitted Bids online on https://www.etender.up.nic.in. e-Tender Fee / Processing Fee and EMD will be checked for veracity of Amount and Form as required by e-tender terms and conditions. If e- Tender Fee / Processing Fee and/ or EMD submitted by any Bidder is not as per e-tender terms and conditions, his Bid will be rejected and will not be considered for further stages of evaluation.

4.1.2. Technical Evaluation

a) Technical Bid

Envelope No. 2 containing hardcopies of technical documents in original as mentioned earlier in section – II will be opened of only those Bidders who have qualified in the Preliminary Stage.

b) Technical Bid – Eligibility Criteria

Bidders qualifying in Stage 1(4.1.1 & 4.1.2 a.) will be considered for further evaluation and the Technical Bids shall be evaluated as per eligibility criteria detailed in Clause 1.4 to 1.11 and Bidder's eligibility for the work shall be determined. If Bidder is not meeting with the minimum eligibility criteria as detailed in Clause 1.4 to 1.11, his Bid will be rejected and will not be considered for further stages of evaluation.

c) Technical Evaluation - Performance of the Contractor

The Bidders qualifying the eligibility criteria **(Clause 2.1)** will be evaluated by evaluation methodology set out below. Only in case of those Bids achieving the minimum qualifying marks, the Financial Bids will be opened.

a) Bidding capacity: The Bidding capacity of the Bidder should be equal to or more than the estimated cost of the work. The Bidding capacity shall be worked out by the following formula:

Bidding capacity = [A x N x 2]- B

Where,

A = Maximum turnover in construction works executed in any one year during the last five years ending on 31.03.2024, if available otherwise upto 31.03.2024 taking into account the completed as well as works in progress. The value of completed work shall be brought to current costing level by enhancing at a simple rate of 7% per annum.

N = Number of years prescribed for completion of work for which Bid has been invited.

B = Value of existing commitments and ongoing works to be completed during the period of completion of work for which tenders have been invited.

The Bidder shall submit the calculation sheet of tendering capacity as per above formula.

b)	Financial strength (Form 'T-1`' & 'T-1 B')	Maximum 20 marks
c)	Experience in similar nature of work during last seven years (Form 'T-2/1, T-2/2' & T-2/3')	Maximum 25 marks
d)	Performance on works (Form 'T-3')– Time overrun	Maximum 25 marks
e)	Performance on works (Form 'T-3')– Quality	Maximum 20 marks
f)	Presentation by Bidders before technical evaluation of Bids	Maximum 10 marks
		Total 100 marks

To become eligible for short listing, the Bidder must secure at least 60% marks (60% for the projects costing more than 100 Cr.) in each attribute {(a), (b), (c) & (d)} and 75% marks in overall aggregate.

ADA will carry out technical assessment of submitted technical proposals to determine that the Tenderer has a full comprehension of the work of the contract. In case the Tenderer's technical submittal is found non- complaint with the requirements of the project the same is liable to be rejected. This process is to assure that only technically acceptable proposals are considered for the work.

ADA, however, reserve the rights to restrict the list of such qualified Bidders to any number deemed suitable by it.

i. The financial Bid of only those Bidders who are technically qualified shall be opened.
ii. The financial Bids of Bidders whose technical Bids are found unacceptable shall be not be opened.
iii. ADA shall notify all the technically qualified Bidders of their technical qualification indicating the date, time and venue for opening of financial Bids.

Stage 2: Financial Bid Evaluation

The evaluation of financial proposals by ADA will take into account, in addition to the tender amounts, the following factors:

a) Arithmetical errors corrected by ADA
b) Such other factors of administrative nature as ADA may consider having a potentially significant impact on contract execution, price and payments, including the effect of items or rates that are unbalanced or unrealistically priced.

The financial proposal shall be processed as under:

i. Evaluation Committee shall open the Financial Bid of the technically qualified Bidders in the presence of the Bidders/their authorized representative, who choose to attend, at the scheduled date and time.

ii. On opening the Financial Bids, the Evaluation Committee shall read out the Financial Bid to all the Bidders and record the same.

iii. If a Bidder quotes nil rates against each item in the tender shall be treated as invalid and will not be considered as lowest tenderer.

iv. All the Financial Bids shall then be ranked according to the Financial Bid in increasing order with the Bidder quoting the least amount ranked L1, Bidder quoting next higher figure as L2 and so on.

v. If two more Bidders quote same lowest price, L1 will be decided on the highest Technical Marks.

vi. L1 will be declared as Successful Bidder and his offer will be processed further.

Letter of Award:

The Successful Bidder would be notified in writing by ADA by issuing the Letter of Award (LOA) in favour of the Lowest (L1) Bidder. ADA will declare the Bidder ranked L1 as Successful Bidder considering the Bid as mentioned in the NIT.

Letter of Appointment:

After the LOA has been issued, the letter of appointment will only be issued by Agra Development Authority for this bid after the change of land use in the Agra Master Plan 2031 for the Atal Puram site is approved by the Government of Uttar Pradesh.

FORM – "A"

FORM OF BID

From (Bidder)

To

Chief Engineer

Agra Development Authority, Agra

Name of Work: "…….. on EPC Basis"

Sir,

Having visited the Site, ascertained the Site conditions and examined the General Conditions of Contract as well as Specific Conditions of Contract, Notice Inviting Bids, Instructions to Bidders etcetera and addenda for the above project, we the undersigned, are pleased to submit our technical and financial Bid along with relevant documents.

1. We acknowledge that the Appendix forms an integral part of the Bid.
2. While preparing this Bid, we have gathered our own information and conducted our own inquiry/survey to our satisfaction and we did not rely solely on the information provided in the Bid Documents. We shall not hold ADA responsible on any account in this regard.
3. We hereby certify that all the statements made and information supplied in the enclosed forms and accompanying statements are true and correct.
4. We have furnished all information and details necessary for eligibility and have no further pertinent information to supply.
5. We submit the requisite certified solvency certificate and authorize to approach the Bank issuing the solvency certificate to confirm the correctness thereof. I/We also authorize …….. to approach individuals, ADAs, firms and corporation to verify our competence, work experience, and general reputation.
6. We undertake, if our Bid is accepted, to commence the works within the stipulated time and to complete the whole of the works comprised in the Contract within the stipulated time calculated from the start date
7. If our Bid is accepted, we will furnish a bank guarantee as Performance Bank Guarantee for the due performance of the Contract. The amount and form of such guarantee or bond will be in accordance with as given in the General Conditions of the Contract.
8. We are aware that in the event of delay in execution of the Project, beyond the agreed timelines due to reasons attributable to us, liquidated damages shall be recovered from us.
9. Our Bid is valid for your acceptance for a period of ONE HUNDRED AND EIGHTY DAYS from the last date of submission of the Bid as per the Bid Documents or any extension thereto.
10. We agree to the General Conditions of Contract and Specific Conditions of Contract and

the terms and conditions mentioned in the Bid Documents.

11. We declare that the submission of this Bid confirms that no agent, middleman or any intermediary has been, or will be engaged to provide any services, or any other item of work related to the award of this Contract. We further confirm and declare that no agency commission or any payment, which may be construed as an agency, commission has been, or will be, paid and that the Bid price does not include any such amount. We acknowledge the right of ADA, if it finds anything to the contrary, to declare our Bid to be non-compliant and if the Contract has been awarded to declare the Contract null and void.
12. We understand that you are not bound to accept the lowest or any Bid you may receive.
13. If our Bid is accepted, we understand that we are to be held solely responsible for the due performance of the Contract.
14. We submit the certificates in support of our suitability, technical knowledge and capability for having successfully completed the works.
15. We enclose;
    a) All documents as per the checklist.
    b) Receipt/Transaction reference number for the online Payment of Rs. 1.475/- Lakhs (Rupees One Lakh Forty-Seven Thousand Five hundred) only, towards Bid Document Cost.
    c) Receipt/Transaction reference number for the online Payment of Rs. 4.87/- Lakhs (Rupees Four Lakhs Eighty-Seven Thousand) only, towards Bid Processing Fee.
    d) Receipt/Transaction reference number for the online Payment of Rs. 4.13/- Cr. (Rupees Four Crore Thirteen Lakh) only, towards EMD.

Note:

i. The Appendix forms part of the Bid
ii. Bidders are required to fill up all the blank spaces in this form of Bid and Appendix.

Dated this……day of..... **2025**

Signature ……

Name…… in the capacity of ……..

duly authorized to sign Bids for and on behalf of……

Address ……

Witness – Signature ……..

Name …….

Address...……

Certificate

It is certified that the information given by us towards meeting the requirement of the eligibility to Bid are correct. It is also certified that I/We shall be liable to be debarred, disqualified/ cancellation of enlistment in case any information furnished by me/us is found to be incorrect.

Date Seal of Bidder

Signature(s) of Bidder(s)

****

Form A Appendix

APPENDIX TO THE FORM OF BID

i.	a) Amount of Performance Bank Guarantee to be deposited by financially successful Bidder	3 percent of the total contract price to be deposited and balance 2.5% to be retained from the running bills. Also, the additional Performance Bank Guarantee for the unbalanced Bid, if any.
	b) Amount of Security Deposit	As per Clause 1 A of GCC
ii	Date for commencement of work	As per Schedule "F"
iii	Time for completion	30 Months plus Five years of Operation and Maintenance including One year of Defect Liability Period.
iv	Amount of compensation in case of extension of completion date due to delays by the Contractor	As per Clause 2 of GCC even as modified in Schedule F
v	Defects Liability Period from the date of issue of "Taking Over Certificate"	The defect liability period for the services completed in a phased manner, shall commence from such completion and shall be upto 36 months after the overall completion of project.
vi	a) Period of validity of Performance Bank Guarantee	As per of GCC Clause 1.
	b) Period of validity of Security Deposit	As per of GCC Clause 1A.

Signature

(Authorized Signatory)

Date…… Name ……..

Place……..... Address …….

FORM 'T-1'

FINANCIAL INFORMATION

1. Financial Analysis-Details to be furnished duly supported by figures in balance sheet, statement of Profit & Loss account along with notes to accounts for the last five years duly certified by the Chartered Accountant mentioning the firm registration number issued by ICAI along with the full address.

   i. Gross Annual Turnover on construction works for last three consecutive financial years ending 31.03.2024

Financial Year	Annual Turn Over in Indian Rupees (or equivalent to Indian Rupees) as per Audited Balance Sheet
2021-22	Rs.
2022-23	Rs.
2023-24	Rs.
Average Annual Turnover over the past three years	Rs.

   ii. Balance Sheet & Statement of Profit & Loss for last five consecutive financial years ending 31.03.2024

Financial Information in Rs. Equivalent	2019-20	2020-21	2021-22	2022-23	2023-24
1. Total Assets					
2. Current Assets					
3. Total Liabilities					
4. Current Liabilities					
5. Profit before Tax					
6. Profit after Tax					
7. Net Worth					
8. Bank solvency amount as mentioned in the bank solvency certificate (form "T- 1B")					

Note:

i. Net Worth shall mean the sum of subscribed and paid-up equity and reserves from which shall be deducted the sum of revaluation reserves, miscellaneous expenditure not written off and reserves not available for distribution to equity shareholders.

Signature of
Chartered Accountant with Seal

FRN Number

Signature of Bidder.

FORM 'T-1 B'

FORM OF BANKERS' CERTIFICATE FROM A SCHEDULED BANK

(SOLVENCY CERTIFICATE)

This is to certify that to the best of our knowledge and information that M/s./Shri …… having marginally noted address, a customer of our bank are/is respectable and can be treated as good for any engagement upto a limit of Rs. …….. (Rupees).

This certificate is issued without any guarantee or responsibility on the bank or any of the officers.

(Signature)
For the Bank

NOTE

1) Bankers' certificates should be on letter head of the Bank, self-attested and should have been issued within Six months from original last date of submission of the Bid.
2) In case of partnership firm, certificate should include names of all partners as recorded with the bank.

FORM 'T-2'

DETAILS OF ELIGIBLE SIMILAR NATURE OF WORKS COMPLETED IN LAST SEVEN YEARS ENDING PREVIOUS DAY OF LAST DATE OF SUBMISSION OF BID

Name of the Bidder…….

S. No.	Details	
1.	Name of work / project and location	
2.	Owner/Client or sponsoring organization	
3.	Type of work (with respect to the eligibility criteria of this Bid)	
4.	Project area in Ha.	
5.	Work Components [Please tick (√) in relevant box]	
a	Laying Flexible Pavement Roads	
b	Construction of Minor Bridges, VUP	
c	Supplying and laying of pumping main pipeline for potable water supply	
d	Supplying and Laying Pipe for sewerage	
e	Construction of STP	
f	Construction of WTP	
g	Supply & Installation / laying of underground MV & LV cables (including Testing & Commissioning)	
h	Installation, Testing & Commissioning of Indoor substation, Distribution Transformer substation, street lighting in Infrastructure project.	
i	Supplying & Laying of DWC and HDPE Cable Duct for Power/ ICT	
j	Construction of RCC Utility Duct for	
l	Installing SCADA system	
6.	Cost of work on completion in Rs. Crores	
7.	Date of commencement as per contract	
8.	Stipulated date of completion	
9.	Actual date of completion	
10.	Date and No. of completion certificate	

11.	Ref. & Page No. of documentary proof of the detail missing in completion certificate	
12.	*Litigation/ arbitration cases pending / in progress with details	
13.	Name and Address (Postal & E-mail) / telephone number of officer to whom reference may be made	
14.	Whether the work was done on back-to-back basis	

Certified that the above list of works is complete and no work has been left out and that the information given is correct to my / our knowledge and belief.

SIGNATURE OF BIDDER(S)
WITH STAMP

*Indicate gross amount claimed and amount awarded by the Arbitrator.

Note: - Copy of work Orders and Completion Certificates of the above works should also be submitted.

FORM 'T-3'

PERFORMANCE REPORT OF WORKS ISSUED BY ADA REFERRED TO IN FORM-T-2

1.	Name of work / Project & Location		
2.	Agreement No.		
3.	Name of Contractor		
4.	Estimated Cost		
5.	Tendered Cost		
6.	Date of Start		
7.	Date of completion		
	i)	Stipulated Date of Completion (as mentioned in work order)	
	ii)	Actual Date of Completion	
8.	i)	Whether case of levy of compensation for delay has been decided or not	Yes/ No.
	ii)	If decided, amount of compensation levied for delayed completion, if any.	
9.	Work Components [Please tick (√) in relevant box]		
a	Laying Flexible Pavement Roads		
b	Construction of Minor Bridges, VUP		
c	Supplying and laying of pumping main pipeline for potable water supply		
d	Supplying and Laying Pipe for sewerage		
e	Construction of STP		
f	Construction of WTP		
g	Supply & Installation / laying of underground MV & LV cables (including Testing & Commissioning)		
h	Installation, Testing & Commissioning of Indoor substation, Distribution Transformer substation, street lighting in Infrastructure project.		
i	Supplying & Laying of DWC and HDPE Cable Duct for Power/ ICT		
j	Construction of RCC Utility Duct for		
l	Installing SCADA system		
10.	Performance Report*		

	1. Quality of Work	Outstanding /Very Good /Good /Satisfactory /Poor
	2. Financial Soundness	Outstanding /Very Good /Good /Satisfactory /Poor
	3. Technical Proficiency	Outstanding /Very Good /Good /Satisfactory /Poor
	4. Resourcefulness	Outstanding /Very Good /Good /Satisfactory /Poor
	5. General Behavior	Outstanding /Very Good /Good /Satisfactory /Poor

* The Tender Inviting Authority shall have the power to get checked the veracity of the report regarding quality as submitted in T3 & the report submitted by the authorized representative of Tender Evaluation Committee shall be final as regards to the quality of works.

Dated:

Executive Engineer or Equivalent

FORM 'T-4'

STRUCTURE & ORGANIZATION

1.	Name & Address of the Bidder		
2.	Telephone No. /Email id /Telex No./Fax No. (Information sent on this e mail shall be considered as postage sent by registered post)		
3.	Legal status of the Bidder (Attach copies of original document defining the legal status).		
	a)	An Individual	
	b)	A proprietary firm	
	c)	A firm in partnership	
	d)	A limited company or Corporation	
	e)	A Joint Venture (JV)	
4.	Particulars of registration with various Government bodies (attach attested photo-copy).		
	ORGANIZATION/ PLACE OF REGISTRATION		REGISTRATION No.
	1.		
	2.		
	3.		
5.	Names and Titles of Directors & Officers with designation to be concerned with this work.		
6.	Designation of individuals authorized to act for the organization.		
7.	Has the Bidder or any constituent partner in case of partnership firm/ Joint Venture, ever abandoned the awarded work before its completion? If so, give name of the project and reasons for abandonment.		
8	Has the Bidder or any constituent partner in case of partnership firm/ limited company/ Joint Venture ever been convicted by the court of law? If so, give details.		
9	In which field of Civil Engineering Construction, the Bidder has specialization and interest?		

10	Any other information considered necessary but not included above.	

Signature of Bidder(s) with stamp

Form –"T-5"

TDS DETAILS FOR PRIVATE SECTOR PROJECTS FOR THE WORKS EXECUTED IN INDIA

Sl. No.	Description	Details
1.	Name of work	
2.	Name of Clients	
3.	Project cost in crores	
4.	No. and date of completion certificate	
5.	Cost of the work on completion in crores	
6.	Payments received as per TDS in Crores	
7.	TDS Corresponding to the payments	
8.	Year wise TDS as per form-26AS/Form 16A relating to the work.	

Note: Value of work done will be considered commensurate with value of TDS certificates.

In case of multiple contracts undertaken from a client, reconciliation for the TDS pertaining to the work mentioned above need to be segregated and reconciled with From- 26AS.
This form needs to be supported with form-26AS taken in HTML format or Form -16A.

Signature of
Chartered Accountant with Seal

FRN Number

Signature of Bidder.

Form- "T-6"

GST Registration Details

Sr. No.	Description	Details
1.	Entity Name	
2.	Address (As per registration with GST)	
3.	City	
4.	Postal code	
5.	Region/State (complete state name)	
6.	Permanent account number (PAN No)	
7.	GSTN/ARN/UID/Provisional with ID No. (Copy of acknowledgement required)	
8.	Type of business (As per registration with GST)	
9.	Service accounting code/HSN Code	
10.	Contact Person	
11.	Phone Number and Mobile Number	
12.	Email –ID	
13.	Compliance Rating (If updated by GSTN)	

Signature of Bidder(s) with stamp

FORM 'T-7'

JV Information Sheet

Attach the Letter of Intent to form JV or certificate of registration/ incorporation and memorandum of association or constitution of the legal entity, if JV is already in existence.

Each member of a JV / must fill in this form

JV /consortium/ SPECIALIST CONTRACTOR'S INFORMATION	
Bidder's legal name	
JV /consortium Partner's legal name	
JV /consortium Partner's financial share in the JV	
JV /consortium Partner's country of Constitution	
JV /consortium Partner's year of Constitution	
JV /consortium Partner's legal address in country of constitution	
JV /consortium Partner's authorized representative information (name, address, telephone numbers, fax numbers, e-mail address)	
Attached are attested copies of the following original documents: 1. Certificate of registration/ incorporation and memorandum of association or constitution of the legal entity named above. 2. Authorization to represent the firm named above.	

FORM 'T-8'

Declaration by the Bidder/ JV

In relation to our Bid submitted to..... *[enter designation and address of the procuring entity]* for procurement of …… *[insert name of the Works]* in response to their Notice Inviting Bids No…… Dated we hereby declare that;

1. We possess the necessary professional, technical, financial and managerial resources and competence required by the Bidding Document issued by the Procuring Entity;
2. We have fulfilled our obligation to pay such of the taxes payable to the Central Government or the State Government or any local authority, as specified in the Bidding Document;
3. We are not insolvent, in receivership, bankrupt or being wound up, not have my/our affairs administered by a court or a judicial officer, not have my/our business activities suspended and are not the subject of legal proceedings for any of the foregoing reasons;
4. We do not have, and our directors and officers not have, been convicted of any criminal offence related to our professional conduct or the making of false statements or misrepresentations as to our qualifications to enter into a procurement contract within a period of three years preceding the commencement of this procurement process, or not have been otherwise disqualified pursuant to debarment proceedings;
5. We do not have a conflict of interest which materially affects fair competition;
6. We have complied and shall continue to comply with the Code of Integrity as specified in this Bidding Document, till completion of all our obligations under the Contract.

Date: Signature of Bidder

Place: Name:

Designation:

Address:

FORM 'T-9'

Joint Venture Agreement (Between not more than three firms)

(ON Rs 100 STAMP PAPER)

Memorandum of Understanding for JOINT VENTURE

This Memorandum of Understanding (hereinafter referred to as "MOU") is made and entered into this ----------
------ ("Effective Date").

BETWEEN

M/s._____, a company incorporated, and having its registered office at _____.(Hereinafter referred to as the **"First Party"/ "One Partner");**

M/s. _____a company incorporated, and having Registered office at _____.(Hereinafter referred to as the **"Second Party"/ "Each Partner")**;

M/s. _____a company incorporated, and having Registered office at _____.(Hereinafter referred to as the **"Third Party"/ "Each Partner")**;

Hereinafter jointly referred to as the **"Parties"** and individually as **"Each Party"** or **"a Party"**

as the case may be. WHEREAS,

A) Agra Development Authority (ADA) (hereinafter referred to as the procuring entity) invited bid for

_____,

(B) The **Parties** hereto formed a Joint Venture or will form a joint venture (hereinafter referred to as the **"JV")**
to jointly execute the above project in all respect

NOW THEREFORE IT IS HEREBY AGREED as follows

ARTICLE 1: JOINT VENTURE:

1.1. The Parties hereto agree to form the Joint Venture with_____designated as the
One Partner and First Partner.

1.2. _____shall be the Second Member – or Second Partner

1.3. _____shall be the Third Member – or Third Partner

1.4. _____shall be the Fourth Member – or Fourth Partner

ARTICLE 2: JOINT VENTURE NAME:

2. The JV shall do business in the name of **"_____Joint Venture".**

ARTICLE 3: JOINT AND SEVERAL LIABILITY:

3. The **Parties** hereto shall, for the above-referred **Projects**, be jointly and severally liable to the **ADA** for the execution of the Projects in accordance with the **Contract** till the actual completion of Contract including defect liability period and operation & maintenance as per bid conditions.

ARTICLE 4: PROPORTIONATE SHARE:

4.1 Each member of the Joint Venture agrees to place at the disposal of the Joint Venture, the benefit of all its experience, technical knowledge and skill, and shall in all respects bear its share of responsibility and burden of completing the contract. The financial share for the lead partner should not be less than 51% and pther parties minimum 23% The parties herein shall be responsible for physical and financial distribution of work as under.

Lead Partner: Financial responsibility: **----------**
Physical responsibility: **----------**
Other Partners: Financial responsibility: **----------**
Physical responsibility: **----------**

4.2 All rights, interests, liabilities, obligations, risks, costs, expenses and pecuniary obligations and all net profits or net losses arising out of the Contract shall be shared or borne by the **Parties** in the above **Proportions**.

4.3 The members in the proportion as mention in article 4.1, shall contribute sufficient Initial fixed capital for timely execution of the project including commissioning & operating period as per the contract.

ARTICLE 5: JOINT EFFORT AND MANAGEMENT:

5.1 The **Parties** shall participate as a JV in the submission of bids and further negotiations with the **Owner** and shall co-operate and contribute their respective expertise and resources to secure and execute the **Projects**.

5.2 On award of **Projects**, the **First Partner** in consultation with the other members of JV will decide on the final management structure for the successful execution of the Projects as per the terms of Contract.

5.3 All the **Parties** hereby agree to pool in their financial, administrative, managerial, technical and material resources for execution of the **Projects**, including commissioning & operation for the period as stipulated in the contract. The share of interest of the **JV** shall be as per the mutual understanding for the successful completion of the project.

5.4 All the **Parties** hereby agree that the composition of the JV shall not be modified during the contract period leave in case of exceptional circumstances with the consent & prior approval of **Agra Development Authority**

ARTICLE 6: EXCLUSIVITY:

6.1 The co-operation between the **Parties** hereto shall be mutually exclusive i.e. none of them shall without the other **Party's** consent & prior approval of **Agra Development Authority**., approach or cooperate with any other parties in respect of the Project.

6.2 In the course of working as associates, the parties to the JV will be sharing information with each other which may be proprietary /confidential information /knowledge acquired by each other. It is hereby agreed that the parties will maintain complete secrecy regarding such information / knowledge and will not divulge to any party for any other purpose except for the success of the joint execution of the contract. All parties will also indemnify each other against any claim that may arise out of using information, which are being claimed proprietary.

ARTICLE 7: Memorandum of Understanding:

7.1 This **Memorandum of Understanding** shall be terminated: -

a) if the **Parties** mutually confirm that the **JV's** bid proposal has not been finally

accepted by **Owner** and all rights and obligations of the **Parties** under or in connection with this **Memorandum of Understanding** have ceased, or

b) after successful completion of the project including commissioning & operation and defect liability period from the date of this **Memorandum of Understanding** unless extended for a further period on demand of **Agra Development Authority**. & mutual consent of the Parties, or

7.2 The **Memorandum of Understanding** can be modified by mutual consent of the Parties to suit the efficient and expeditious execution of Projects including commissioning & operation of Plant or to make this agreement more meaningful to suit the requirements of Owner **after the consent of the Owner**.

ARTICLE 8: ARBITRATION:

8.1 Any dispute resulting from this Agreement shall be settled amicably by mutual Consultation by the Chief Engineer of Agra Development Authority. In the event that an amicable settlement is not reached within 60 days in any particular case, the dispute shall be referred to arbitration and shall be resolved in accordance with and subject to the provisions of the and any statutory modifications and enactment hereof for the time being in force. The decision of the arbitrators shall be final and binding upon both parties. The venue of arbitration will be Agra .

ARTICLE 9: GOVERNING LAWS:

9.1 This Agreement shall in all respects be governed by and interpreted in accordance with the…….. Laws.

ARTICLE 10: CONFIDENTIALITY:

10.1 No Party hereto shall disclose to any other party any information of a confidential nature including but not limited to trade secrets, know-how acquired from any Party in connection with the subject matter of this Agreement.

ARTICLE 11: ADDRESS OF CONSORTIUM:

Any and all correspondence from the Owner to the JV shall be addressed to (**name of JV**) at the address stated herein below–(any one of the partners). The address of the Consortium office of the partner companies will be deemed to be the address for the purpose of communication. The notice, if any required to be served on the party by the other party, will be deemed to be served, if the said notice / communication is delivered by Registered Post at the respective address (**name of JV**)

_____

_____

ARTICLE 12: Authorized Representative:

The JV shall nominate a Representative who shall have the authority to conduct all business for and on behalf of any and all the parties of the JV during the bidding process and, in the event the JV is awarded the Contract, during contract execution.

Authorized Representative of JV……:

ARTICLE 13: ASSIGN ABILITY:

13.1 The interests and rights of a Party in the Contract and as a Party of the Joint Venture shall not be transferable or assignable without the written consent of the Owner & other party.

ARTICLE14: INTERPRETATION OF HEADINGS:

14.1 The headings of each of the Articles herein contained are inserted merely for convenience of reference and shall be ignored in the interpretation and construction of any of the provisions herein contained.

ARTICLE 15: OTHERS

15.1 Any other matters not contained in this Agreement shall be discussed and amicably agreed upon by the **Parties** in the spirit of mutual trust and cooperation for timely completion of project including commissioning & operation of project. Notwithstanding anything above all the **Parties** are severally and jointly responsible to the **Owner for execution of the Contract**:

IN WITNESS WHEREOF the Parties hereto have caused this Agreement to be executed by each of the duly authorized representatives as appearing below: -

Signed by
For and on behalf of

---

in the presence of:

Name……..

Designation…….

Name……..

Designation…….

Name……..

Designation…….

Form 'T- 10'

CRITERIA FOR EVALUATION OF THE PERFORMANCE OF BIDDERS/ CONTRACTORS FOR PRE-ELIGIBILITY

	Bidders qualifying the initial criteria as set out in para 2.2 will be evaluated for following criteria by scoring method on the basis of details furnished by them.	
a	Financial strength (Form 'T-1' & 'T-1B')–	Maximum 20 marks
b	Experience in similar nature of work during last seven years (Form 'T- 2')	Maximum 25 marks
c	Performance on works (Form 'T-3') – Time over run	Maximum 25 marks
d	Performance on works (Form 'T-3') – Quality	Maximum 20 marks
e	Presentation by Bidders before technical evaluation of Bids	Maximum 10 marks
	Total -	100 marks

To become eligible for short listing, the Bidder must secure at least 60% marks in each attribute and minimum 75% marks in aggregate.

	ATTRIBUTES	**EVALUATION**
(a)	**Financial Strength (20 Marks)**	
	Average Annual Turnover (16 Marks)	i. 60% marks for minimum eligibility criteria. ii. 100% marks for twice the minimum eligibility criteria or more In between (i) & (ii) – on pro rata basis
	Solvency Certificate (4 Marks)	i. 60% marks for minimum eligibility criteria. ii. 100% marks for twice the minimum eligibility criteria or more In between (i) & (ii) – on pro rata basis

* Note: The Bidders have to give a presentation before technical evaluation of Bids showing their work program, timeline, resources, work methodology and prospective cash flow. The time and venue of the presentation shall be informed through e-mail.

(b)	Experience of similar class of works (20 marks)	i. 60% marks for minimum eligibility criteria. ii. 100% marks for twice the minimum eligibility criteria or more In between (i) & (ii) – on pro rata basis

(c)	Performance on works (Time over run) (20 Marks)			
	Parameter	**Calculation for Point**	**Score**	**Maximum Points**

	If TOR= AT/ ST	1.0	1-2	2-3	3-3.5	25
	i. Without Levy of compensation	25	15	10	5	
	ii. With Levy of compensation	20	10	5	-5	
	iii. Levy of compensation not decided	20	10	0	0	
	TOR = AT/ ST, where AT = Actual Time; ST = Stipulated Time sanctioned extension of time, if any.					
	Note: - Marks for value in between the stages indicated above is to be determined by straight line variation method.					
(d)	Performance of Works (Quality) (20 Marks)	Performance				
		Outstanding	20			
		Very Good	18			
		Good	15			
		Satisfactory	12			
		Poor	0			
(e)	Presentation by Bidders before technical evaluation of Bids (20 Marks) *					

Form-B

DELETED

Form C

(On Required Non-Judicial Stamp Paper)

FORM OF PERFORMANCE BANK GUARANTEE BANK GUARANTEE

(On a stamp paper of appropriate value from any Nationalised Bank or Scheduled Bank)

To,

Vice Chairman
Agra Development Authority, Agra

Dear Sir,

In consideration of the …….. at district ……, U.P., India" on EPC Mode having awarded to M/s (hereinafter referred to as "the said Contractor (s)", which expression shall include his successor and assignees) for the work of _____a Contract No_____ in terms inter alia, of the _____Letter No. _____dated _____ and the General Conditions of Contract and upon the condition of the Contractor's furnishing Security for the performance of the Contractor's obligations and discharge of the Contractor's liability under and in connection with the said Contract upto a sum of Rs._____ (Rupees only) amounting to Rs._____ percent of the total Contract value.

1. We, _____(hereinafter called `The Bank' which expression shall include its successors and assignees) hereby jointly and severally undertake to guarantee the payment to the Employer in rupees forthwith on demand in writing and without protest or demur or any and all moneys payable by the Contractor to the Employer in respect of or in connection with the said Contract inclusive of all the Employer's losses and damages and costs, (inclusive between attorney and ADA) charges and expenses and other moneys payable in respect of the above as specified in any notice

of demand made by the Employer to the Bank with reference to this guarantee upto an aggregate limit of Rs. (Rupees only).

2. We _____Bank further agree that the Employer shall be sole judge of and as to whether the said Contractor has committed any breach or breaches of any of the terms and conditions of the said Contract and the extent of loss, damage, cost, charges and expenses caused to or suffered by or that may be caused to or suffered by the Employer on account thereof and the decision of the Employer that the said Contractor has committed such breach or breaches and as to the amount or amounts of loss, damage, costs, charges and expenses caused to or suffered by the Employer from time to time shall be final and binding on us.
3. The Employer shall be at liberty without reference to the Bank and without affecting the full liability of the Bank hereunder to take any other Security in respect of the Contractor's obligations and liabilities hereunder or to vary the Contract or the work to be done there under vis-a-vis the Contractor or to grant time or indulgence to the Contractor or to reduce or to increase or otherwise vary the prices of the total Contract value or to release or to forbear from enforcement of all or any of the Security and/or any other Security(ies) now or hereafter held by The Employer and no such dealing(s) reduction(s) increase(s) or other indulgence(s) or arrangements with the Contractor or release or forbearance whatsoever shall absolve the bank of the full liability to the Employer hereunder or prejudice the rights of the Employer against the bank.
4. This guarantee shall not be determined or affected by the liquidation or winding up, dissolution, or change of constitution or insolvency of the Contractor but shall in all respects and for all purposes be binding and operative until payment of all monies payable to the Employer in terms thereof.
5. The bank hereby waives all rights at any time inconsistent with the terms of this guarantee and the obligations of the Bank in terms hereof shall not be anywise affected or suspended by reason of any dispute or disputes having been raised by the Contractor stopping or preventing or purporting to stop or prevent any payment by the Bank to the Employer in terms hereof.

6. The amount stated in any notice of demand addressed by the Employer to the Bank as liable to be paid to the Employer by the Contractor or as suffered or incurred by the Employer on account of any losses or damages or costs, charges and/or expenses shall be conclusive evidence of the amount so liable to be paid to the Employer or suffered or incurred by the Employer as the case may be and shall be payable by the Bank to The Employer in terms hereof.
7. This guarantee shall be a continuing guarantee and shall remain valid and irrevocable for all claims of the Employer and liabilities of the Contractor arising upto and until midnight of.
8. **This guarantee is valid till _____ (date to be mentioned) (18 months beyond the stipulated date of completion or the extended period, thereof).**
9. This guarantee shall be in addition to any other guarantee or Security whatsoever that the Employer may now or at any time anywise may have in relation to the Contractor's obligations/or liabilities under and/or in connection with the said Contract, and the Employer shall have full authority to have recourse to or enforce this Security in preference to any other guarantee or Security which the Employer may have or obtain and no forbearance on the part of the Employer in enforcing or requiring enforcement of any other Security shall have the effect of releasing the Bank from its full liability hereunder.
10. It shall not be necessary for the Employer to proceed against the said Contractor before proceeding against the Bank and the Guarantee herein contained shall be enforceable against the Bank notwithstanding that any Security which The Employer may have obtained or obtain from the Contractor shall at the time when proceedings are taken against the said bank hereunder be outstanding or unrealised.
11. We, the said Bank undertake not to revoke this guarantee during its currency except with the consent of the Employer in writing and agree that any change in the constitution of the said Contractor or the said bank shall not discharge our liability hereunder.
12. We _____the said Bank further that we shall pay forthwith the amount stated in the notice of demand notwithstanding any dispute/difference pending between the parties before the arbitrator and/or that any dispute is being referred to arbitration.
13. Notwithstanding anything contained herein above, our liability under this guarantee shall be

restricted to Rs. _____(Rupees _____)

and this guarantee shall remain in force till _____and unless a claim is made on us within 3 months from that date, that is before _____all the claims under this guarantee shall be forfeited and we shall be relieved of and discharged from our liabilities there under.

Dated _____day of _____2025

For and on behalf of Bank.

Issued under seal:

Form D

FORM OF AGREEMENT

This agreement is made at ---------- on the ---- day of ---------- 2020 between Vice Chairman Agra Development Authority (hereafter referred to as "VC ADA"" which expression shall, unless repugnant to the context or meaning thereof be deemed to mean and include its successors, in office of the **First Part.**

M/s ---------- a Company incorporated under the Companies Act 1956 having Head Office at ----------

----------, through..... (hereinafter called the "Contractor" which expression unless repugnant to the context shall mean and include its successors-in-interest assigns in office) of the **Second Part.**

Whereas Agra Development Authority (hereinafter referred to as "ADA") is desirous that certain works should be executed, for "Construction of" At …….... , Uttar Pradesh, INDIA" on EPC Basis (hereinafter called "The Project") and has accepted a Tender submitted by the contractor for the execution and completion of such works as well as guarantee of such works and the remedying of defects therein.

NOW THIS AGREEMENT WITHNESSES as follows:

1. In this agreement words and expression shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to.
2. The following documents shall be deemed to form and be read and constructed as part of this agreement Viz.

Volume – 1 (NIT & ITB)

Volume – 2 General Conditions of Contract (GCC)

Volume – 3 – Specific Conditions of Contract (SCC)

Volume – 4 – Design Basis Report (DBR)

Volume – 5 Technical Specifications

Volume – 6 (Tender Drawings)

Volume – 7 (Financial Bid)

All the correspondence till award of contract i.e. addendum, LOA etcetera Technical and Financial Bids submitted by Bidder.

3. In consideration of the payment to be made by ADA to the Contractor as hereinafter mentioned, the Contractor hereby covenants with ADA to executed and complete the Project by _____and remedy and defects therein in conformity in all respects with the provisions of the Contract.

4. ADA hereby covenants to pay the Contractor in consideration of the execution and completion of the Project and the remedying of defects therein, the total Contract Price of Rs._____ only) being the sum stated in the letter of Award (LOA) subject to such additions thereto or deductions there from as may be made under the provisions of the Contract at the times and in the manner prescribed by the Contract.

5. OBLIGATION OF THE CONTRACTOR

The Contractor shall ensure full compliance with tax laws of India with regard to this Contract and shall be solely responsible for the same.

IN WITHNESS OF WEREOF the parties hereto have caused their respective common seals to be hereunto affixed / (or have hereunto set their respective hands and seals) the day and year first above written.

For and on behalf of the Contractor	For and on behalf of the ADA

Signature of the authorized official	(Seal)
Name of the Contractor Stamp / Seal of the Contractor	Name of the official Stamp / Seal
SIGNED, SEALED AND DELIVERED By the said	By the Said
on behalf of the Contractor:	on behalf of the VC ADA
in the presence of: Witness_____ Name_____ Address_____	in the presence of: Witness_____ Name_____ Address_____

Form E

FORMAT FOR POWER OF ATTORNEY FOR

SIGNING OF PROPOSAL (Authorized Signatory)

Know all men by these presents, we …….. (Name of the Tenderer and address of their registered office) do hereby constitute, appoint and authorize Mr. / Ms…….. (name and residential address of Power of Attorney holder) who is presently employed with us and holding the position of ……..… as our attorney, to do in our name and on our behalf, all such acts, deeds and things necessary in connection with or incidental to our Bid for the Project and submission of all documents and providing information / responses to _____, representing us in all matters before _____,and generally dealing with in all matters in connection with our proposal for the said Project.

We hereby agree to ratify all acts, deeds and things lawfully done by our said attorney pursuant to this Power of Attorney and that all acts, deeds and things done by our aforesaid attorney shall and shall always be deemed to have been done by us.

FORM F

UNDERTAKING (FOR SPECIALIZED AGENCY)

DELETED

Form G

AFFIDAVIT

(On a Rs 100/- non judicial stamp paper duly notarized)

1 I, the undersigned, do hereby certify that all the statements made in the required attachments are true and correct.

2 The undersigned also hereby certificate our firm M/s _____neither abandoned any contract awarded to us nor such works have been rescinded, during the last five years prior to the date of this application.

3 The undersigned also hereby confirmers that M/s_____ have not been blacklisted/debarred/penalized by any government agency or public sector undertaking or judicial authority/arbitration body.

4 The undersigned hereby authorize (s) and request (s) any bank, person, form or corporation to furnish pertinent information deemed necessary and requested by the Department to verify this statement or regarding my (our) competence and general reputation.

5 The undersigned understands and agrees that further qualifying information may be requested, and agrees to furnish any such information at the request of the ADA.

6 The undersigned undertake that 'I/We have not altered/ modified the financial Bid attached in the e-tender portal. If it is found during the tender stage or later that the BOQ is modified by us, the ADA shall have the right to reject our Bid'.

_____

Signed by an Authorised
Officer of the Bidder

Form H

UNDERTAKING

(On a Rs 100/- non judicial stamp paper duly notarized)

We do hereby indemnify ADA, against all penal action that may be levied/ affected by any concerned authority for default in any labour regulation/PF/ESI and other statutory requirements of the relevant Acts/Laws related to the work of the contractor and will bear the legal charges, if any, and will pay the legal charges/dues directly to the concerned authority.

_____

Signed by an Authorised
Officer of the Bidder

~~**Form-I**~~

DELEATED

FORM J

(On Rs100/- Non-Judicial Stamp papers)

FORM FOR BIDDER'S BIDDING CAPACITY

Name of the Firm / Bidder: -……...

Name of Work:- Development of Atal Puram Township Gwalior Road Agra, Uttar Pradesh on EPC basis.

1. The Bidding capacity of the Bidder should be equal to or more than the estimated cost of the work put to tender. The Bidding capacity shall be worked out by the following formula:

   Bidding Capacity (Rs.) = {[AxNx2]-B}

   Where,

A= Maximum turnover in construction works executed in any one year during the last five years taking into account the completed as well as works in progress. The value of completed works shall be brought to current costing level by enhancing at a simple rate of 7% per annum.

N = Number of years prescribed for completion of work for which Bid has been invited.

B = Value of existing commitments and ongoing works to be completed during the period of completion of work for which Bid has been invited (Value of B worked out from "Form K").

2. E-tender Fee/Processing Fee and or EMD is as per e-tender terms and conditions.
3. The firm or any JV in which the firm has ever participated has not been blacklisted & currently in force by any state Government, Central Government or any Public Sector Unit of either Central Government or State government, so far.

Signature of Chartered Accountant with Seal **Seal & Signature of Bidder**

FORM K

PROJECT UNDER EXECUTION

S. No.	Details	
1.	Name of work / project and location	
2.	Owner or sponsoring organization	
3.	Cost of work in Rs. (in Crores)	
4.	Date of commencement as per contract	
5.	Stipulated date of completion	
6.	Up to Date % Financial Progress	
7.	Value of Balance Commitment to Complete work till Period for which Bid Invited (Crore)	
8.	Slow progress if any and reasons thereof	
9.	Name and Address (Postal & E-mail) / telephone number of officer to whom reference may be Made	
10	Remarks	

It is to undertake that above is the total list of works under progress and information furnished is true and nothing has been hiding. Further that, if such a violation comes for hiding information or incorrect information to the notice of Department, then I/we shall be debarred for Bidding in PWD in future forever.

Note:

1- In Row No 6 above, only the percentage of financial progress shall be mentioned. In substantiation of financial progress, the Bidder shall submit the statement of up-to-date payment made against each work, obtained from the Executive Engineer/Project Manager in charge of the work or by the chartered accountant.

SIGNATURE (S) OF BIDDER(S)

(WITH STAMP)

Annexure -1 – Checklist

CHECKLIST OF DOCUMENTS TO BE SUBMITTED WITH THE BID

TECHNICAL PACKAGE – Hardcopy and Online

Sl. No.	Name of Document	Mode of submission
1.	**Receipt of online submission of** Rs 1,47,500/- (Rupees One Lakhs Forty-Seven Thousand Five hundred including GST) as e-Tender Fee	**submit Original Scanned Copy Online**
2.	**Receipt of online submission of** Rs 4,87,000/- (Rupees Four lakhs eighty-seven thousand only including GST) as bid processing fee	
2.	**Receipt of online submission of EMD** favor of "**Agra Development Authority**	
3.	Form of Bid and Appendix (Form A) for the Bid	
4.	Power of Attorney (Form E) in favor of the person signing the Bid	
~~5.~~	~~Undertaking for engaging specialized agencies (Form F)~~	
6.	Affidavit by Bidder (Form G) duly notarized on non-judicial of appropriate value- stamp paper	
7.	Affidavit/ Indemnity / Undertaking (Form H)	
8.	Form "T-1" (Financial Information)	
9.	Form "T-1-B" (Solvency Certificate as per Clause 1.4)	
10.	Form "T-5" (TDS details for Private Sector Projects for the works executed in India)	
11.	Form "T-2" (Details of Eligible Similar Works completed)	**submit Original Scanned Copy Online**
12.	Form "T-3" (Performance Report of Works referred to in Form T-2/1, 2 & 3)	
13.	Form "T-4" (Structure and Organization)	
14.	Form "T-6" (GST Registration Details)	
15.	Form "T-7" (JV Information Sheet)	
16.	Form "T-8" (Declaration by Bidder/JV)	
16a.	Form "T-9" (JV Agreement)	

17.	Copies of GST Registration or undertaking / EPF Registration/ PAN Number	
18.	Integrity Pact Agreement duly signed by the authorized signatory on behalf of the Bidder (as per proforma given in GCC Vol-2)	
19.	All pages of the entire Corrigendum/ addendum (if any)/ pre-Bid clarifications (if any) signed by the authorized person of the Bidder/Bidder.	
20.	All TDS Certificates of Private Sector Projects for the works executed in India.	
21.	Form 'J' Form for Bidder's Bidding Capacity	
22.	Form 'K' Project under Execution	
23.	Form 'L' LETTER COMPRISING THE FINANCIAL BID	
24.	Any other document as specified in the Bid document.	
Note: - All the uploaded documents should be in readable, printable & legible form.		

FINANCIAL PACKAGE: Online

S. No	**Name of Document**	**Mode of submission**
1.	Digitally signed Bid / Price Bid (Financial Bids – Volume-7)	Online

END OF VOLUME – 1

VOLUME - 2

CONDITIONS OF CONTRACT

Item Rate EPC mode Tender & Contract

Index

Tender and Contract for Works on EPC Mode

(A) Tender for the work of:-

.....

.....

i. To be uploaded by……. hours on …….

ii. To be opened in presence of tenderers who may be present at ……. hours on ….....…….in the office of .....

TENDER

I/We have read and examined the notice inviting tender, schedule A, D, E & F Specifications, Drawings & Designs, General Rules and Directions, Conditions of Contract, clauses of contract, Special conditions, Schedule of Rates, other documents, regulations, Acts and Rules referred to in the conditions of contract and all other contents in the tender document for the work.

I/We hereby tender for the planning, designing and execution of the work as per scope mentioned in this tender document specified for the Governor of Uttar Pradesh within the time specified in Schedule 'F' viz., schedule of quantities and in accordance in all respect with the applicable municipal byelaws , regulations, Acts, NGT guidelines, specifications, designs, drawing and instructions in writing referred to in Rule-1 of General Rules and Directions and in Clause 11 of the Conditions of contract and with such materials as are provided for, by, and in accordance with, such conditions so far as applicable. I/We agree to keep the tender open for 180 days from the due date of its opening in case of single Bid system or 180 days from the date of opening of technical Bid in case tenders are invited in 2/3 Bid system for work and not to make any modification in its terms and conditions. I/We have deposited EMD for the prescribed amount through payment gateway available on e-portal-https://www.etender.up.nic.in as per the Bid document.

A copy of earnest money deposit receipt of prescribed amount deposited in the form of Insurance Surety Bonds, Account Payee Demand Draft, Fixed Deposit Receipt, Banker's Cheque or Bank Guarantee (as prescribed) issued by a Commercial Bank, is scanned and uploaded (strike out as the case may be). If I/We, fail to furnish the prescribed Performance Bank Guarantee within prescribed period, I/We agree that the Governor of Uttar Pradesh or

his successors, in office shall without prejudice to any other right or remedy, be at liberty to forfeit the said earnest money absolutely.

Further, if I/We fail to commence work as specified, I/ We agree that Governor of Uttar Pradesh or the successors in office shall without prejudice to any other right or remedy available in law, be at liberty to forfeit the said Performance Bank Guarantee absolutely. The said Performance Bank Guarantee shall be a guarantee to execute all the works referred to in the tender documents upon the terms and conditions contained or referred to those in excess of that limit at the rates to be determined in accordance with the provision contained in Clause 12 of the tender form. Further, I/We agree that in case of forfeiture of Earnest Money or Performance Bank Guarantee as aforesaid, I/We shall be debarred for participation in the re-tendering process of this work.

I/We undertake and confirm that eligible similar work(s) has/have not been got executed through another contractor on back to back basis. Further that, if such a violation comes to the notice of department, then I/We shall be debarred for tendering in ADA as per enlistment rules applicable. Also, if such a violation comes to the notice of Department before date of start of work, the Engineer-in-charge shall be free to forfeit the entire amount of Earnest Money Deposit/Performance Bank Guarantee.

I/We hereby declare that I/We shall treat the tender documents, drawings and other records connected with the work as secret/confidential documents and shall not communicate information derived there from to any person other than a person to whom I/We am/are authorized to communicate the same or use the information in any manner prejudicial to the safety & integrity of the State.

Dated Signature of Contractor

Witness: Postal Address

Address:

Occupation:

A C C E P T A N C E

The above tender (as modified by you as provided in the letters mentioned hereunder) is accepted by me for and on behalf of the Agra Development Authority for a sum of

Rs……

(Rupees.....

.....

.....)

The letters referred to below shall form part of this contract agreement: -

a)

b)

c)

For & on behalf of the
Agra Development Authority.

Signatures

….....

Designation .....
Dated:

Agra Development Authority

General Rules Directions

1. All works proposed for execution by contract will be notified in the form of invitation to tender posted on website. This form will state the work to be carried out, as well as the date for submitting and opening tenders and the time allowed for carrying out the work, also the amount of earnest money to be deposited with the tender, and the amount of the security deposit and Performance Bank Guarantee to be deposited by the successful tenderer and the percentage, if any, to be deducted from bills. Copies of the specifications, designs, drawings and any other document applicable to the work shall be open for inspection by the contractor in the office of officer inviting tender during office hours.

The work involves execution as per name of work under EPC Mode that will involve part Engineering (preparation of structural and services design and drawings), procurement & construction by the contractor based on Preliminary/ Conceptual Infrastructure and Architectural design and drawings attached with the tender documents; detailed design and drawings may be provided by the Engineer-in-Charge in stages/ parts during execution.

2. In the event of tender being submitted by a firm/company, it must be signed separately by each partner/director thereof or in the event of the absence of any partner/director, it must be signed on his behalf by a person holding a power of attorney authorizing him to do so, such power of attorney to be produced with the tender, and it must disclose that the firm/company is duly registered under the applicable Indian PartnershipAct 1932/ Companies Act 2013.

3. Receipts for payment made on account of work, when executed by a firm/company/ JV, must also be signed by all the partners/directors, except where contractors are described in their tender as a firm/company/ JV, in which case the receipts must be signed in the name of the firm by one of the partners/directors (duly authorized by the firm/company/ JV), or by some other person having due authority to give effectual receipts for the firm/company.

4. The rate(s) must be quoted in decimal coinage. Amounts must be quoted in full rupees by ignoring (less than and equal to) fifty paisa and considering more than fifty paisa as rupee one. In case the lowest tendered amount (worked out on the basis of quoted rate of Individual items) of two or more contractors is same, then such lowest contractors may be asked to submit sealed revised offer quoting rate of each item of the schedule of quantity for all sub sections/sub heads as the case may be, but the revised quoted rate of each item of schedule of quantity for all sub sections/sub heads should not be higher than their respective original rate quoted already at the time of submission of tender. The lowest tender shall be decided on the basis of revised offer.

   If the revised tendered amount (worked out on the basis of quoted rate of individual items) of two or more contractors received in revised offer is again found to be equal, then the lowest tender, among such contractors, shall be decided by draw of lots in the presence of the Secretary ADA, Chief Engineer & Executive Engineer and the lowest contractors those have quoted equal amount of their tenders.

   In case of any such lowest contractor in his revised offer quotes rate of any item more

than their respective original rate quoted already at the time of submission of tender, then such revised offer shall be treated as invalid. Such case of revised offer of the lowest contractor or case of refusal to submit revised offer by the lowest contractor shall be treated as withdrawal of his tender before acceptance and 50% of his earnest money shall be forfeited.

In case all the lowest contractors those have same tendered amount (as a result of their quoted rate of individual items), refuse to submit revised offers, then tenders areto be recalled after forfeiting 50% of EMD of each lowest contractor.

Contractor, whose earnest money is forfeited because of non- submission of revised offer, or quoting higher revised rate(s) of any item(s) than their respective original rate quoted already at the time of submission of his Bid shall not be allowed to participate in the retendering process of the work.

5. The officer inviting tender or his duly authorized representative will open tenders in the presence of any intending contractors who may be present at the time of opening of tenders.

6. The officer inviting tenders shall have the right of rejecting all or any of the tenders and will not be bound to accept the lowest or any other tender.

7. The receipt of an accountant or clerk for any money paid by the contractor will not be considered as any acknowledgment or payment to the officer inviting tender and the contractor shall be responsible for seeing that he procures a receipt signed by the officer inviting tender or a duly authorized Cashier.

8. In the case of Item Rate EPC Tenders, only rates quoted shall be considered. Any tender containing percentage below/above the rates quoted is liable to be rejected. Rates quoted by the contractor in item rate EPC tender in figures and words shall be accurately filled in so that there is no discrepancy in the rates written in figures and words. However, if a discrepancy is found, the rates which correspond with the amount worked out by the contractor shall unless otherwise proved be taken as correct. If the amount of an item is not worked out by the contractor or it does not correspond with the rates written either in figures or in words, then the rates quoted by the contractor in words shall be taken as correct. Where the rates quoted by the contractor in figures and in words tally, but the amount is not worked out correctly, the rates quoted by the contractor will unless otherwise proved be taken as correct and not the amount. In event no rate has been quoted for any item(s), leaving space both in figure(s), word(s), and amount blank, it will be presumed that the contractor has included the cost of this/these item(s) in other items and rate for such item(s) will be considered as zero and work will be required to be executed accordingly.

   However, if a tenderer quotes nil rates against any item in item rate EPC tender, the tender shall be treated as invalid and will not be considered as lowest tenderer and earnest money deposited shall be forfeited.

9. (i) The Contractor whose tender is accepted, will be required to furnish Performance Bank Guarantee from a Nationalized Bank at specified percentage of the tendered amount as mentioned in Schedule 'E' and within the period specified in Schedule F.

(ii) The contractor whose tender is accepted will also be required to furnish by way of Security Deposit for the fulfillment of his contract, an amount equal to 2.5% of the tendered amount of the work. The Security deposit will be collected by deductions from the running bills as well as final bill of the contractor at the rates mentioned above. The Security amount will also be accepted in the shape of Insurance Surety Bonds, Account Payee Demand Draft, Fixed Deposit Receipt or Bank Guarantee from any of the Commercial Banks will be accepted for this purpose provided confirmatory advice is enclosed.

10. On acceptance of the tender, the name of the accredited representative(s) of the

contractor who would be responsible for taking instructions from the Engineer-in- Charge shall be communicated in writing to the Engineer-in-Charge.

11. GST or any other tax applicable in respect of inputs procured by the contractor for this contract shall be payable by the Contractor and Government will not entertain any claim whatsoever in respect of the same. However, component of GST at time of supply of service (as provided in CGST Act 2017) provided by the contract shall be varied if different from that applicable on the last date of receipt of tender including extension if any. Accordingly, payment or recovery shall be done.
12. The contractor shall give a list of both gazetted and non-gazetted ADA employees related to him.
13. The tender for composite work includes, in addition to infrastructure development works, all other works such as ancillary buildings, horticulture, landscaping, urban design works etc.

CONDITIONS OF CONTRACT

Definitions

1. The EPC Contract means the documents forming the tender and acceptance thereof and the formal agreement executed between the Agra Development Authority and the Contractor, together with the documents referred to therein including conditions, specifications, designs, drawings and instructions issued from time to time by the Engineer-in- Charge and all these documents taken together, shall be deemed to form one contract and shall be complementary to one another.

2. In the contract, the following expressions shall, unless the context otherwise requires, have the meanings, hereby respectively assigned to them:

    i. The expression, works or work shall, unless there be something either in the subject or context repugnant to such construction, be construed and taken to mean the works by or by virtue of the contract contracted to be executed whether temporary or permanent, and whether original, altered, substituted or additional.

    ii. The Site shall mean the land, places on, into or where work is to be executed under the contract or any adjacent land, path or street or where work is to be executed under the contract or any adjacent land, path or street which may be temporally allotted or used for the purpose of carrying out the contract.

    iii. The Contractor shall mean the individual, firm or company, whether incorporated or not, undertaking the works and shall include the legal personal representative of such individual or the persons composing such firm or company, or the successors of such firm or company and the permitted assignees of such individual, firm or company.

    iv. The Governor means the Governor of Uttar Pradesh and his successors.

    v. Government or Government of Uttar Pradesh shall mean the governor of Uttar Pradesh through Concerned Administrative Department of the Government of Uttar Pradesh.

    vi. The Vice Chairman means the Vice Chairman of Agra Development Authority and his/ her successors.

    vii. The Engineer-in-charge means the Engineer Officer who shall supervise and be in charge of the work and who shall execute the contract on behalf of the Agra Development Authority as mentioned in Schedule 'F' hereunder.

    viii. The term Director General includes Special Director General/Additional Director General/ Chief Engineer.

    ix. Accepting Authority shall mean the authority mentioned in Schedule F '.

    x. Excepted Risk are risks due to riots (other than those on account of contractor's employees), war (whether declared or not) invasion, act of foreign enemies, hostilities, civil war, rebellion revolution, insurrection, military or usurped power, any acts of Government, damages from aircraft, acts of God, such as earthquake, lightening, unprecedented floods and other causes over which the contractor has no control and accepted as such by the Accepting Authority or causes solely due to use or occupation by Government of the part of the works in respect of which a certificate of completion has been issued or a cause solely due to Government's faulty design of works.

xi. Market Rate shall be the rate as decided by the Engineer-in-charge on the basis of the cost of materials and labour at the site where the work is to be executed plus applicable overheads and profits as mentioned in schedule F.

Scope and Performance

Provided that no extra overheads and profits shall be payable on the part(s) of work assigned to other agency(s) by the contractor as per terms of contract.

Schedule(s) referred to in these conditions shall mean the relevant schedule(s) annexed to the tender documents or the standard Schedule of Rates of the government mentioned in Schedule 'F' hereunder, with the amendments thereto issued upto the date of receipt of the tender.

xii. Authority means Agra Development Authority as specified in schedule 'F'.

xiii. District Specifications means the specifications followed by the State Government in the area where the work is to be executed.

xiv. Tendered value means the value of the entire work as stipulated in the letter of award.

xv. Date of commencement of work: The date of commencement of work shall be the date of start as specified in schedule ' F ' or the first date of handing over of the site, whichever is later, in accordance with the phasing if any, as indicated in the tender document.

xvi. GST shall mean Goods and Service Tax - Central, State and Inter State.

3. Where the context so requires, words imparting the singular only also include the plural and vice versa. Any reference to masculine gender shall whenever required include feminine gender and vice versa.

4. Headings and Marginal notes to these General Conditions of Contract shall not be deemed to form part thereof or be taken into consideration in the interpretation or construction thereof or of the contract.

5. The contractor shall be furnished, free of cost one certified copy of the contract documents except standard specifications, Schedule of Rates and such other printed and published documents, together with all drawings as may be forming part of the tender documents. None of these documents shall be used for any purpose other than that of this contract.

Works to be carried out

6. The work to be carried out under the Contract shall, except as otherwise provided in these conditions, include all labourers, materials, tools, plants, equipment and transport which may be required for full and entire execution and completion of the works. The descriptions given in the Schedule of Quantities (Schedule A) shall, unless otherwise stated, be held to include wastage on materials, carriage and cartage, carrying and return of empties, hoisting, setting, fitting and fixing in position and all other labours necessary in and for the full and entire execution and completion of the work as aforesaid in accordance with good practice and recognized principles.

Sufficiency of Tender

7. The Contractor shall be deemed to have satisfied himself before tendering as to the correctness and sufficiency of his tender for the works and of the rates quoted in the Schedule of Quantities, which rates and prices shall, except as otherwise provided, cover all his obligations under the Contract and all matters and things necessary for the proper completion and maintenance of the works.

Discrepancies and Adjustment of Errors

8. The several documents forming the Contract are to be taken as mutually explanatory of one another, detailed drawings being followed in preference to small scale drawing and figured dimensions in preference to scale and special conditions in preference to General Conditions.

8.1. In the case of discrepancy between the schedule of Quantities, the Specifications and/ or the Drawings, the following order of preference shall be observed:

i. Description of Schedule of Quantities.

ii. Particular Specification and Special Condition, if any. (iii) Drawings.

iii. CPWD Specifications / UPPWD Specifications/ ADA Specifications

iv. Indian Standard Specifications of B.I.S.

8.2. If there are varying or conflicting provisions made in any one document forming part of the contract, the Accepting Authority shall be the deciding authority with regard to the intention of the document and his decision shall be final and binding on the contractor.

8.3. Any error in description, quantity or rate in Schedule of Quantities or any omission therefrom shall not vitiate the Contract or release the Contractor from the execution of the whole or any part of the works comprised therein according to drawings and specifications or from any of his obligations under the contract.

Signing of Contract

9. The successful tenderer/contractor, on acceptance of his tender by the Accepting Authority, shall, within 15 days from the stipulated date of start of the work, sign thecontract consisting of:

i. the notice inviting tender, all the documents including drawings, if any, forming the tender as issued at the time of invitation of tender and acceptance thereof together with any correspondence leading thereto.

ii. Standard CPWD/ ADA Form as mentioned in Schedule 'F' consisting of:

a) Various standard clauses with corrections up to the date stipulated in Schedule ' F ' along with annexures thereto.

b) CPWD/ UPPWD Safety Code.

c) Model Rules for the protection of health, sanitary arrangements for workers employed by NIYOJAN VIBHAG/UPPWD/ADA or its contractors.

d) ADA Contractor's Labour Regulations.

e) List of Acts and omissions for which fines can be imposed.

iii. No payment for the work done will be made unless contract is signed by the Contractor.

GENERAL CONDITION OF CONTRACTCLAUSES OF CONTRACT

Performance Bank Guarantee

Clause 1

(i) The contractor shall submit an irrevocable Performance Bank Guarantee from a Nationalized Bank at specified percentage of the tendered amount as mentioned in Schedule 'E', in addition to other deposits mentioned elsewhere in the contract for his proper performance of the contract agreement, (not withstanding and/or without prejudice to any other provisions in the contract) within period specified in Schedule 'F' from the date of issue of letter of acceptance. This period can be further extended by the Engineer- in-Charge up to a maximum period as specified in schedule 'F' on written request of the contractor stating the reason for delays in procuring the Performance Bank Guarantee, to the satisfaction of the Engineer-in-Charge.

(ii) The Performance Bank Guarantee shall be submitted by the contractor on format as per GCC and shall be initially valid up to the stipulated date of completion plus minimum 6 months beyond that. In case the time for completion of work gets enlarged, the contractor shall get the validity of Performance Bank Guarantee extended to cover such enlarged time for completion of work. After recording of the completion certificate for the work by the competent authority, the Performance Bank Guarantee shall be returned to the contractor, without any interest. However, in case of contracts involving maintenance of services/any other work after construction of same services/other work, then 50% of Performance Bank Guarantee shall be retained as Security Deposit. The same shall be returned year wise proportionately.

(iii) The Engineer-in-Charge shall not make a claim under the Performance Bank Guarantee except for amounts to which the Agra Development Authority is entitled under the contract (notwithstanding and/or without prejudice to any other provisions in the contract agreement) in the event of:

a) Failure by the contractor to extend the validity of the Performance Bank Guarantee as described herein above, in which event the Engineer-in-Charge may claim the full amount of the Performance Bank Guarantee.

b) Failure by the contractor to pay Agra Development Authority any amount due, either as agreed by the contractor or determined under any of the Clauses/Conditions of the agreement, within 30 days of the service of notice to this effect to the contractor by Engineer-in-Charge.

(iv) In the event of the contract being determined or rescinded under provision of any of the Clause/Condition of the agreement, the Performance Bank Guarantee shall stand forfeited in full and shall be absolutely at the disposal of the Agra Development Authority.

(v) On substantial Completion of any work which has been completed to such an extent that the intended purpose of the work is met and ready to use, then a provisional Completion certificate shall be recorded by the Engineer-in-Charge. The provisional certificate so recorded shall be appended with a list of outstanding balance items of work that need to be completed in accordance with the provisions of the contract.

Recovery of Security Deposit

This provisional completion certificate shall be recorded by the concerned Engineer- in-Charge with the approval of Vice Chairman ADA, if required. After recording of the provisional Completion Certificate for the work by the competent authority, the 40 % of Performance Bank Guarantee shall be returned to the contractor, without any interest.

Clause 1A

The person(s) whose tender may be accepted (hereinafter called the contractor) shall permit ADA at the time of making any payment to him for work done under the contract to deduct a sum at the rate of 2.5% of the gross amount of each running and final bill till the sum deducted will amount to security deposit of 2.5% of the tendered amount of the work. Such deductions will be made and held by ADA by way of Security Deposit unless he/they has/have deposited the amount of Security at the rate mentioned above in the form of Government Securities or fixed deposit receipts. In case a fixed deposit receipt of any Bank is furnished by the contractor to the ADA as part of the security deposit and the Bank is unable to make payment against the said fixed deposit receipt, the loss caused thereby shall fall on the contractor and the contractor shall forthwith on demand furnish additional security to ADA to make good the deficit.

All compensations or the other sums of money payable by the contractor under the terms of this contract may be deducted from or paid by the sale of a sufficient part of his security deposit or from the interest arising there from, or from any sums which may be due to or may become due to the contractor by ADA on any account whatsoever and in the event of his Security Deposit being reduced by reason of any such deductions as aforesaid, the contractor shall within 10 days make good by submitting Account Payee Demand Draft, Fixed Deposit Receipt, Banker's Cheque of commercial Banks or Government Securities (if deposited for more than 12 months) endorsed in favour of the Engineer-in-charge any sum or sums which may have been deducted from or raised by sale of his security deposit or any part thereof. The security deposit shall be collected from the running bills and the final bill of the contractor at the rates mentioned above.

The security deposit as deducted above can be released against bank guarantee issued by a commercial bank, on its accumulations to a minimum of Rs. 50 lac subject to the condition that amount of such bank guarantee, except last one, shall not be less than Rs. 50 lac. Provided further that the validity of bank guarantee shall be in conformity with provisions contained in clause 17 which shall be extended from time to time depending upon extension of contract granted under provisions of clause 2 and clause 5.

In case of contracts involving Operation and Maintenance after construction of same work, then 50% of Performance Bank Guarantee shall be retained as Security Deposit. The same shall be returned year wise proportionately.

Note-1: Government papers tendered as security will be taken at 5% (five per cent) below its market price or at its face value, whichever is less. The market price of Government paper would be ascertained by the Engineer-in- charge at the time of collection of interest and the amount of interest to the extent of deficiency in value of the Government paper will be withheld if necessary.

Note-2: Government Securities will include all forms of Securities mentioned in Rule No. 274 of the G.F. Rules except fidelity bond. This will be subject to the observance of the condition mentioned under the rule against each form of security.

Note-3: Note 1 & 2 above shall be applicable for both clause 1 and 1A

Compensation for Delay

Clause 2

If the contractor fails to maintain the required progress in terms of clause 5 or to complete the work and clear the site on or before the stipulated completion date or justified extended date of completion determined as per clause 5 (excluding any extension under clause 5.5)also considering any extension granted under clauses 12 and 15, he shall, without prejudice to any other right or remedy available under the law to the Government on account of such breach, pay as compensation, the amount calculated as below :

(i) Compensation for delay of work @ 0.5% of accepted tendered amount per month of delay (to be computed on per day basis).

Provided further that the total amount of compensation for delay to be paid under this condition shall not exceed 5 % (five percent) of the accepted Tendered Value of work or of the accepted Tendered Value of the Sectional part of work as mentioned in Schedule 'F' for which a separate period of completion is originally given.

The period of delay solely attributable to contractor shall be computed as the time taken by contractor going beyond the 'justified date of completion' as determined by the authority specified in schedule F under clause 5. Further, in case where the contractor is entitled to additional time under clause 12 and /or clause 15, that shall also be accounted for while deciding the net period of delay. In case, the authority specified in schedule F decides to levy compensation during the progress of work, the period of delay attributable to contractor shall be computed (by such authority) as the period by which the progress is behind the schedule on date of such decision, after due consideration of justified extension at that stage of work.

In case no compensation has been decided by the authority in Schedule 'F' during the progress of work, this shall be no waiver of right to levy compensation by the said authority if the work remains incomplete on final justified extended date of completion.

If the Engineer in Charge decides to give further extension of time allowing performance of work beyond the justified extended date the contractor shall be liable to pay compensation for such extended period. The levy of compensation under this clause shall be without prejudice to the right of action by the Engineer-in-charge under clause 3 or any other clause in contract.

In case action under clause 2 has not been finalized and the work has been determined under clause 3, the right of action under clause 2 shall remain post determination of contract and in such case the levy of compensation shall be for days the progress is behind the schedule on date of determination, as assessed by the authority in Schedule F, after due consideration of justified extension. The compensation for delay, if not decided before the determination of contract, shall be decided after of determination of contract. Further, in such case where the contract has been determined, the total amount of recovery against compensation under clause 2 plus that under clause 3 (i.e. forfeiture of security deposit, Performance Bank Guarantee) shall not exceed 8 % of the accepted tendered value of work.

The amount of compensation may be adjusted or set-off against any sum payable to the Contractor under this or any other contract with the ADA.

In case, the contractor does not achieve a particular milestone mentioned in schedule F, or the re-scheduled milestone(s) in terms of Clause 5, the amount shown against that milestone shall be withheld, to be adjusted against the compensation levied as above. With-holding of this amount on failure to achieve a milestone, shall be automatic without any notice to the contractor. However, if the contractor catches up with the progress of work on the subsequent milestone(s), the withheld amount shall be released. In case the contractor fails to make up for the delay in subsequent milestone(s), amount mentioned against each milestone missed subsequently also shall be withheld. The amount so withheld can be released against BG/FDR from a commercial bank of equivalent amount. Further, no interest, whatsoever, shall be payable on such withheld amount.

When Contract can be Determined

Clause 3

Subject to other provisions contained in this clause, the Engineer-in- Charge may, without prejudice to his any other rights or remedy against the contractor in respect of any delay, not following safety norms, inferior workmanship, any claims for damages and/or any other provisions of this contract or otherwise, and whether the date of completion has or has not elapsed, by notice in writing absolutely determine the contract in any of the following cases:

(i) If the contractor having been given by the Engineer-in-charge a notice in writing to rectify, reconstruct or replace any defective work or that the work is being performed in an inefficient or otherwise improper or un-workman like manner shall omit to comply with the requirement of such notice for a period of seven days thereafter.

(ii) If the contractor has, without reasonable cause, suspended the progress of the work or has failed to proceed with the work with due diligence and continues to do so after a notice in writing of seven days from the Engineer-in-Charge.

(iii) If the contractor fails to complete the work or section of work with individual date of completion on or before the stipulated or justified extended date, on or before such date of completion; and the Engineer in Charge without any prejudice to any other right or remedy under any other provision in the contract has given further reasonable time in a notice given in writing in that behalf as either mutually agreed or in absence of such mutual agreement by his own assessment making such time essence of contract and in the opinion of Engineer-in-Charge the contractor will be unable to complete the same or does not complete the same within the period specified.

(iv) If the contractor persistently neglects to carry out his obligations under the contract and/ or commits default in complying with any of the terms and conditions of the contract and does not remedy it or take effective steps to remedy it within 7 days after a notice in writing is given to him in that behalf by the Engineer-in- Charge.

(v) If the contractor shall offer or give or agree to give to any person in Government service or to any other person on his behalf any gift or consideration of any kind as an inducement or reward for doing or forbearing to do or for having done or forborne to do any act in relation to the obtaining or execution of this or any other contract for ADA /Government.

If the contractor shall enter into a contract with Government in connection with which commission has been paid or agreed to be paid by him or to his knowledge, unless the particulars of any such commission and the terms of payment thereof have been previously disclosed in writing to the Engineer-in- Charge.

(i) If the contractor had secured the contract with Government as a result of wrong tendering or other non-bonafide methods of competitive tendering or commits breach of Integrity Agreement.

(ii) If the contractor being an individual, or if a firm, any partner thereof shall at any time be adjudged insolvent or have a receiving order or order for administration of his estate made against him or shall take any proceedings for liquidation or composition (other than a voluntary liquidation for the purpose of amalgamation or reconstruction) under any Insolvency Act for the time being in force or make any conveyance or assignment of his effects or composition or arrangement for the benefit of his creditors or purport so to do, or if any application be made under any Insolvency Act for the time being in force for the sequestration of his estate or if a trust deed be executed by him for benefit of his creditors.

(iii) If the contractor being a company shall pass a resolution or the court shall make an order that the company shall be wound up or if a receiver or a manager on behalf of a creditor shall be appointed or if circumstances shall arise which entitle the court or the creditor to appoint a receiver or a manager or which entitle the court to make a winding up order.

(iv) If the contractor shall suffer an execution being levied on his goods and allow it to be continued for a period of 21 days.

(v) If the contractor assigns (excluding part(s) of work assigned to other agency(s) by the contractor as per terms of contract), transfers, sublets (engagement of labour on a piece-work basis or of labour with materials not to be incorporated in the work, shall not be deemed to be subletting) or otherwise parts with or attempts to assign, transfer, sublet or otherwise parts with the entire works or any portion thereof without the prior written approval of the Engineer -in-Charge. When the contractor has made himself liable for action under any of the cases aforesaid, the Engineer-in-Charge on behalf of the Agra Development Authority shall have powers:

a. To determine the contract as aforesaid so far as performance of work by the Contractor is concerned (of which determination notice in writing to the contractor under the hand of the Engineer-in-Charge shall be conclusive evidence). Upon such determination, the Performance Bank Guarantee shall stand forfeited in full, Security Deposit already recovered and Security deposit recoverable shall be liable to be forfeited and shall be absolutely at the disposal of the ADA.

b. After giving notice to the contractor to measure up the work of the contractor and to take such whole, or the balance or part thereof, as shall be un-executed out of his hands and to give it to another contractor to complete the work. The contractor, whose contract is determined as above, shall not be allowed to participate in the tendering process for the remaining work which may include any new items to complete the work. In the event of above courses being adopted by the Engineer-in-Charge, the contractor shall have no claim to compensation for any loss sustained by him by reasons of his having purchased or procured any materials or entered into any engagements or made any advances on account or with a view to the execution of the work or the performance of the contract. And in case action is taken under any of the provision aforesaid, the contractor shall not been titled to recover or be paid any sum for any work thereof or actually performed under this contract unless and until the Engineer-in-Charge has certified in writing the performance of such work and the value payable in respect thereof and he shall only be entitled to be paid the value so certified.

Clause 3A

In case, the work including planning designing and execution as per scope of contract cannot be started due to reasons not within the control of the contractor within 1/8th of the stipulated time for completion of work or 180 days whichever is higher, either party may close the contract by giving notice to the other party stating the reasons. In such eventuality, the Performance Bank Guarantee of the contractor shall be refunded within 30 days of closing of the contract.

Neither party shall claim any compensation for such eventuality. This clause is not applicable for any breach of the contract by either party.

Contractor liable to pay compensation even if action not taken under Clause 3

Clause 4

In any case in which any of the powers conferred upon the Engineer-in-Charge by Clause 3 thereof, shall have become exercisable and the same are not exercised, the non-exercise thereof shall not constitute a waiver of any of the conditions hereof and such powers shall not withstanding be exercisable in the event of any future case of default by the contractor and the liability of the contractor for compensation shall remain unaffected. In the event of the Engineer-in-Charge putting in force all or any of the powers vested in him under the preceding clause he may, if he so desires after giving a notice in writing to the contractor, take possession of (or at the sole discretion of the Engineer-in-Charge which shall be final and binding on the contractor) use as on hire (the amount of the hire money being also in the final determination of the Engineer-in-Charge) all or any tools, plant, materials and stores, in or upon the works, or the site thereof belonging to the contractor or procured by the contractor and intended to be used for the execution of the work/or any part thereof, paying or allowing for the same in account at the contract rates, or, in the case of these not being applicable, at current market rates to be certified by the Engineer-in-Charge, whose certificate thereof shall be final, and binding on the contractor, clerk of the works, foreman or other authorized agent to remove such tools, plant, materials, or stores from the premises (within a time to be specified in such notice) in the event of the contractor failing to comply with any such requisition, the Engineer-in-Charge may remove them at the contractor's expense or sell them by auction or private sale on account of the contractor and his risk in all respects and the certificate of the Engineer-in-Charge as to the expenses of any such removal and the amount of the proceeds and expenses of any such sale shall be final and conclusive against the contractor.

Time and Extension for Delay

Clause 5

The time allowed for execution of the Works as specified in the Schedule 'F' or the extended time in accordance with these conditions shall be the essence of the Contract. The execution of the work shall commence from such date as mentioned in schedule 'F' or from the date of handing over of the site, as notified by the Engineer-in-Charge, whichever is later. If the Contractor commits default in commencing the execution of the work as aforesaid and such default continues even after 10 days after a notice in writing has been given by the Engineer in charge, the Performance Bank Guarantee shall be forfeited by the Engineer in Charge and shall be absolutely at the disposal of the Government without prejudice to any other right or remedy available in law. The contract shall stand determined when such decision regarding the forfeiture of the Performance Bank Guarantee is communicated to the contractor.

5.1.1 The contractor shall within 10 (ten) working days of award of work, submit a time program to the Engineer-in Charge. Such program shall be made in due consideration of:

a) Schedule of handing over of site as specified in the Schedule 'F'

b) Schedule of issue of designs as specified in the Schedule 'F',

Further, program shall be prepared using the mutually agreed format/software or in other format/software as directed by Engineer- in-Charge. The said program shall be in direct relation to the time stated in the Contract document for completion of items of the works. It shall indicate the forecast of the dates of commencement and completion of various trades/ sections of the work and may be amended as necessary by agreement between the Engineer-in-Charge and the Contractor, within the limitations of overall time imposed in the Contract

documents.

5.1.2 The Engineer-in-Charge shall within 10 (ten) working days of receipt of such program, make modifications, if any and communicate the approved program to the contractor.

In case of non- submission of construction program by the contractor, the program prepared by the Engineer-in-Charge shall be deemed to be final. Such program by the Engineer-in-Charge shall not relieve the contractor of any of the obligations under the contract.

5.1.3 The contractor shall submit the progress report using the mutually agreed software or in other format decided by Engineer-in-Charge for the work done during previous month to the Engineer-in-charge on or before 5th day of each month, failing which a recovery as per Schedule F shall be made as agreed compensation and shall be recovered from the next running account bill without any notice.

5.2 Delays due to reasons beyond the control of both parties

If the work(s) be delayed by:-

(i) force majeure, or

(ii) abnormally bad weather, or

(iii) serious loss or damage by fire, or

(iv) civil commotion, local commotion of workmen, strike or lockout, affecting any of the trades employed on the work, or

(v) delay on the part of other contractors or tradesmen engaged by Engineer-in-Charge in executing work not forming part of the Contract, or

(vi) any other cause like above which, in the reasoned opinion of the Engineer-in- Charge is beyond the control of both parties then upon the happening of any such event causing delay, the Contractor shall immediately give notice thereof in writing to the Authority indicated in schedule F.

(vii) The said authority, on receipt of such notice, considering the factual ground situation, give a fair and reasonable 'justified extension of time' and reschedule the mile stones for completion of work.

(viii) The contractor shall have no claim of damages against the delays listed in this subclause i.e. sub clause 5.2. The contractor shall have no claim of damages for extension of time granted or rescheduling of milestone/s for events listed in sub clause 5.2.

5.3 Delays attributable to the Department and the Concurrent delays

In case the work is hindered, by the Department or for any reason / event, for which the Department is responsible, the Contractor shall immediately give notice thereof to the authority indicated in schedule F. The said authority shall, after verification of facts, give a fair and reasonable 'justified extension of time' and reschedule the mile stones for completion of work. Such extension of time or rescheduling of milestone/s shall be without prejudice to any other right or remedy of the parties in contract or in law, provided further that for the concurrent delays i.e. the delays occurring concurrently due to the defaults of both the parties, the contractor be entitled for extension of time but shall have no claim of damages.

5.4 Rescheduling of milestones and 'Justified extended date'

The request for rescheduling the Mile stones or extension of time, shall be made by the Contractor in writing within fourteen days of the happening of the event causing delay on the prescribed forms i.e. Form of application by the contractor for seeking rescheduling of milestones or Form of application by the contractor for seeking extension of time (Appendix -XVI) to the authority as indicated in Schedule 'F'. The Contractor shall indicate in such a request the period by which rescheduling of milestone/s or extension of time is desired.

The authority as indicated in Schedule 'F', after examining the request, shall give a fair and reasonable 'justified extension of time' for completion of work and simultaneously reschedule the mile stones. In event of non- application by the contractor for extension of time, the authority as indicated in schedule F, after affording opportunity to the contractor, may give, fair and reasonable justified extension and reschedule the milestones, within a reasonable period of occurrence of the event causing delay. Such justified extension of time shall determine the 'justified extended date' of completion of work.

5.5 Delays beyond the 'justified extended date'

(delays attributable solely to the contractor):

In case the work is delayed by reasons solely attributable to contractor i.e. for the reasons beyond the events/reasons stated in clause 5.2 & clause 5.3, requiring the execution of work beyond the 'justified extended date' (as stated in clause 5.4), the authority indicated in schedule F, without prejudice to the provisions under clause 3, may grant extension of time required for completion of work without rescheduling the milestones and without altering the 'justified extended date'. In such case, the contractor shall be liable for levy of compensation for such delay/such period of extension of time (i.e. for the period beyond the 'justified extended date' as determined in clause5.4) and this default of contractor shall be dealt in conjunction with clause 2 of contract document.

5.6 It is a term of contract that the authority indicated in schedule F while deciding the extension of time case as per clause 5.1 to 5.5, shall also segregate the overall period of delay in following categories:

a) delays due to reasons beyond the control of both parties (under clause 5.2)

b) delays attributable solely to the Department (under clause 5.3)

c) concurrent delays (under clause 5.3)

d) delays solely attributable to contractor (under clause 5.5)

5.7 Online record of hinderances:

The Engineer-in-Charge may require the contractor to give notice of hinderances on any online system devised by him. All the notices of hinderances have to be submitted through such online system by the contractor timely to claim extension of time/ rescheduling of milestone(s). The contractor shall not be entitled for any damages in case such online notices are not given timely by the contractor.

Computerized Measurement Book

Clause 6

Engineer-in-Charge shall, except as otherwise provided, ascertain and determine by measurement the value of work done in accordance with the contract.

All measurements as per the stage payments mentioned in Schedule F having financial value shall be entered by the contractor and compiled in the shape of the Computerized Measurement Book having pages of A-4 size as per the format of the department so that a complete record is obtained of all the stages of works performed under the contract.

All such measurements recorded by the contractor or his authorized representative from time to time, during the progress of the work, shall be got checked by the contractor from the Engineer-in-Charge or his authorized representative as per interval or program fixed in consultation with Engineer-in-Charge or his authorized representative. After the necessary corrections made by the Engineer-in-Charge, the measurement sheets shall be returned to the contractor for incorporating the corrections and for resubmission to the Engineer-in- Charge for the dated signatures by the Engineer-in- Charge and the contractor or their representatives in token of their acceptance.

Whenever bill is due for payment, the contractor would initially submit draft computerized measurement sheets and these measurements would be got checked/test checked from the Engineer-in-Charge and/or his authorized representative. The contractor will, thereafter, incorporate such changes as may be done during these checks/test checks in his draft computerized measurements, and submit to the department a computerized measurement book, duly bound, and with its pages machine numbered. The Engineer-in- Charge and/or his authorized representative would thereafter check this MB, and record the necessary certificates for their checks/test checks.

The final, fair, computerized measurement book given by the contractor, duly bound, with its pages machine numbered, should be 100% correct. No cutting or over-writing in the measurements would thereafter be allowed. If at all any error is noticed, the contractor shall have to submit a fresh computerized MB with its pages duly machine numbered and bound, after getting the earlier MB cancelled by the department. Thereafter, the MB shall be taken in the Divisional Office records, and allotted a number as per the Register of Computerized MBs. This should be done before the corresponding bill is submitted to the Division Office for payment. The contractor shall submit two spare copies of such computerized MBs for the purpose of reference and record by the various officers of the department.

The contractor shall also submit to the Engineer-in-Charge separately his computerized Abstract of Cost and the bill based on these measurements, duly bound, and its pages machine numbered along with two spare copies of the bill. Thereafter, this bill will be processed by the Division Office and allotted a number as per the computerized record in the same way as done for the measurement book meant for measurements.

The contractor shall, without extra charge, provide all assistance with every appliance, labour and other things necessary for checking of measurements by the Engineer-in-Charge or his representative.

Except where any general or detailed description of the work expressly shows to the contrary, measurements shall be taken in accordance with the procedure set forth in the contract notwithstanding any provision in the relevant Standard Method of measurement or any general or local custom.

The contractor shall give not less than seven days' notice to the Engineer- in-Charge or his authorized representative in charge of the work before covering up or otherwise placing beyond the reach of checking and/or test checking the measurement of any work in order that the same may be checked and/or test checked and correct dimensions thereof be taken before the same is covered up or placed beyond the reach of checking and/or test checking measurement and shall not cover up and place beyond reach of measurement any work without consent in writing of the Engineer- in-Charge or his

authorized representative in charge of the work who shall within the aforesaid period of seven days inspect the work, and if any work shall be covered up or placed beyond the reach of checking and/or test checking measurements without such notice having been given or the Engineer-in-Charge's consent being obtained in writing the same shall be uncovered at the Contractor's expense, or in default thereof no payment or allowance shall be made for such work or the materials with which the same was executed.

Engineer-in-Charge or his authorized representative may cause either themselves or through another officer of the department to check the measurements recorded by contractor and all provisions stipulated herein above shall be applicable to such checking of measurements or levels.

It is also a term of this contract that checking and/or test checking the measurements of any item of work in the measurement book and/or its payment in the interim, on account of final bill shall not be considered as conclusive evidence as to the sufficiency of any work or material to which it relates nor shall it relieve the contractor from liabilities from any over measurement or defects noticed till completion of the defects liability period.

Payment on intermediate certificate to be regarded as Advances

Clause 7

The running account bills shall be submitted by the contractor for the work executed on the basis of such recorded measurements as per Clause 6 on the format of the Department in triplicate on or before the date of every month fixed for the same by the Engineer-in-Charge. The contractor shall not be entitled to be paid any such interim payment if the gross work done together with net payment/ adjustment of advances for material collected, if any, since the last such payment is less than the amount specified in Schedule 'F', in which case the interim bill shall be prepared on the appointed date of the month after the requisite progress is achieved. Engineer-in-Charge shall arrange to have the bill verified in the event of the failure of the contractor to submit the bills, no claims whatsoever due to delays on payment including that of interest shall be payable to the contractor. Payment on account of amount admissible shall be made by the Engineer-in-Charge certifying the sum to which the contractor is considered entitled by way of interim payment at such rates as decided by the Engineer-in-Charge.

An amount of ad-hoc payment not less than 75% of the net amount of the bill under check, shall be made within 10 working days of submission of the bill. The remaining payment is also to be made after final checking of the bill within 28 working days of submission of bill by the contractor.

All such interim payments shall be regarded as payment by way of advances against final payment only and shall not preclude the requiring of bad, unsound and imperfect or unskilled work to be rejected, removed, taken away and reconstructed or re-erected. Any certificate given by the Engineer- in-Charge relating to the work done or materials delivered forming If

the revised tendered amount (worked out on the basis of quoted rate of individual items) part of such payment, may be modified or corrected by any subsequent such certificate(s) or by the final certificate and shall not by itself be conclusive evidence that any work or materials to which it relates is/are in accordance with the contract and specifications. Any such interim payment, or any part thereof shall not in any respect conclude, determine or affect in any way powers of the Engineer-in-Charge under the contract or any of such payments be treated as final settlement and adjustment of accounts or in any way vary or affect the contract.

Pending consideration of extension of date of completion, interim payments shall continue to be made as herein provided without prejudice to the right of the department to take action under the terms of this contract for delay in the completion of work, if the extension of date of completion is not granted by the competent authority.

Clause 7A

No Running Account Bill shall be paid for the work till the applicable labour licenses, registration with EPFO, ESIC and BOCW Welfare Board, whatever applicable are submitted by the contractor to the Engineer-in- Charge.

Clause 7B

If the exigencies of the work so demand, the engineer-in-charge may allow payment to a third party, who is creditor to the contractor, after fulfilling the following conditions.

a) The contractor gives an authority letter addressed to the engineer-in-charge on a non- judicial stamp paper of Rs.100 in the format given below.

I/We authorize the Executive Engineer, ……Division, Agra Development Authority to pay directly on my/our behalf to …… ……... (name of the third party) an amount of Rs.....(Rupees.....in words) for the work done or supplies made by ……. (name of the third party). I/We shall be responsible for the quality and quantity of the same under the provisions of agreement number .....

Signature of the contractor

b) The total fee of third party (or parties) for the inspection of the works executed on Quality & financial audit shall not exceed 1.0% of the agreement cost of the work and will be paid under the same contract value. No additional cost shall be reserved for the fee of Third-Party Inspection. All the fee of third party (or parties) for the inspection, factory visit by ADA etc. shall be borne by the contractor. The fees amount will be deducted from RA bills raised by the contractor.

Full reasons for proposing such third-party payment shall be recorded and prior written approval of the next higher authority shall be obtained before making such payment.

Clause 8

Within ten days of the completion of the work, the contractor shall give notice of such completion to the Engineer-in-Charge and within thirty days of the receipt of such notice, the Engineer-in-Charge shall inspect the work and if there is no defect in the work, shall furnish the contractor with a final certificate of completion, otherwise a provisional certificate of physical completion indicating defects (a) to be rectified by the contractor and/or (b) for which payment will be made at reduced rates, shall be issued. But no final certificate of completion shall be issued, nor shall the work be considered to be complete until the contractor shall have removed from the premises on which the work shall be executed all scaffolding, surplus materials, rubbish and all huts and sanitary arrangements required for his/their work people on the site in connection with the execution of the works as shall have been erected or constructed by the contractor(s) and cleaned off the site, in, upon, or about which the work is to be executed or of which

he may have had possession for the purpose of the execution, thereof, and not until the work shall have been measured by the Engineer-in-Charge. If the contractor fails to comply with the requirements of this Clause as to removal of scaffolding, surplus materials and rubbish and all huts and sanitary arrangements as aforesaid and cleaning off dirt on or before the date fixed for the completion of work, the Engineer-in-Charge may at the expense of the contractor remove such scaffolding, surplus materials and rubbish etc., and dispose off the same as he thinks fit and clean off such dirt as aforesaid, and the contractor shall have no claim in respect of scaffolding or surplus materials or final cleaning work as aforesaid except for any sum actually realized by the sale thereof.

Clause 8A

The contractor shall submit as built drawings for all infrastructure and architectural works within thirty days of the completion of the work.

In case, the contractor fails to submit the as built drawings as aforesaid, he shall be liable to pay a sum of 0.1 % (zero-point one percent) of Tendered Value or limit prescribed in Schedule F whichever is more as may be fixed by the authority as mentioned in Schedule F and in this respect the decision of the that authority shall be final and binding on the contractor.

Clause 9

The final bill shall be submitted by the contractor in the same manner as specified in interim bills within three months of physical completion of the work or within one month of the date of the final certificate of completion furnished by the Engineer-in-Charge whichever is earlier. No further claims shall be made by the contractor after submission of the final bill and these shall be deemed to have been waived and extinguished. Payments of those items of the bill in respect of which there is no dispute and of items in dispute, for quantities and rates as approved by Engineer-in-Charge, will, as far as possible be made within the period of three months the period being reckoned from the date of receipt of the bill by the Engineer-in- Charge or his authorized Asst. Engineer.

Payment of Contractors Bills to Banks

Clause 9A

Payments due to the contractor may, if so desired by him, be made to his bank, registered financial, co-operative or thrift societies or recognized financial institutions instead of direct to him provided that the contractor furnishes to the Engineer-in-Charge (1) an authorization in the form of a legally valid document such as a power of attorney conferring authority on the bank, registered financial, co-operative or thrift societies or recognized financial institutions to receive payments and (2) his own acceptance of the correctness of the amount made out as being due to him by ADA or his signature on the bill or other claim preferred against ADA before settlement by the Engineer-in-Charge of the account or claim by payment to the bank, registered financial, co-operative or thrift societies or recognized financial institutions. While the receipt given by such banks registered financial, co-operative or thrift societies or recognized financial institutions shall constitute a full and sufficient discharge for the payment, the contractor shall whenever possible present his bills duly receipted and discharged through his bank, registered financial, co-operative or thrift societies or recognized financial institutions.

Nothing herein contained shall operate to create in favour of the bank, registered financial, co-operative or thrift societies or recognized financial institutions any rights or equities vis-a- vis the Agra Development Authority.

Materials to be provided by the Contractor

Clause 10A

The contractor shall, at his own expense, provide all materials, required for the works other than those which are stipulated to be supplied by the ADA.

The contractor shall, at his own expense and without delay supply to the Engineer-in-Charge samples of materials to be used on the work and shall get these approved in advance. All such materials to be provided by the Contractor shall be in conformity with the specifications laid down or referred to in the contract. The contractor shall, if requested by the Engineer- in-Charge furnish proof, to the satisfaction of the Engineer-in-Charge that the materials so comply. The Engineer-in-Charge shall within thirty (30) days of supply of samples or within such further period as he may require intimate to the Contractor in writing whether samples are approved by him or not. If samples are not approved, the Contractor shall forthwith arrange to supply to the Engineer-in-Charge for his approval, fresh samples complying with the specifications laid down in the contract. When materials are required to be tested in accordance with specifications, approval of the Engineer-in-Charge shall be issued after the test results are received.

The Contractor shall at his cost submit the samples of materials to be tested or analysed and shall not make use of or incorporate in the work any materials represented by the samples until the required tests or analysis have been made and materials finally accepted by the Engineer-in-Charge. The Contractor shall not be eligible for any claim or compensation either arising out of any delay in the work or due to any corrective measures required to be taken on account of and as a result of testing of materials.

The contractor shall, at his cost, make all arrangements and shall provide all facilities as the Engineer-in-Charge may require for collecting and preparing the required number of samples for such tests at such time and to such place or places as may be directed by the Engineer- in-Charge and bear all charges including testing charges. The Engineer - in- Charge or his authorized representative shall always have access to the works and to all workshops and places where work component is being prepared or from where materials, manufactured articles or machinery are being obtained for the works and the contractor shall afford every facility and every assistance in obtaining the right to such access.

The Engineer-in-Charge shall have full powers to require the removal from the premises of all materials which in his opinion are not in accordance with the specifications and in case of default, the Engineer-in-Charge shall be at liberty to employ at the expense of the contractor, other persons to remove the same without being answerable or accountable for any loss or damage that may happen or arise to such materials. The Engineer-in-Charge shall also have full powers to require other proper materials to be substituted thereof and in case of default, the Engineer-in-Charge may cause the same to be supplied and all costs which may attend such removal and substitution shall be borne by the Contractor.

The contractor shall at his own expense, provide a material testing lab at the site for conducting routine field tests. The lab shall be equipped at least with the testing equipment as specified in schedule F.

Clause 10B

(i) The contractor, on signing an indenture form specified in appendix XV, shall be entitled to be paid during the progress of the execution of the work up to 75% of the assessed value of any materials, which are in the opinion of the Engineer-in- charge non-perishable, non-fragile and non-combustible and are in accordance with the contract and which have been brought on the site in connection therewith and are adequately stored and/ or protected against damage by weather or other causes but which have

not at the time of advance been incorporated in the works. When materials on account of which an advance has been made under this sub-clause are incorporated in the work, the amount of such advance shall be recovered/deducted from the next payment made under any of the clause or clauses of this contract.

Such secured advance shall also be payable on other items of perishable nature, fragile and combustible with the approval of the Engineer-in-charge provided the contractor provides a comprehensive insurance cover for the full cost of such materials. The decision of the Engineer-in-charge shall be final and binding on the contractor in this matter. No secured advance, shall however, be paid on high-risk materials such as ordinary glass, sand, petrol, diesel, cement, etc.

Mobilisation Advance

No Mobilization Advance will be paid any circumstances.

Plant Machinery & Shuttering Material Advance

Clause Deleted.

Interest & Recovery

(ii) Clause Deleted.

Price adjustment for works

(iii) Clause Deleted.

Clause 10CC

Deleted

Clause 10D

The contractor shall treat all materials obtained during dismantling of a structure, excavation of the site for a work, etc. as ADA's property and such materials shall be disposed off to the best advantage of ADA according to the instructions in writing issued by the Engineer-in-Charge.

Work to be Executed in Accordance with Specifications, Drawings, Orders as per mode mentioned in schedule F.

Clause 11

The contractor shall execute the whole and every part of the work in the most substantial and workmanlike manner both as regards materials and otherwise in every respect in strict accordance with the specifications. The contractor shall also conform exactly, fully and faithfully to the design, drawings and instructions in writing in respect of the work issued bythe Engineer-in-Charge. Contractor shall be furnished free of charge one copy of the contract documents.

The contractor shall comply with the provisions of the contract and with the care and diligence execute and maintain the works and provide all labour and materials, tools and plants including for measurements and supervision of all works, structural plans and other things of temporary or permanent nature required for such execution and maintenance in so far as the necessity for providing these, is specified or is reasonably inferred from the contract.

The Contractor shall take full responsibility for adequacy, suitability and safety of all the works and methods of construction.

Deviations/ Variations Extent and Pricing

Clause 12

The Engineer-in-Charge shall have power (i) to make alterations in, additions to or substitutions for the original scope of work as defined in the contract, that may appear to him to be necessary or advisable during the progress of the work, and (ii) to omit a part of the works in case of non-availability of a portion of the site or due to any other reason (save except Clause-13), the contractor shall be bound to carry out the works in accordance with any instructions given to him in writing signed by the Engineer-in-Charge and such alterations, omissions, additions or substitutions shall form part of the contract as if originally provided therein and any change in the scope of work as defined in the contract, which the contractor may be directed to do in the manner specified above as part of the works, shall be carried outby the contractor on the same terms and conditions in all respects, except for increase/ decrease in the cost and additional time due to change of scope, to be determined based on the sub-clauses hereunder :

12.1 The time for completion of the works shall, in the event of any deviations resulting in additional cost over the tendered value sum being ordered, be extended, if requested by the contractor, as follows:

(i) In the proportion which the additional cost of the altered, additional or substituted work, bears to the original tendered value plus

(ii) 25% of the time calculated in (i) above or such further additional time as may be considered reasonable by the Engineer-in-Charge.

12.2 Payment of deviations/variations beyond 0.25% of the accepted tendered amount.

In case there is any change in scope as defined in the contract, the contractor shall carry out the changes as per direction of Engineer in Charge and nothing extra shall be payable to the contractor on account of same if the additional cost of such work is up to 0.25% (zero-point two five percent) of the accepted tendered amount and worked out as per sub-clause 12.3 below. Variations/deviations upto 0.25% (zero-point two five percent) of the accepted tendered amount shall be deducted from overall variations/deviations for making payment.

12.3 DETERMINATION OF RATES

In the event, there is any deviations/variations in work as defined in the contract, the contractor shall submit the complete proposal to Engineer-in-charge within 15 days duly supported with:-

a) Analysis of rates for items involved, along with relevant documents, rates of materials, tools/plants and labour, etc.

b) The impact, if any, which the deviations/variations is likely to have on the project completion schedule,

On receipt of such proposal, either individually or covering group of items, the

Engineer- in-charge shall examine the proposal regarding its admissibility and finalize the proposal/rates within 45 days after receipt of proposal with all requisite details and documents from the contractors, after giving due consideration to the proposal, analysis and rates of materials and labours, etc.

12.3.1 The increase/decrease in the rates due to deviations/variations shall be decided based on the following criteria:-

(i) Pricing of deviations

a) If the item of work as stipulated in the schedule of quantity/scope of work deviates on plus side, then the rate for the deviated quantity shall be paid at the agreement rate up to the deviation limit as specified in schedule "F" with the same terms & conditions of the contract. Beyond deviation limit as specified in the schedule "F", rate shall be payable on market rates to be determined based on the relevant documents and prevailing market rates, as per Para below

b) If the item of work as stipulated in the schedule of quantity/scope of work deviates on minus side, then the amount for such deviated quantity shall be deducted proportionately at the agreement rate.

(ii) Pricing of variations

If there are changes in the quantity/specifications/ alterations/ substitutions/additions, etc. in the items, other than mentioned in para above, the rates shall be determined based on detailed analysis of rates with original stipulated scope of items & newly proposed/provided items. The difference of rates so determined shall be payable to/ recoverable from the contractor. The rates for both the components i.e. materials & labour shall be based on prevailing market rates. The rate finalized by the Engineer-in-Charge shall be final and binding.

123.2 In case of either non-submission of timely proposal or incomplete proposal by the contractor for deviations/variations, the Engineer-in-Charge shall give final opportunity to the Contractor to submit the complete proposal for change of cost within next 15 days. In case of non-submission or further in complete submission by the contractor within the stated period, the Engineer-in-Charge shall initiate the proposal and decide the change of cost. In such case the proposal finalized by the Engineer-in-Charge shall be final and binding on the contractor.

Restrictions on Deviations/Variations

(i) Work(s) due to deviations/variations shall be executed only after getting the instructions of Engineer-in-charge, save except to meet any work of emergent nature.

(ii) Notwithstanding anything to the contrary in this clause 12, any change arising from default of the contractor in the performance of his obligations under this agreement shall not be deemed to be deviations/variations, and shall not result in any adjustment of the contract price or the project completion schedule.

Foreclosure of contract due to Abandonment or Reduction in Scope of Work

Clause 13

If at any time after acceptance of the tender or during the progress of work, the purpose or object for which the work is being done changes due to any supervening cause and as a result of which the work has to be abandoned or reduced in scope, the Engineer-in-Charge shall give notice in writing to that effect to the contractor stating the decision as well as the cause for such decision and the contractor shall act accordingly in the matter. The contractor shall have no claim to any payment of compensation or otherwise whatsoever, on account of any profit or advantage which he might have derived from the execution of the works in full but which he did not derive in consequence of the foreclosure of the whole or part of the works.

The contractor shall be paid at contract rates, full amount for works executed at site and, in addition, a reasonable amount as certified by the Engineer-in-Charge for the items hereunder mentioned which could not be utilized on the work to the full extent in view of the foreclosure;

(i) Any expenditure incurred on preliminary site work, e.g. temporary access roads, temporary labour huts, staff quarters and site office; storage accommodation and water storage tanks.

(ii) ADA shall have the option to take over contractor's materials or any part thereof either brought to site or of which the contractor is legally bound to accept delivery from suppliers (for incorporation in or incidental to the work) provided, however ADA shall be bound to take over the materials or such portions thereof as the contractor does not desire to retain. For materials taken over or to be taken over by ADS, cost of such materials as detailed by Engineer-in- Charge shall be paid. The cost shall, however, take into account purchase price, cost of transportation and deterioration or damage which may have been caused to materials whilst in the custody of the contractor.

(iii) Reasonable compensation for transfer of T & P from site to contractor's permanent stores or to his other works, whichever is less. If T & P are not transported to either of the said places, no cost of transportation shall be payable.

(iv) Reasonable compensation for repatriation of contractor's site staff and imported labour to the extent necessary.

The contractor shall, if required by the Engineer- in-Charge, furnish to him, books of account, wage books, time sheets and other relevant documents and evidence as may be necessary to enable him to certify the reasonable amount payable under this condition.

The reasonable amount of items on (i), (iii) and (iv) above shall not be in excess of 2% of the cost of the work remaining incomplete on the date of closure, i.e. total stipulated cost of the work as per accepted tender less the cost of work actually executed under the contract and less the cost of contractor's materials at site taken over by the ADA as per item (ii) above. Provided always that against any payments due to the contractor on this account or otherwise, the Engineer-in-Charge shall be entitled to recover or be credited with any outstanding balances due from the contractor for advance paid in respect of any tool, plants and materials and any other sums which at the date of termination were recoverable by the ADA from the contractor under the terms of the contract.

In the event of action being taken under Clause 13 to reduce the scope of work, the contractor may furnish fresh Performance Bank Guarantee on the same conditions, in the same manner and at the same rate for the balance tendered amount and initially valid up to the extended date of completion or stipulated date of completion if no

extension has been granted plus minimum180 days beyond that. Wherever such a fresh Performance Bank Guarantee is furnished by the contractor the Engineer-in-Charge may return the previous Performance Bank Guarantee.

Pre-Construction Activities

Clause 14

The data supplied by the Department, if any, are for General Guidance only. The contractor shall be responsible for carrying out pre- construction activities for construction of work as defined in the tender documents. The contractor shall also carry out site investigations to verify site details / Data at his own cost.

Suspension of Work

Clause 15

(i) The contractor shall, on receipt of the order in writing of the Engineer-in-Charge, (whose decision shall be final and binding on the contractor) suspend the progress of the works or any part thereof for such time and in such manner as the Engineer-in- Charge may consider necessary so as not to cause any damage or injury to the work already done or endanger the safety thereof for any of the following reasons:

a) on account of any default on the part of the contractor or;

b) for proper execution of the works or part thereof for reasons other than the default of the contractor; or

c) for safety of the works or part thereof. The contractor shall, during such suspension, properly protect and secure the works to the extent necessary and carry out the instructions given in that behalf by the Engineer in- Charge.

(ii) If the suspension is ordered for reasons (b) and (c) in sub-para (i) above:

a) the contractor shall be entitled to an extension of time equal to the period of every such suspension plus 25%, for completion of the item or group of items of work for which a separate period of completion is specified in the contract andof which the suspended work forms a part, and;

b) If the total period of all such suspensions in respect of an item or group of items or work for which a separate period of completion is specified in the contract exceeds thirty days, the contractor shall, in addition, be entitled to such compensation as the Engineer-in- Charge may consider reasonable in respect of salaries and/or wages paid by the contractor to his employees and labour at site, remaining idle during the period of suspension, adding thereto 2% to cover indirect expenses of the contractor provided the contractor submits his claim supported by details to the Engineer-in- Charge within fifteen days of the expiry of the period of 30 days.

If the works or part thereof is suspended on the orders of the Engineer-in- Charge for more than three months at a time, except when suspension is ordered for reason (a)in sub para (i) above, the contractor may after receipt of such order serve a written notice on the Engineer-in-Charge requiring permission within fifteen days from receipt by the Engineer in- Charge of the said notice, to proceed with the work or part thereof in regard to which progress has been suspended and if such permission is not granted

within that time, the contractor, if he intends to treat the suspension, where it affects only a part of the works as an omission of such part by ADA or where it affects whole of the works, as an abandonment of the works by ADA, shall within ten days of expiry of such period of 15 days give notice in writing of his intention to the Engineer-in-Charge. In the event of the contractor treating the suspension as an abandonment of the contract by ADA, he shall have no claim to payment of any compensation on account of any profit or advantage which he might have derived from the execution of the work in full but which he could not derive in consequence of the abandonment. He shall, however, be entitled to such compensation, as the Engineer-in-Charge may consider reasonable, in respect of salaries and/or wages paid by him to his employees and labour at site, remaining idle in consequence adding to the total thereof 2% to cover indirect expenses of the contractor provided the contractor submits his claim supported by details to the Engineer-in-Charge within 30 days of the expiry of the period of 3 months.

Action in case Work not done as per Specifications

Clause 16

All works under or in course of execution or executed in pursuance of the contract, shall at all times be open and accessible to the inspection and supervision of the Engineer-in charge, his authorized subordinates in charge of the work and all the superior officers, officer of the Quality Assurance Unit of the Department or any organization engaged by the Department for Quality Assurance and of the Chief Technical Examiner's Office, and the contractor shall, at all times, during the usual working hours and at all other times at which reasonable notice of the visit of such officers has been given to the contractor, either himself be present to receive orders and instructions or have a responsible agent duly accredited in writing, present for that purpose. Orders given to the Contractor's agent shall be considered to have the same force as if they had been given to the contractor himself.

If it shall appear to the Engineer-in-charge or his authorized subordinates in charge of the work or to the Chief Engineer in charge of Quality Assurance or his subordinate officers or the officers of the organization engaged by the Department for Quality Assurance or to the Chief Technical Examiner or his subordinate officers, that any work has been executed with unsound, imperfect, or unskilful workmanship, or with materials or articles provided by him for the execution of the work which are unsound or of a quality inferior to that contracted or otherwise not in accordance with the contract, the contractor shall, on demand in writing which shall be made within twelve months (six months in the case of work costing Rs. 10 Lac and below except road work) of the completion of the work from the Engineer-in- Charge specifying the work, materials or articles complained of, notwithstanding that the same may have been passed, certified and paid for, forthwith rectify, or remove and reconstruct the work so specified in whole or in part, as the case may require or as the case may be, remove the materials or articles so specified and provide other proper and suitable materials or articles at his own charge and cost. In the event of the failing to do so within a period specified by the Engineer-in- Charge in his demand aforesaid, then the contractor shall be liable to pay compensation at the same rate as specified under clause 2 of the contract (for non-completion of the work in time) for this default.

In such case the Engineer-in-Charge may not accept the item of work at the rates applicable under the contract but may accept such items at reduced rates as the authority specified in schedule 'F' may consider reasonable during the preparation of on account bills or final bill or any other amount due to the contractor, if the item is so acceptable without detriment to the safety and utility of the item and the structure or

he may reject the work outright without any payment and/or get it along with other connected and incidental items rectified, or removed and re-executed at the risk and cost of the contractor. Decision of the Engineer-in-Charge to be conveyed in writing in respect of the same will be final and binding on the contractor.

Damages and Defects liability

Clause 17

17.1 During progress of work

If the contractor or his working staff or workers damage any part of the work in the scope of contract, or any road, road kerb, fence, enclosure, water pipe, cables, drains, electric or telephone post or wires, trees, grass, grassland, cultivated ground, etc. contiguous to the premises on which the work or any part of it is being executed, the contractor shall make good the same at his own cost.

Contractor shall repair/replace and restore the damaged structures/services in a time bound manner as required and as directed by the Engineer-in-Charge. Contractor shall not be given any benefit of hindrance caused in the execution of the work owing to such damaged structure/service and time taken in its restoration by the contractor.

17.2 During defect liability period (DLP)

The contractor shall be responsible for all the defects and deficiencies in the work within the scope of this contract, during the defect liability period which shall be for 3 (three) years after the date of actual completion of work as recorded by the Engineer-in-Charge. The liability of contractor for defects and deficiencies may arise due to:

a) Improper planning and design of the project, if in the scope of contract.

b) Works, Tools, Plant & Machinery, Materials or Workmanship not being in accordance with this contract.

c) Improper upkeep & maintenance during construction of the work.

d) Improper upkeep, operation and/or maintenance during defect liability period, if these are in the scope of this contract.

e) Failure by the contractor to comply with any other obligation under this contract.

Such defects and deficiencies shall be made good by the contractor at his own cost after getting instructions/notice from the Engineer-in- Charge within the time period specified in such instructions/notice.

However, contractor need not wait for instructions/notice from Engineer-in-Charge for rectification of defects in work which come to his notice and he should initiate action for needful rectification of defect on priority, under intimation to Engineer-in-Charge, to avoid any untoward incident.

If any plant/ equipment/ any other item procured by the contractor for the project comes with manufacture's / company's warranty, then the DLP will be equal to the warranty period or 5 years whichever is higher.

As per UPPCL Norms, if any plant/ equipment/ any other item procured by the contractor for power Infrastructure comes with manufacture's / company's warranty, then the DLP will be equal to the warranty period or 5 years whichever is higher.

17.3 Structural Soundness

The contractor shall follow the good engineering practice for safety, serviceability and structural soundness of the building/ structure/road work etc. as covered in the scope of contract.

17.3.1 Structure design in the scope of contract

The contractor shall have obligation to rectify all defects in the structural elements or any other part of building/structure/road etc. due to design deficiency at his own cost for 10 (ten) years from the date of completion as recorded in the completion certificate by the Engineer- in-Charge. Such defects shall be made good by the contractor at his own cost after getting instructions/notice from the Engineer-in-Charge within the time period specified in such instructions/notice and as per the methodology duly approved by the Engineer-in-Charge.

17.3.2 DELETED

17.3.3 Liability for execution

The contractor shall be fully liable for any deficiency in structural soundness of work owing to execution of the work under the scope of this contract. The contractor shall have obligation to rectify all defects in the structural elements owing to any deficiency in execution of work at his own cost for 10 (ten) years from the date of completion as recorded in the completion certificate by Engineer-in-Charge. Such defects shall be made good by the contractor at his own cost after getting instructions/notice from the Engineer-in-Charge within the time period specified in such instructions/notice and as per methodology duly approved by the Engineer-in-Charge.

17.4 Methodology for rectification of defects

The design, methodology and quality of rectification of defects carried out by the contractor shall be as per sound engineering practice.

17.5 Contractor's failure to rectify defects as defined in the sub-clauses 17.1, 17.2, 17.3 & 17.4.

In the event that the contractor fails to repair or rectify the defect or deficiency within the period specified by the Engineer-in-Charge, the Engineer-in-Charge shall be entitled to get the same repaired, rectified or remedied at the contractor's cost and recover such amount from any dues like Performance Bank Guarantee, security deposits etc. available with Engineer-in-Charge. Engineer-in-Charge may take action for debarment of contractor from tendering in the department by following due process. For inaction or failure to rectify the defects covered under sub clause 17.3 within specified time limit, the Engineer-in-Charge may also initiate legal and/or other actions under other applicable laws in addition to other remedies available in the contract.

17.6 Release of security deposit

Fifty percent (50%) of the security deposit of the contractor shall be retained for a period of 18 (Eighteen) months from the date of completion of work as per completion certificate issued by the Engineer-in-Charge or till the final bill has been passed whichever is later. This balance fifty percent (50%) security deposit shall be released after completion of defect liability period.

Provided further, that the security deposit shall be released within a month of its due

date as stated above only if satisfactory performance is observed during the said period and after deduction of Government dues from the contractor, if any.

Recovery of Compensation paid to Workmen

Clause 18A

In every case in which by virtue of the provisions under sub- section (1) of section 12 of the Workmen's Compensation Act. 1923, Government is obliged to pay compensation to a workman employed by the contractor, in execution of the works , Government will recover from the contractor , the amount of the compensation so paid and, without prejudice to the rights of the Government under sub- section(2) of section 12 of the said Act, Government shall be at liberty to recover such amount or any part thereof by deducting it from the security deposit or from any sum due by Government to the contractor whether under this contract or otherwise. Government shall not be bound to contest any claim made against it under sub- section (1) of section 12, of the said Act, except on the written request of the contractor and upon his giving to Government full security for all costs for which Government might become liable in consequence of contesting such claim.

Ensuring Payment and Amenities to Workers if Contractor fails

Clause 18B

In every case in which by virtue of the provisions of the Contract Labour (Regulation and Abolition) Act, 1970, and the Contract Labour (Regulation and Abolition) Central Rules, 1971, Government is obliged to pay any amounts of wages to a workman employed by the contractor in execution of the works, or to incur any expenditure in providing welfare and health amenities required to be provided under the above said Act, and the rules, under Clause 19H or under the PWD Contractor's Labour Regulations, or under the Rules framed by Government from time to time for the protection of health and sanitary arrangements for workers employed by PWD Contractors, Government will recover from the contractor, the amount of wages so paid or the amount of expenditure so incurred; and without prejudice to the rights of the Government under sub-section(2) of Section 20, and sub-section (4) of Section 21, of the Contract Labour (Regulation and Abolition) Act, 1970, Government shall be at liberty to recover such amount or any part thereof by deducting it from the security deposit or from any sum due by Government to the contractor whether under this contract or otherwise Government shall not be bound to contest any claim made against it under sub-section (1) of Section 20, sub-section (4) of Section 21, of the said Act, except on the written request of the contractor and upon his giving to the Government full security for all costs for which Government might become liable in contesting such claim.

Labour Laws to be complied by the Contractor

Clause 19

The contractor shall comply with the provisions of the Contract Labour (Regulation and Abolition) Act, 1970, and the Contract Labour (Regulation and Abolition) Central Rules, 1971. The contractor shall also obtain a valid license under the said Act before the commencement of the work, and continue to have a valid license until its completion.

The contractor shall also comply with provisions of the Inter-State Migrant Workmen (Regulation of Employment and Conditions of Service) Act, 1979. The contractor shall also abide by the provisions of the Child Labour and Adolescent Labour (Prohibition and Regulation) Act, 1986.

The contractor shall also comply with the provisions of the building and other Construction Workers (Regulation of Employment & Conditions of Service) Act, 1996 and the building and other Construction Workers Welfare Cess Act, 1996.

Any failure to fulfil these requirements shall attract the penal provisions of this contract arising out of the resultant non-execution of the work.

Clause 19A

No labour below the age of eighteen years shall be employed on the work.

Payment of Wages

Clause 19B

i. The contractor shall pay to labour employed by him either directly or through subcontractors, wages not less than fair wages as defined in the PWD Contractor's Labour Regulations or as per the provisions of the Contract Labour (Regulation and Abolition) Act, 1970 and the contract Labour (Regulation and Abolition) Central Rules, 1971, wherever applicable.

ii. The contractor shall, notwithstanding the provisions of any contract to the contrary, cause to be paid fair wage to labour indirectly engaged on the work, including any labour engaged by his sub-contractors in connection with the said work, as if the labour had been immediately employed by him.

iii. In respect of all labour directly or indirectly employed in the works for performance of the contractor's part of this contract, the contractor shall comply with or cause to be complied with the Central Public Works Department contractor's Labour Regulations made by Government from time to time in regard to payment of wages, wage period, deductions from wages recovery of wages not paid and deductions unauthorizedly made, maintenance of wage books or wage slips publication of scale of wage and other terms of employment, inspection and submission of periodical returns and all other matters of the like nature or as per the provisions of the Contract Labour (Regulation and Abolition) Act, 1970, and the Contract Labour (Regulation and Abolition) Central Rules, 1971, wherever applicable

iv. (a) The Engineer-in-Charge concerned shall have the right to deduct from the moneys due to the contractor any sum required or estimated to be required for making good the loss suffered by a worker or workers by reason of nonfulfillment of the conditions of the contract for the benefit of the workers, nonpayment of wages or of deductions made from his or their wages which are not justified by their terms of the contract or non-observance of the Regulations.

(b) Under the provision of Minimum Wages (Central) Rules, 1950, the contractor is bound to allow to the labours directly or indirectly employed in the works one day rest for 6 days continuous work and pay wages at the same rate as for duty. In the event of default, the Engineer-in-Charge shall have the right to deduct the sum or sums not paid on account of wages for weekly holidays to any labours and pay the same to the persons entitled thereto from any money due to the contractor by the Engineer-in-Charge concerned.

In the case of Union Territory of Delhi, however, as the all-inclusive minimum daily wages fixed under Notification of the Delhi Administration No.F.12(162)MWO/DAB/ 43884-91, dated 31-12- 1979 as amended from time to time are inclusive of wages for the weekly day of rest, the question of extra

payment for weekly holiday would not arise.

The contractor shall comply with the provisions of the Payment of Wages Act, 1936, Minimum Wages Act, 1948, Employees Liability Act, 1938, Workmen's Compensation Act, 1923, Industrial Disputes Act, 1947, Maternity Benefits Act, 1961, and the Contractor's Labour (Regulation and Abolition) Act 1970, or the modifications thereof or any other laws relating thereto and the rules made there under from time to time

i. The contractor shall indemnify and keep indemnified Government against payments to be made under and for the observance of the laws aforesaid and the PWD Contractor's Labour Regulations without prejudice to his right to claim indemnity from his sub-contractors.

ii. The laws aforesaid shall be deemed to be a part of this contract and any breach thereof shall be deemed to be a breach of this contract.

iii. Whatever is the minimum wage for the time being, or if the wage payable is higher than such wage, such wage shall be paid by the contractor to the workmen directly without the intervention of Jamadar and that Jamadar shall not be entitled to deduct or recover any amount from the minimum wage payable to the workmen as and by way of commission or otherwise.

iv. The contractor shall ensure that no amount by way of commission or otherwise is deducted or recovered by the Jamadar from the wage of workmen.

Clause 19C

In respect of all labour directly or indirectly employed in the work for the performance of the contractor's part of this contract, the contractor shall at his own expense arrange for the safety provisions as per CPWD Safety Code framed from time to time and shall at his own expense provide for all facilities in connection therewith. In case the contractor fails to make arrangement and to provide necessary facilities as aforesaid, he shall be liable to pay a penalty as mentioned in Schedule 'F' for each default and in addition, the Engineer-in-Charge shall be at liberty to make arrangement and provide facilities as aforesaid and recover the cost incurred in that behalf from the contractor.

Clause 19D

The contractor shall submit by the 4th and 19th of every month, to the Engineer-in-Charge, a true statement showing in respect of the second half of the preceding month and the first half of the current month respectively:

1) the number of labourers employed by him on the work,
2) their working hours,
3) the wages paid to them,
4) the accidents that occurred during the said fortnight showing the circumstances under which they happened and the extent of damage and injury caused by them, and
5) the number of female workers who have been allowed maternity benefit according to Clause 19F and the amount paid to them.

Failing which the contractor shall be liable to pay to Government, a sum as mentioned in Schedule F for each default or materially incorrect statement. The decision of the Divisional Officer shall be final in deducting from any bill due to the contractor, the amount levied as fine and be binding on the contractor.

Clause 19E

In respect of all labour directly or indirectly employed in the works for the performance of the contractor's part of this contract, the contractor shall comply with or cause to be complied with all the rules framed by Government from time to time for the protection of health and sanitary arrangements for workers employed by the CPWD and its contractors.

Clause 19F

Leave and pay during leave shall be regulated as follows:

1. Leave:
   i. in the case of delivery - maternity leave not exceeding 8 weeks, 4 weeks up to and including the day of delivery and 4 weeks following that day,
   ii. in the case of miscarriage - upto 3 weeks from the date of miscarriage.

2. Pay:
   i. in the case of delivery - leave pay during maternity leave will be at the rate of the women's average daily earnings, calculated on total wages earned on the days when full time work was done during a period of three months immediately preceding the date on which she gives notice that she expects to be confined.
   ii. in the case of miscarriage - leave pay at the rate of average daily earning calculated on the total wages earned on the days when full time work was done during a period of three months immediately preceding the date of such miscarriage.

3. Conditions for the grant of Maternity Leave:

No maternity leave benefit shall be admissible to a woman unless she has been employed for a total period of not less than six months immediately preceding the date on which she proceeds on leave.

4. The contractor shall maintain a register of Maternity (Benefit) in the Prescribed Form as shown in appendix -I and II, and the same shall be kept at the place of work.

Clause 19G

In the event of the contractor(s) committing a default or breach of any of the provisions of the CPWD, Contractor's Labour Regulations and Model Rules for the protection of health and sanitary arrangements for the workers as amended from time to time or furnishing any information or submitting or filing any statement under the provisions of the above Regulations and' Rules which is materially incorrect, he/they shall, without prejudice to any other liability, pay to the Government a sum as mentioned in Schedule F for every default, breach or furnishing, making, submitting, filing such materially incorrect statements and in the event of the contractor(s) defaulting continuously in this respect, the penalty may be enhanced to as mentioned in Schedule F per day for each day of default subject to a maximum of 5 percent of the estimated cost of the work put to tender. The decision of the Engineer- in-Charge shall

be final and binding on the parties.

Should it appear to the Engineer-in-Charge that the contractor(s) is/are not properly observing and complying with the provisions of the CPWD Contractor's Labour Regulations and Model Rules and the provisions of the Contract Labour (Regulation and Abolition) Act 1970, and the Contract Labour (R& A) Central Rules 1971, for the protection of health and sanitary arrangements for work-people employed by the contractor(s) (hereinafter referred as "the said Rules") the Engineer-in-Charge shall have power to give notice in writing to the contractor(s) requiring that the said Rules be complied with and the amenities prescribed therein be provided to the work-people within a reasonable time to be specified in the notice. If the contractor(s) shall fail within the period specified in the notice to comply with and/ observe the said Rules and to provide the amenities to the work-people as aforesaid, the Engineer-in-Charge shall have the power to provide the amenities hereinbefore mentioned at the cost of the contractor(s). The contractor(s) shall erect, make and maintain at his/ their own expense and as per approved standards all necessary huts and sanitary arrangements required for his/their work-people on the site in connection with the execution of the works, and if the same shall not have been erected or constructed according to approved standards, the Engineer-in-Charge shall have power to give notice in writing to the contractor(s) requiring that the said huts and sanitary arrangements be remodelled and/or reconstructed according to approved standards, and if the contractor(s) shall fail to remodel or reconstruct such huts and sanitary arrangements according to approved standards within the period specified in the notice, the Engineer-in-Charge shall have the power to remodel or reconstruct such huts and sanitary arrangements according to approved standards at the cost of the contractor(s).

Clause 19H

The contractor(s) shall at his/their own cost provide his/their labour with a sufficient number of huts (hereinafter referred to as the camp) of the following specifications on a suitable plot of land to be approved by the Engineer-in-Charge.

a) The minimum height of each hut at the eaves level shall be 2.10m (7 ft.) and the floor area to be provided will be at the rate of 2.7 sq.m. (30 sq.ft.) for each member of the worker's family staying with the labourer.

b) The contractor(s) shall in addition construct suitable cooking places having a minimum area of 1.80m x 1.50m (6'x5') adjacent to the hut for each family.

c) The contractor(s) shall also construct temporary latrines and urinals for the use of the labourers each on the scale of not less than four per each one hundred of the total strength, separate latrines and urinals being provided for women.

d) The contractor(s) shall construct sufficient number of bathing and washing places, one unit for every 25 persons residing in the camp. These bathing and washing places shall be suitably screened.

a) All the huts shall have walls of sun-dried or burnt-bricks laid in mud mortar or other suitable local materials as may be approved by the Engineer-in-Charge. In case of sun-dried bricks, the walls should be plastered with mud gobri on both sides. The floor may be kutcha but plastered with mud gobri and shall be at least 15 cm (6") above the surrounding ground. The roofs shall be laid with thatch or any other materials as may be approved by the Engineer-in-Charge and the contractor shall ensure that throughout the period of their occupation, the roofs remain water-tight.

b) The contractor(s) shall provide each hut with proper ventilation.

c) All doors, windows, and ventilators shall be provided with suitable leaves for security purposes.

d) There shall be kept an open space of at least 7.2m (8 yards) between the rows of huts which may be reduced to 6m (20 ft.) according to the availability of site with the approval of the Engineer-in-Charge. Back-to-back construction will be allowed.

Water Supply - The contractor(s) shall provide adequate supply of water for the use of labourers. The provisions shall not be less than two gallons of pure and wholesome water per head per day for drinking purposes and three gallons of clean water per head per day for bathing and washing purposes. Where piped water supply is available, supply shall be at stand posts and where the supply is from wells or river, tanks which may be of metal or masonry, shall be provided. The contractor(s) shall also at his/ their own cost make arrangements for laying pipe lines for water supply to his/ their labour camp from the existing mains wherever available, and shall pay all fees and charges therefore

iii. The site selected for the camp shall be high ground, with removed from jungle clearances, if required.

iv. Disposal of Excreta - The contractor(s) shall make necessary arrangements for the disposal of excreta from the latrines by trenching or incineration which shall be according to the requirements laid down by the Local Health Authorities. If trenching or incineration is not allowed, the contractor(s) shall make arrangements for the removal of the excreta through the Municipal Committee/authority and inform it about the number of labourers employed so that arrangements may be made by such Committee/authority for the removal of the excreta. All charges on this account shall be borne by the contractor and paid direct by him to the Municipality/authority. The contractor shall provide one sweeper for every eight seats in case of dry system.

v. Drainage - The contractor(s) shall provide efficient arrangements for draining away sullage water so as to keep the camp neat and tidy.

vi. The contractor(s) shall make necessary arrangements for keeping the camp area sufficiently lighted to avoid accidents to the workers.

vii. Sanitation - The contractor(s) shall make arrangements for conservancy and sanitation in the labour camps according to the rules of the Local Public Health and Medical Authorities.

Clause 19I

The Engineer-in-Charge may require the contractor to dismiss or remove from the site of the work any person or persons in the contractors' employ upon the work who may be in competent or misconduct himself and the contractor shall forthwith comply with such requirements. In respect of maintenance/repair or renovation works etc. where the labour has an easy access to the individual houses, the contractor shall issue identity cards to the labourers, whether temporary or permanent and he shall be responsible for any untoward action on the part of such labour.

Clause 19J

It shall be the responsibility of the contractor to see that the site is not occupied by unauthorized person(s) during construction, and is handed over to the Engineer- in-Charge without any such occupation. If the site is occupied illegally, then the Engineer-in-Charge shall have the option to refuse to accept in that position. Any

delay in acceptance on this account will be treated as the delay in completion and for such delay, a compensation shall be levied as per clause 2 of the agreement, by the Superintending Engineer/ Chief Engineer whose decision shall be final both with regard to the justification and quantum and be binding on the contractor.

However, the Superintending Engineer/ Chief Engineer, through a notice, may require the contractor to remove the illegal occupation any time on or before construction and delivery.

Employment of skilled/semi-skilled workers

Clause 19K

The contractor shall, at all stages of work, deploy skilled/semi-skilled tradesmen who are qualified and possess certificate in particular trade from National CPWD Academy, Industrial Training Institute, National Institute of construction Management and Research (NICMAR), National Academy of Construction, CIDC or any similar reputed and recognized Institute managed or certified by State/Central Government. The number of such qualified tradesmen shall not be less than 20% of total skilled/semi-skilled workers required in each trade at any stage of work. The contractor shall submit number of man days required in respect of each

trade, its scheduling and the list of qualified tradesmen along with requisite certificate from recognized Institute to Engineer in charge for approval. Notwithstanding such approval, if the tradesmen are found to have inadequate skill to execute the work of respective trade, the contractor shall substitute such tradesmen within two days of written notice from Engineer- in- Charge. Failure on the part of contractor to obtain approval of Engineer-in-Charge or failure to deploy qualified tradesmen will attract a compensation to be paid by contractor at the rate specified in schedule 'F' per such tradesman per day. Decision of Engineer in Charge as to whether particular tradesman possesses requisite skill and amount of compensation in case of default shall be final and binding.

The contractor shall arrange on site training as per National Skill Development Corporation (NSDC) norms for at least 30% of the unskilled workers engaged in the project in coordination with the CPWD Regional Training Institute & National Skill Development Corporation (NSDC) for certification at the level of skilled/semi-skilled tradesmen. The cost of such training as stated above shall be borne by the Government. The necessary space and workers shall be provided by the contractor and no claim what so ever shall be entertained.

Clause 19L

The ESI and EPF contributions on the part of ADA in respect of this contract shall be paid by the contractor. These contributions on the part of the ADA paid by the contractor shall be reimbursed by the Engineer-in-charge to the contractor on actual basis. The verification of deployment of labour will be done through biometric attendance system or any other suitable method by the Engineer-in-charge. The applicable and eligible amount of EPF & ESI shall be reimbursed preferably within 7 days but not later than 30 days of submission of documentary proof of payment provided same are in order.

Minimum Wages Act to be Complied With

Clause 20

The contractor shall comply with all the provisions of the Minimum Wages Act, 1948, and Contract Labour (Regulation and Abolition) Act, 1970, amended from time to time

and rules framed there under and other labour laws affecting contract labour that may be brought into force from time to time.

Work not to be sublet, Action in case of insolvency

Clause 21

The contract shall not be assigned or sublet without the written approval of the Engineer-in-Charge. And if the contractor shall assign or sublet his contract, or attempt to do so, or become insolvent or commence any insolvency proceedings or make any composition with his creditors or attempt to do so, or if any bribe, gratuity, gift, loan, perquisite, reward or advantage pecuniary or otherwise, shall either directly or indirectly, be given, promised or offered by the contractor, or any of his servants or agent to any public officer or person in the employ of Government in any way relating to his office or employment, or if any such officer or person shall become in any way directly or indirectly interested in the contract, the Engineer-in-Charge on behalf of the Governor of Uttar Pradesh shall have power to adopt the course specified in Clause 3 hereof in the interest of Government and in the event of such course being adopted, the consequences specified in the said Clause 3 shall ensue.

QUALITY ASSURANCE AND SUPERVISION FOR EXECUTION PART of WORK

Clause 22

22.1 Quality of Materials and Workmanship

The Contractor shall ensure that the Materials and workmanship are in accordance with the requirements specified in this Agreement, Specifications and Standards and Sound Engineering practice. The work shall be of the specified quality and standard, both in respect of ingredients as well as the intended functions it is supposed to perform for service life.

The Contract warrants that all Materials shall be new, unused, not reconditioned, unless otherwise allowed as per contract or by Engineer-in-Charge, and in conformity with Specification and Standards, Applicable Laws and Sound Engineering Practice, and that the Contractor shall not use any materials which are generally recognized as being deleterious under Sound Engineering Practice.

22.2 Quality Assurance System

The Contractor shall devise a quality assurance mechanism to ensure compliance with the provisions of this Agreement (the "Quality Assurance Plan" or "QAP").

i. The Contractor shall, submit to the Engineer-in-Charge, its Quality Assurance Plan 15 (fifteen) days in advance of start of the execution stage specified in the NIT. The Engineer-in-Charge shall convey its comments to the Contractor within a period of 7 (seven) days of receipt of the QAP stating the modifications, if any, required and the Contractor shall incorporate those in the QAP conforming with the provisions of this clause. The QAP shall include the following:

   a) Contractor's Organization & structure, duties and responsibilities of individual key personnel, quality policy of contractor, procedure for control of non-conformities and corrective action, inspections and documentation.

   b) Internal quality audit system.

   c) Machinery, Shuttering, other Tool & Plants, etc. required to be deployed at site.

   d) Method statement of important activities. These can be submitted as per the sequencing of the activities of the work.

e) Quality control mechanism including sampling and testing of Materials, test frequencies, standards, acceptance criteria, testing facilities, reporting, recording and interpretation of test results, approvals, proforma for testing and calibration in accordance with the Specifications and Standards and Sound Engineering Practice; and Material Lot size, number of required tests and frequency of testing for different construction materials.

All the relevant and applicable codes, specifications and standards, as well as the acceptance criteria for various items of work, workmanship, materials and process employed needs to be mentioned.

f) Check-list for various items and materials.

g) Formats for site documentation, monthly reports on implementation of QAP.

Sampling of materials

ii. All samples of materials including Cement Concrete Cubes shall be taken by the QA engineers deployed by the Contractor and shall be witnessed by the Engineer-in-Charge or his authorized representatives as specified in NIT. All the necessary assistance, facilities and safety shall be provided by the contractor. Cost of sample of materials and testing charges shall be borne by the contractor and he/she is responsible for safe custody of samples to be tested at site.

iii. Testing of Materials

The contractor shall establish temporary field laboratory of adequate size with all necessary facilities. Field laboratory shall be equipped with the testing equipment for conducting routine field tests as per this contract. It will also have copies of standards, BIS codes, IRC codes, relevant publications.

All the tests in field lab setup at construction site shall be carried out by the QA Staff deployed by the contractor and shall be witnessed by the Engineer-in-Charge or his authorized subordinates as specified in NIT. The contractor shall provide all necessary facility to them for witnessing the tests in the field laboratory. In general, contractor shall carry out 90% of field tests in site laboratory and 10% tests shall be got carried out from outside laboratory as indicated below. Contractor shall endeavour to obtain test reports for tests conducted from outside laboratory in a reasonable time.

iv. Maintenance of Register of Test -

- All the entries in the register of test are to be made by the designated QA Engineers of the contractor and same is to be regularly reviewed by the field officers as well as the Engineer-in-Charge. The contractor shall allow inspection of such records any time as desired by Engineer-in-Charge or his authorized representative.
- All the tests carried out at construction site or outside laboratories are to be maintained by the contractor in the prescribed format in the test registers provided by the contractor and duly authenticated by Engineer-in- Charge. The test reports shall also be maintained in hard file.
- Contractor is responsible for maintenance and safe custody of all the test registers and test records.
- Mandatory test conducted as per approved proforma shall be attached with each Running bill. Submission of copy of all test registers and material at site register along with each alternate Running Account Bill and with Final Bill is mandatory.

v. Maintenance of Material at Site (MAS) Register-

MAS register of the key materials including Cement and Steel Registers shall be maintained in the proforma approved by Engineer-in-Charge. All the entries in the MAS registers are made by the designated staff of the contractor and same is regularly reviewed by the field officers as well as the Engineer-in-Charge. Contractor is responsible for maintenance and safe custody of MAS registers.

vi. The Contractor shall procure all relevant codes, publications, apparatus and instruments, fuel, consumables, water, electricity, labour, materials, samples and qualified personnel as are necessary for examining and testing the Works, Materials and workmanship in accordance with the Quality Assurance Plan.

vii. All the cost of testing including cost of samples, packaging, transportation, testing charges of Construction, Materials and workmanship under this clause shall be borne by the contractor.

The contractor shall submit monthly quality progress report on implementation of the provisions of Quality Assurance Plan on the format approved by the Engineer-in- Charge.

22.3 Samples

The Contractor shall, at its own expense and without delay, provide the samples of Materials and relevant information like Manufacturer's test reports, standard samples of manufactured Materials and Samples of such other Materials as the Engineer-in-Charge may require for review and approvals in accordance with Clause 10A of GCC before actual use.

22.4 Test

i. For determining that the Works conform to the Specifications and Standards, the Engineer-in-Charge shall require the Contractor to carry out or cause to be carried out tests, at such time and frequency and in such manner as specified in this Agreement and in accordance with sound engineering practice for quality assurance. Frequency and the manner in which tests shall be conducted shall be in the following order of preference:

a) Contract provisions.

b) CPWD/PWD specifications.

c) BIS codes.

d) IRC codes.

e) MoRTH Specifications.

f) International Codes.

g) Manufacturer's specifications.

Outside tests shall be conducted at Government labs /IITs/NITs and other approved laboratories by the Engineer-in-Charge for testing of materials.

ii. The Contractor shall, with due diligence, carry out all the tests in accordance with the Agreement and furnish the results thereof to the Engineer-in-Charge. The Engineer-in- Charge or his authorized representative shall witness or participate during the testing as specified in NIT. The contractor shall provide all necessary assistance for witnessing/participating in the field tests.

iii. In the event that results of any tests conducted under this clause establish any defects or deficiencies in the Works, the Contractor shall carry out remedial measures at its own cost and furnish a report to the Engineer-in-Charge in this regard. The Engineer-in- Charge shall require the Contractor to carry out or cause to be carried out tests to determine that such remedial measures have brought the works into compliance with the Specifications and standards and the procedure shall be repeated until such Works conform to the Specifications and Standards.

22.5 Method Statement

The 'Method statement' is a statement by which the construction procedures for important activities are stated, checked, and approved. The method statement shall be prepared for important activities as identified by the contractor as mentioned in QAP or any other activity as instructed by Engineer-in Charge. The 'Method statement', should have a description of the item with elaborate procedure in steps to implement the same, the specifications of the materials involved, equipment to be deployed, measures for ensuring safety, their testing and acceptance criteria, precautions to be taken, mode of measurement, etc. The Contractor shall, at least 15 (fifteen) days prior to the commencement of activities, submit to the Engineer-in-Charge for review, the method statements proposed to be adopted for executing the various items of work. The Engineer-in-Charge shall complete the review and convey its comments, if any, to the Contractor within a period of 07 (seven) days from the date of receipt of the proposed methodology from the Contractor.

22.6 Inspection & review by the Engineer-in-Charge and External Audit.

The Engineer-in-Charge, his authorized subordinates, senior officers of department, QA unit or any other third party may inspect and review the progress and quality of the work and issue appropriate directions to the Contractor for taking remedial action in the event the work is not in accordance with the provisions of this Agreement. The work may be inspected at any time/stage by external inspection teams like CTE or TE, Third Party Quality assurance agency, PWD team etc. may conduct inspection of the quality of the works. The findings of the inspections shall be notified to the Contractor for taking remedial action in accordance with the agreement. The Contractor shall provide all assistance as may be required by the inspection teams in the conduct of its inspection here under.

Suitable actions shall be taken as per the provisions contained in the relevant clauses of the agreement, if the work is not found to be as per specifications or quality as specified in the agreement.

The cost of Third-Party inspection will be deducted from the RA bills raised by the contractor.

22.7 Inspection of records

The Engineer-in-Charge or his authorized representative shall have the right to inspect the records of the Contractor relating to the works.

22.8 Inspection of Works

i. The Engineer-in-Charge and his authorized subordinates shall at all times;

ii. have full access to all parts of the site and to all places from which natural materials are being obtained for use in the works; and

iii. during production, manufacture and construction at the site and at the place

of production, be entitled to examine, inspect, measure and test the materials and workmanship and to check the progress of the manufacturer of Materials.

iv. The Contractor shall give the Engineer-in-Charge and its authorized representative access, facilities and safety equipment for carrying out their obligations under this Agreement.

22.9 Examination of work before covering up/ Test Check of item of Work

In respect of the work which the Engineer-in-Charge or his authorized representatives are required to examine, inspect, measure or test before it is covered up or put out of view or any part of the work is placed thereon, the Contractor shall give notice to the Engineer- in-Charge whenever any such work is ready and before it is covered up. The Engineer-in- Charge shall then either carry out the examination, inspection or testing without unreasonable delay within 7 days, or promptly give notice to the Contractor that the Engineer-in-Charge does not require him to do so. Provided, however, that if any work is of a continuous nature where it is not possible or prudent to keep it uncovered or incomplete, the Contractor shall notify the schedule of carrying out such work to give sufficient opportunity, not being less than 3(three) business days' notice to the Engineer-in-Charge to conduct its inspection, measurement or test while the work is continuing. Provided further that in the event the Contractor receives no response from the Engineer-in-Charge within a period of 3 (three) business days from the date on which the Contractor's notice hereunder is delivered to the Engineer-in-Charge, the Contractor shall be entitled to assume that the Engineer-in-Charge would not undertake the said inspections.

22.10 Rejection

i. If, as a result of an examination, inspection, measurement or testing, any Plant, Materials, design or workmanship is found to be defective or otherwise not in accordance with the provisions of this Agreement, the Engineer-in-Charge may reject such piece of work, Plant, Materials, design or workmanship by giving notice to the Contractor, with reasons. The Contractor shall then promptly make good the defect and ensure that the rejected item complies with the requirements of this Agreement.

ii. If the Engineer-in-Charge requires a Piece of work, Plant, Material, design or workmanship to be retested, the tests shall be repeated on the same terms and conditions, as applicable in each case. If the rejection and retesting cause the department to incur any additional costs, such costs shall be recoverable by the Engineer-in-Charge from the Contractor and may be deducted by the Engineer- in-Charge from any amount due to be paid to the Contractor.

iii. The Contractor shall not be entitled to any extension of time on account of rectifying any defect or retesting as specified in this clause.

iv. Examination, inspection, measurement or testing of any Plant, Material, design or workmanship by the Engineer-in-Charge or its failure to convey its observations or to examine, inspect, measure or test shall neither relieve the Contractor of its obligations and liabilities under this Agreement in any manner nor shall the Engineer-in-Charge be liable for the same in any manner.

22.11 Remedial work

i. Notwithstanding any previous test or certification, the Engineer-in-Charge may instruct the Contractor to:

ii. remove from the site and replace any piece of work, plant or materials which

are not in accordance with the provisions of this Agreement.

iii. remove and re-execute any work which is not in accordance with the provisions of this Agreement and the Specification and Standards; and

iv. execute any work which is urgently required for the safety of the Project, whether because of an accident, unforeseeable event or otherwise.

If the Contractor fails to comply with the instructions issued by the Engineer- in-Charge under aforesaid para, within the time specified in the notice or as mutually agreed, the Engineer-in-Charge may get the work executed by another agency. The cost so incurred by the Engineer-in-Charge for undertaking such work shall, without prejudice to the rights of the Engineer-in-Charge to recover damages in accordance with the provisions of this Agreement, be recoverable from the Contractor and may be deducted by the Engineer-in-Charge from any amount due to be paid to the Contractor.

22.12 Quality Control Records

The Contractor shall hand over authenticated copy of all its quality control records and documents to the Engineer-in-Charge before the Completion Certificate is issued.

22.13 Video recording

During the Construction Period, the Contractor shall provide to the Engineer-in-Charge for every calendar quarter, a video recording which will be compiled into a 15(fifteen) minutes digital video covering the status and progress of work in that quarter. Video recording should show different activities, stage of work, quality assurance activities etc. including animation, graphs, digital maps, commentary, sub titles, etc. spread over the quarter. The video recording shall be provided to the Engineer- in- Charge no later than 15 (fifteen) days after the close of each quarter to be reckoned from next full month of date of start of work.

22.14 Suspension of unsafe Construction Works

i. Upon recommendation of the Engineer-in-Charge to this effect, or on his own volition in cases of emergency or urgency, the Engineer-in-Charge may by notice require the Contractor to suspend forthwith the whole or any part of the Works if, in the reasonable opinion of Engineer-in-Charge, as the case maybe, such work threatens the safety of the Users and or other persons on or about the Project. Provided, however, that in case of an emergency, the Engineer-in-Charge may Suo moto issue the notice referred to hereinabove.

ii. The Contractor shall, pursuant to the notice under above para, suspend the Works or any part thereof for such time and in such manner as may be specified by the Engineer- in-Charge and thereupon carry out remedial measures to secure the safety of suspended works, the Users, other persons and vehicles on or about the Project. The Contractor by notice require the Engineer-in-Charge to inspect such remedial measures forthwith and request for revocation of suspension. Upon reviewing the remedial measures, the Engineer-in-Charge shall either revoke such suspension or instruct the Contractor to carry out such other and further remedial measures as may be necessary and reasonable and the procedure set forth in this Clause shall be repeated until the suspension hereunder is revoked.

iii. Subject to other provisions of the agreement, all reasonable cost incurred for maintaining and protecting the Works or part thereof during the period of suspension (the "Preservation Costs") shall be borne by the contractor, if in

the opinion of Engineer- in-Charge suspension is on account of reasons attributable to the contractor.

iv. If suspension of Work is for reasons not attributable to the Contractor, the Engineer- in-Charge shall determine any Time Extension, if required, in accordance with the provisions of clause-5.

22.15 Online maintenance of Site records including testing records.

The Engineer-in-Charge may require the contractor to upload all the site records in any online system devised by him. The contractor shall have to ensure that all the required site records, as desired by the Engineer-in- Charge shall be uploaded in this online system. Nothing extra on this account shall be payable to the contractor. In case these records are to be maintained in any online module then contractor shall comply with this.

Clause 23

Where the contractor is a partnership firm/company/LLP/ Joint Venture, the prior approval in writing of the Engineer-in-charge shall be obtained before any change is made in the constitution of the firm/company/LLP/ Joint Venture. Where the contractor is an individual or a Hindu undivided family business concern, such approval as aforesaid shall likewise be obtained before the contractor enters into any partnership agreement where under the partnership firm would have the right to carry out the works hereby undertaken by the contractor. If previous approval as aforesaid is not obtained, the contract shall be deemed to have been assigned in contravention of clause 21 hereof and the same action may be taken, and the same consequences shall ensue as provided in the said clause 21.

Clause 24

Deleted

Clause 25:

Except where otherwise provided in the contract, all questions and disputes relating to the meaning of the specifications, designs, drawings and instructions hereinbefore mentioned and as to the quality of workmanship or materials used in the work or as to any other question, claim, right, matter or thing whatsoever in any way arising out of or relating to the contract, designs, drawings, specifications, estimates, instructions, orders or otherwise concerning the works or the execution or failure to execute the same whether arising during the progress of the work or after the cancellation, termination, completion or abandonment thereof shall be dealt with as mentioned hereinafter.

Conciliation: If the contractor considers any work demanded of him to be outside the requirements of the contract, or disputes any drawing, record or decision given in writing by the Engineer- in-Charge; or if the Engineer-in-Charge considers any act or decision of the contractor on any matter in connection with or arising out of the contract or carrying out of the work to be unacceptable and disputed; such party may promptly refer such disputes and amount claimed for each dispute to the Conciliator (Divisional Commissioner, Agra Division) in the proforma prescribed in Appendix XVII mentioned in Schedule F, under intimation to the other party. The Conciliator may then request each party to submit to him a brief written statement describing the disputes and the points at issue. Each party shall send a copy of such statement to the other party. At any stage of the conciliation proceedings, the Conciliator may request a party to submit to him such additional information as he deems appropriate. When it appears to the Conciliator that there exist elements of a settlement which may be acceptable to the parties, he shall formulate the terms of a possible settlement and

submit them to the parties for their observations. After receiving the observations of the parties, he may re-formulate the terms of a possible settlement in the light of such observations. If the parties reach agreement on a settlement of the disputes, they may draw up and sign a written settlement agreement on non-judicial stamp paper as per Stamp Act. The Conciliator shall authenticate the settlement agreement and furnish a copy thereof to each party. The termination of conciliation proceedings shall be in accordance with Section 76 of The Arbitration and Conciliation Act, 1996. No party shall be represented before the said Conciliator by an advocate or legal counsel. The conciliation proceedings shall be completed within 45 days from the receipt of reference. This time may be enlarged by 15 days by the Conciliator. The conciliation proceedings shall be deemed to have been terminated at the end of 60 days from the receipt of reference.

25.1 Arbitration:

If the aforesaid conciliation proceedings fail or the Conciliator fails to give proposal for settlement within the aforesaid period, either party may promptly give notice in the proforma prescribed in Appendix XVIII, under intimation to the other party, to the Chief Engineer or the Superintending Engineer concerned with the work (as applicable), hereinafter referred to as the Arbitrator Appointing Authority as indicated in Schedule F, for appointment of Arbitrator.

However, a party may seek appointment of Arbitrator without taking recourse to the process of conciliation mentioned in sub-clause 25.1 above.

In the event of either party giving a notice to the Arbitrator Appointing Authority for appointment of Arbitrator, the said Authority shall appoint Arbitrator as per the procedure given below and refer such disputes to arbitration.

a) Number of Arbitrators: The disputes may be referred to an Arbitral Tribunal of three Arbitrators.

b) Qualification of Arbitrators: It is a term of this contract that each member of the Arbitral Tribunal shall be Graduate Engineer with experience in execution of public works engineering contracts, and he should have worked earlier at a level not lower than the Chief Engineer or Superintending Engineer (equivalent to level of Joint Secretary to the Government of Uttar Pradesh).

The aforesaid educational qualification and work experience shall be mandatory for appointment as Arbitrator.

The age of Arbitrator at the time of appointment shall not exceed 75 years. An Arbitrator may be appointed notwithstanding the total number of active arbitration cases with him.

c) Parties to select Arbitrator: Based on the criteria specified above, a list of empanelled Arbitrators has been prepared in ADA, and the parties shall have option to select an Arbitrator from the list sent to them.

25.2 Appointment of Sole Arbitrator:

Not Applicable

25.3 Appointment of Arbitral Tribunal of three Arbitrators:

The Arbitrator Appointing Authority shall prepare two separate lists of five Arbitrators each from the list of ADA Empanelled Arbitrators, and send one to the party seeking arbitration and other to the responding party, within 15 days of the receipt of notice. The parties will then choose any one Arbitrator from the list provided to them within 15 days of receipt of the list. The Arbitrator Appointing Authority shall then appoint those chosen by the respective parties as Arbitrators and also a third Arbitrator from the list of ADA Empanelled Arbitrators to act as presiding Arbitrator, within 15 days of

receipt of choice from both the parties.

It is a term of this arbitration agreement that if the parties fail to select, within the period prescribed above, an Arbitrator of their choice from the list of ADA Empanelled Arbitrators forwarded to them, the Arbitrator Appointing Authority shall himself select and appoint Arbitrator from the said list.

25.4 Applicable Law:

The provisions of the Arbitration and Conciliation Act, 1996 (Act 26 of 1996) and any further statutory modification or re-enactment thereof shall be applicable. Further, the fast-track procedure for arbitration contained in Section 29B of the said Act shall apply.

25.5 Fee payable to Arbitrator(s):

The fee payable to the arbitral tribunal shall be as per CPWD OM No.2/2006/SE(TLC)/CSQ/137 dated 19.11.2019 (or latest amendment), and shall be shared equally by both the parties.

25.6 Place of Arbitration:

The place of arbitration shall preferably be as mentioned in Schedule F. However, the Arbitral Tribunal may decide the place in consultation with both the parties.

25.7 Terms of reference:

The Arbitral Tribunal shall adjudicate on only such disputes as are referred to it by the Arbitrator Appointing Authority and give separate award against each dispute referred to him and shall give reasons for the award in all cases where the total amount of the claim by any party exceeds Rs.50.0 Crore.

25.8 Interest on Arbitration award:

It is also a term of this arbitration agreement that where the Arbitral award against any dispute is for the payment of money, no pre-suit and pendent elite interest shall be payable on any part of the Arbitral award.

Contractor to indemnify Government against Patent Rights

Clause 26

The contractor shall fully indemnify and keep indemnified the Agra Development Authority against any action, claim or proceeding relating to infringement or use of any patent or design or any alleged patent or design rights and shall pay any royalties which may be payable in respect of any article or part thereof included in the contract. In the event of any claims made or action brought against ADA in respect of any such matters as aforesaid, the contractor shall be immediately notified thereof and the contractor shall be at liberty, at his own expense, to settle any dispute or to conduct any litigation that may arise there from, provided that the contractor shall not be liable to indemnify the Agra Development Authority if the infringement of the patent or design or any alleged patent or design right is the direct result of an order passed by the Engineer-in-charge in this behalf.

Withholding and lien in respect of sum due from Contractor

Clause 27

i. Whenever any claim or claims for payment of a sum of money arises out of or under the contract or against the contractor, the Engineer-in-charge or the Government shall be entitled to withhold and also have a lien to retain such sum or sums in whole or in part from the security, if any deposited by the contractor and for the purpose aforesaid, the Engineer-in-charge or the

Government shall be entitled to withhold the security deposit, if any, furnished as the case may be and also have a lien over the same pending finalization or adjudication of any such claim. In the event of the security being insufficient to cover the claimed amount or amounts or if no security has been taken from the contractor, the Engineer-in-Charge or the Government shall be entitled to withhold and have a lien to retain to the extent of such claimed amount or amounts referred to above, from any sum or sums found payable or which may at any time thereafter become payable to the contractor under the same contract or any other contract with the Engineer-in-Charge of the Government or any contracting person through the Engineer-in-Charge pending finalization of adjudication of any such claim.

It is an agreed term of the contract that the sum of money or moneys so withheld or retained under the lien referred to above by the Engineer- in-Charge or Government will be kept withheld or retained as such by the Engineer-in-Charge or Government till the claim arising out of or under the contract is determined by the arbitrator(if the contract is governed by the arbitration clause) by the competent court, as the case may be and that the contractor will have no claim for interest or damages whatsoever on any account in respect of such withholding or retention under the lien referred to above and duly notified as such to the contractor. For the purpose of this clause, where the contractor is a partnership firm or a limited company, the Engineer-in-charge or the Government shall be entitled to withhold and also have a lien to retain towards such claimed amount or amounts in whole or in part from any sum found payable to any partner/limited company as the case may be, whether in his individual capacity or otherwise.

ii. Government shall have the right to cause an audit and technical examination of the works and the final bills of the contractor including all supporting vouchers, abstract, etc., to be made after payment of the final bill and if as a result of such audit and technical examination any sum is found to have been overpaid in respect of any work done by the contractor under the contract or any work claimed to have been done by him under the contract and found not to have been executed, the contractor shall be liable to refund the amount of over-payment and it shall be lawful for Government to recover the same from him in the manner prescribed in sub- clause (i) of this clause or in any other manner legally permissible; and if it is found that the contractor was paid less than what was due to him under the contract in respect of any work executed by him under it, the amount of such under payment shall be duly paid by Government to the contractor, without any interest thereon whatsoever.

Provided that the Government shall not be entitled to recover any sum overpaid, nor the contractor shall be entitled to payment of any sum paid short where such payment has been agreed upon between the Superintending Engineer or Executive Engineer on the one hand and the contractor on the other under any term of the contract permitting payment for work after assessment by the Superintending Engineer or the Engineer-in-Charge.

Lien in respect of claims in other Contracts

Clause 28

Any sum of money due and payable to the contractor (including the security deposit returnable to him) under the contract may be withheld or retained by way of lien by the Engineer-in- charge or the Government or any other contracting person or persons through Engineer-in- charge against any claim of the Engineer-in-charge or

Government or such other person or persons in respect of payment of a sum of money arising out of or under any other contract made by the contractor with the Engineer-in-charge or the Government or with such other person or persons. It is an agreed term of the contract that the sum of money so withheld or retained under this clause by the Engineer-in-charge or the Government will be kept withheld or retained as such by the Engineer-in-charge or the Government or till his claim arising out of the same contract or any other contract is either mutually settled or determined by the arbitration clause or by the competent court, as the case may be and that the contractor shall have no claim for interest or damages whatsoever on this account or on any other ground in respect of any sum of money withheld or retained under this clause and duly notified as such to the contractor.

Employment of coal mining or controlled area labour not Permissible

Clause 29

Deleted

Water for Works

Clause 30

The contractor(s) shall make his/their own arrangements for water required for the work and nothing extra will be paid for the same. This will be subject to the following conditions.

i. That the water used by the contractor(s) shall be fit for construction purposes to the satisfaction of the Engineer-in-Charge.

ii. The Engineer-in-Charge shall make alternative arrangements for supply of water at the risk and cost of contractor(s) if the arrangements made by the contractor(s) for procurement of water are in the opinion of the Engineer-in-Charge, unsatisfactory.

Alternate water arrangements

Clause 31

The contractor shall be allowed to construct temporary wells in Government land for taking water for construction purposes only after he has got permission of the Engineer-in- charge in writing. No charges shall be recovered from the contractor on this account, but the contractor shall be required to provide necessary safety arrangements to avoid any accidents or damage to adjacent buildings, roads and service lines. He shall be responsible for any accidents or damage caused due to construction and subsequent maintenance of the wells and shall restore the ground to its original condition after the wells are dismantled on completion of the work.

Employment of Technical Staff and employees

Clause 32

Contractors Superintendence, Supervision, Technical Staff & Employees

i. The contractor shall provide all necessary superintendence during execution of the work and all along thereafter as may be necessary for proper fulfilling of the obligations under the contract.

As per tendered amount (worked out on the basis of quoted rate of individual items) and before commencement of the work, intimate in writing to the Engineer-in-Charge, the name(s), qualifications, experience, age, address(s) and other particulars along with certificates, of the principal technical representative to be in charge of the work and other technical representative(s)

who will be supervising the work. Minimum requirement of such technical representative(s) and their qualifications and experience shall not be lower than specified in Schedule 'F'. Even of the contractor (or partner(s) in case of firm/ company) is himself / herself an Engineers, it is necessary on the part of the contractor to Employ principal technical representative / technical representative (s)as per stipulation in Schedule 'F'.

The Engineer-in-Charge shall within 3 days of receipt of such communication intimate inwriting his approval or otherwise of such a representative(s) to the contractor. Any such approval may at any time be withdrawn and in case of such withdrawal, the contractor shall appoint another such representative(s) according to the provisions of this clause. Decision of the tender accepting authority shall be final and binding on the contractor in this respect. Such a principal technical representative and other technical representative(s)shall be appointed by the contractor soon after receipt of the approval from Engineer-in-charge and shall be available at site before start of work.

All the provisions applicable to the principal technical representative under the Clause will also be applicable to other technical representative(s) The principal technical representative and other technical representative(s) shall be present at the site of work for supervision at all times when any construction activity is in progress and also present himself/themselves, as required, to the Engineer-in-Charge and/or his designated representative to take instructions. Instructions given to the principal technical representative or other technical representative(s) shall be deemed to have the same force as if these have been given to the contractor. The principal technical representative and other technical representative(s) shall be actually available at site fully during all stages of execution of work, during recording/checking/test checking of measurements of works and whenever so required by the Engineer-in- Charge and shall also note down instructions conveyed by the Engineer-in-Charge or his designated representative(s) in the site order book and shall affix his/their signature in token of noting down the instructions and in token of acceptance of measurements/checked measurements/ test checked measurements. The representative(s) shall not look after any other work. Substitutes, duly approved by Engineer-in-Charge of the work in similar manner as aforesaid shall be provided in event of absence of any of the representative(s) by more than two days.

If the Engineer-in-Charge, whose decision in this respect is final and binding on the contractor, is convinced that no such technical representative(s) is/are effectively appointed or is/are effectively attending or fulfilling the provision of this clause, a recovery (non- refundable) shall be effected from the contractor as specified in Schedule 'F' and the decision of the Engineer-In-Charge as recorded in the site order book and measurement recorded checked/test checked in Measurement Books shall be final and binding on the contractor. Further if the contractor fails to appoint suitable technical Principal technical representative and/or other technical representative(s) and if such appointed persons are not effectively present or are absent by more than two days without duly approved substitute or do not discharge their responsibilities satisfactorily, the Engineer-in-Charge shall have full powers to suspend the execution of the work until such date as suitable other technical representative(s) is/are appointed and the contractor shall be held responsible for the delay so caused to the work. The contractor shall submit a certificate of employment of the technical representative(s) (in the form of copy of Form-16 or CPF deduction issued to the Engineers employed by him) along with every on account bill/ final bill and shall produce evidence if at any time so required by the Engineer-in-Charge.

ii. The contractor shall provide and employ on the site only such technical assistants as are skilled and experienced in their respective fields and such foremen and supervisory staff as are competent to give proper supervision to the work.

The contractor shall provide and employ skilled, semiskilled and unskilled labour as is necessary for proper and timely execution of the work.

The Engineer-in-Charge shall be at liberty to object to and require the contractor to remove from the works any person who in his opinion misconducts himself, or is incompetent or negligent in the performance of his duties or whose employment is otherwise considered by the Engineer-in-Charge to be undesirable. Such person shall not be employed again at works site without the written permission of the Engineer-in- Charge and the persons so removed shall be replaced as soon as possible by competent substitutes.

Levy/Taxes payable by Contractor

Clause 33

i. GST, Building and other Construction Workers Welfare Cess or any other tax, levy or Cess in respect of input for or output by this contract shall be payable by the contractor and Government shall not entertain any claim whatsoever in this respect except as provided under Clause 34.

ii. The contractor shall deposit royalty and obtain necessary permit for supply of the red bajri, stone, kankar, stone aggregate, earth, sand etc. from local authorities.

If pursuant to or under any law, notification or order any royalty, cess or the like becomes payable by the Government of India and does not any time become payable by the contractor to the State Government, Local authorities in respect of any material used by the contractor in the works, then in such a case, it shall be lawful to the Government of India and it will have the right and be entitled to recover the amount paid in the circumstances as aforesaid from dues of the contractor.

Conditions for reimbursement of levy/taxes if levied after receipt of Tenders

Clause 34

i. All tendered rates shall be inclusive of any tax, levy or cess applicable on last stipulated date of receipt of tender including extension if any. No adjustment i.e. increase or decrease shall be made for any variation in the rate of GST, Building and Other Construction Workers Welfare Cess or any tax, levy or cess applicable on inputs.

However, effect of variation in rates of GST or Building and Other Construction Workers Welfare Cess or imposition or repeal of any other tax, levy or cess applicable on output of the works contract shall be adjusted on either side, increase or decrease.

Provided further that for Building and Other Construction Workers Welfare Cess or any tax (other than GST), levy or cess varied or imposed after the last date of receipt of tender including extension if any, any increase shall be reimbursed to the contractor only if the contractor necessarily and properly pays such increased amount of taxes/levies/cess.

Provided further that such increase including GST shall not be made in the extended period of contract for which the contractor alone is responsible for delay as determined by authority for extension of time under Clause 5 in Schedule F.

ii. The contractor shall keep necessary books of accounts and other documents for the purpose of this condition as may be necessary and shall allow inspection of the same by a duly authorized representative of the Government and/or the Engineer-in-charge and shall also furnish such other information/document as the Engineer-in-Charge may require from time to time.

iii. The contractor shall, within a period of 30 days of the imposition of any such further tax or levy or cess, or variation or repeal of such tax or levy or cess give a written notice thereof to the Engineer-in-charge that the same is given pursuant to this condition, together with all necessary information relating thereto.

Termination of Contract on death of contractor

Clause 35

Without prejudice to any of the rights or remedies under this contract, if the contractor dies, the Engineer-in-charge on behalf of the Agra Development Authority shall have the option of terminating the contract without compensation to the contractor.

If relative working in Agra Development Authority (ADA), then the contractor not allowed to tender

Clause 36

The contractor shall not be permitted to tender for works in the ADA in case his near relative is posted as Accountant or as an officer in any capacity between the grades of the Superintending Engineer and Junior Engineer (both inclusive). He shall also intimate the names of persons who are working with him in any capacity or are subsequently employed by him and who are near relatives to any Officer in the ADA. Any breach of this condition by the contractor would render him liable to be removed from the approved list of contractors of this Department.

NOTE: By the term "near relatives" is meant wife, husband, parents and grandparents, children and grandchildren, brothers and sisters, uncles, aunts and cousins and their corresponding in-laws.

No Gazetted Engineer to work as Contractor within one year of retirement

Clause 37

No engineer of gazetted rank or other gazetted officer employed in engineering or administrative duties in an engineering department of the Government of India shall work as a contractor or employee of a contractor for a period of one year after his retirement from government service without the previous permission of Government of India in writing. This contract is liable to be cancelled if either the contractor or any of his employees is found at any time to be such a person who had not obtained the permission of Government of India as aforesaid, before submission of the tender or engagement in the contractor's service, as the case may be.

Theoretical consumption of Material

Clause 38

i. After completion of the work and also at any intermediate stage in the event of No reconciliation of materials issued theoretical quantity of materials used in the work shall be calculated on the basis and method given hereunder:

a. Quantity of cement & bitumen shall be calculated on the basis of quantity of cement & bitumen required for different items of work as shown in the Schedule of Rates mentioned in Schedule 'F'. In case any item is executed for which standard constants for the consumption of cement or bitumen are not available in the above-mentioned schedule/statement or cannot be derived from the same shall be calculated on the basis of standard formula to be laid down by the Engineer-in-Charge.

b. Theoretical quantity of steel reinforcement or structural steel sections shall be taken as the quantity required as per design or as authorized by Engineer-in-Charge, including authorized lappages, chairs etc. plus 3% wastage due to cutting into pieces, such theoretical quantity being determined and compared with the actual, each diameter wise, section wise and category wise separately.

c. Theoretical quantity of G.I. & C.I. or other pipes, conduits, wires and cables, pig lead and G.I./M.S. sheets shall be taken as quantity actually required and measured plus 5% for wastage due to cutting into pieces (except in the case of G.I./M.S. sheets it shall be 10%), such determination & comparison being made diameter wise & category wise.

d. For any other material as per actual requirements.

Over the theoretical quantities of materials so computed a variation shall be allowed as specified in Schedule 'F' For nonscheduled items, the decision of the Chief Engineer regarding theoretical quantities of materials which should have been actually used, shall be final and binding on the contractor.

ii. The said action under this clause is without prejudice to the right of the Government to take action against the contractor under any other conditions of contract for not doing the work according to the prescribed specifications.

Compensation during warlike situations

Clause 39

The work (whether fully constructed or not) and all materials, machines, tools and plants, scaffolding, temporary buildings and other things connected therewith shall be at the risk of the contractor until the work has been delivered to the Engineer-in-Charge and a certificate from him to that effect obtained. In the event of the work or any materials properly brought to the site for incorporation in the work being damaged or destroyed in consequence of hostilities or warlike operation, the contractor shall when ordered (in writing) by the Engineer-in-Charge to remove any debris from the site, collect and properly stack or remove in store all serviceable materials salvaged from the damaged work and shall be paid at the contract rates in accordance with the provision of this agreement for the work of clearing the site of debris, stacking or removal of serviceable material and for reconstruction of all works ordered by the Engineer- in-Charge, such payments being in addition to compensation upto the value of the work originally executed before being damaged or destroyed and not paid for. In case of works damaged or destroyed but not already measured and paid for, the compensation shall be assessed by the Divisional Officer upto Rs.2,00,000/- and by the next higher officer concerned for a higher amount. The contractor shall be paid for the damages/destruction suffered and for restoring the material at the rate based on analysis of rates tendered for in accordance with the provision of the contract. The certificate of the Engineer-in-Charge regarding the quality and quantity of materials and the purpose for which they were collected shall be final and binding on all parties to this contract.

Provided always that no compensation shall be payable for any loss in consequence of hostilities or warlike operations (a) unless the contractor had taken all such

precautions against air raid as are deemed necessary by the A.R.P. (Air Raid Precaution) Officers or the Engineer-in-Charge (b) for any material etc. not on the site of the work or for any tools, plant, machinery, scaffolding, temporary building and other things not intended for the work. In the event of the contractor having to carry out reconstruction as aforesaid, he shall be allowed such extension of time for its completion as is considered reasonable by the Divisional Officer.

Apprentices Act provisions to be complied with

Clause 40

The contractor shall comply with the provisions of the Apprentices Act, 1961 and the rules and orders issued there under from time to time. If he fails to do so, his failure will be a breach of the contract and the Superintending Engineer may, in his discretion, cancel the contract. The contractor shall also be liable for any pecuniary liability arising on account of any violation by him of the provisions of the said Act.

Release of Security deposit

Clause 41

The Security Deposit of the work shall be refunded if no labour complaint has been received from the labour officer till the due date of its payment. If a labour complaint is received during this period, the Engineer-in-Charge shall, after issue of notice in this regard to the contractor, deduct the amount required to settle the complaint from his security deposit and refund the balance amount.

Joint and Several Liability

Clause 42

If the Contractor constitutes (under applicable Laws) a joint venture or other unincorporated grouping of two or more persons:

a. these persons shall be deemed to be jointly and severally liable to the Employer for the performance of the Contract;
b. these persons shall notify the Employer of their leader who shall have authority to bind the Contractor and each of these persons; and
c. the Contractor shall not alter its composition or legal status without the prior consent of the Employer.

INTEGRITY PACT

(Integrity Pact is applicable for all works of estimated cost put to tender equal to or more than the threshold value given in Schedule-F)

This Integrity Pact is made at ..... on this ..... day of ..... 20 .....

BETWEEN

Governor of Uttar Pradesh represented by the Engineer-in-Charge (hereinafter referred to as the Principal, which expression shall unless repugnant to them meaning or context here of include its successors and permitted assignees)

AND

.....

(Name and address of the Bidder)

(Hereinafter referred to as the Bidder/Contractor and which expression shall unless repugnant to the meaning or context hereof include its successors and permitted assignees)

Preamble

WHEREAS the Principal has floated the tender (NIT No .....) (herein after referred to as the Tender) and intends to award, under laid down organizational procedure, contract for …….. (Name of work) …….....hereinafter referred to as the Contract.

AND WHEREAS the Principal values full compliance with all relevant laws of the land, rules, regulations, economic use of resources and of fairness/transparency in its relation with its Bidder(s) and Contractor(s).

AND WHEREAS to meet the purpose aforesaid both the parties have agreed to enter into this Integrity Agreement (hereinafter referred to as Integrity Pact), the terms and conditions of which shall also be read as integral part and parcel of the Tender/Bid documents and Contract between the parties.

In order to achieve these goals, the Principal will appoint Independent External Monitors (IEMs) who will monitor the tender process and the execution of the contract for compliance with the principles mentioned hereunder.

NOW, THEREFORE, in consideration of mutual covenants contained in this Pact, the parties hereby agree as follows and this Integrity Pact witnesses as under:

Articles

Article 1: Commitment of the Principal

1. The Principal commits itself to take all measures necessary to prevent corruption and to observe the following principles:

   a) No employee of the Principal, personally or through any of his/her family members, will in connection with the Tender, or the execution of the Contract, demand, take a promise for or accept, for self or third person, any material or immaterial benefit which the person is not legally entitled to.

   b) The Principal will, during the Tender process, treat all Bidder(s) with equity and reason. The Principal will, in particular, before and during the Tender process, provide to all Bidder(s) the same information and will not provide to any Bidder(s) confidential/ additional information through which the Bidder(s) could obtain an advantage in relation to the Tender process or the Contract execution.

   c) The Principal shall endeavour to exclude from the Tender process any person, whose conduct in the past has been of biased nature.

2. If the Principal obtains information on the conduct of any of its employees which is a criminal offence under the Indian Penal code (IPC)/Prevention of Corruption Act, 1988 (PC Act) or is in violation of the principles herein mentioned or if there be a substantive suspicion in this regard, the Principal will inform the Chief Vigilance Officer and in addition can also initiate disciplinary actions as per its internal laid down policies and procedures.

Article 2: Commitment of the Bidder(s)/Contractor(s)

1. It is required that each Bidder/Contractor (including their respective officers, employees and agents) adhere to the highest ethical standards, and report to the Government/ Departmental suspected acts of fraud or corruption or Coercion or Collusion of which it has knowledge or becomes aware, during the tendering process and throughout the negotiation or award of a contract.
2. The Bidder(s)/Contractor(s) commits himself to take all measures necessary to prevent

corruption. He commits himself to observe the following principles during his participation in the Tender process and during the Contract execution:

a) The Bidder(s)/Contractor(s) will not, directly or through any other person or firm, offer, promise or give to any of the Principal employees involved in the Tender process or execution of the Contract or to any third person any material or other benefit which he/she is not legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever during the Tender process or during the execution of the Contract.

b) The Bidder(s)/Contractor(s) will not enter with other Bidder(s) into any undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of Bids or any other actions to restrict competitiveness or to cartelize in the Bidding process.

c) The Bidder(s)/Contractor(s) will not commit any offence under the relevant IPC/PC Act. Further the Bidder(s)/ Contract(s) will not use improperly, (for the purpose of competition or personal gain), or pass on to others, any information or documents provided by the Principal/Owner as part of the business relationship, regarding plans, technical proposals and business details, including information contained or transmitted electronically.

d) The Bidder(s)/Contractor(s) of foreign origin shall disclose the names and addresses of agents/ representatives in India, if any. Similarly Bidder(s)/Contractor(s) of Indian nationality shall disclose names and addresses of foreign agents/representatives, if any. Either the Indian agent on behalf of the foreign principal or the foreign principal directly could Bid in a tender but not both. Further, in cases where an agent participates in a tender on behalf of one manufacturer, he shall not be allowed to quote on behalf of another manufacturer along with the first manufacturer in a subsequent/parallel tender for the same item.

e) The Bidder(s)/Contractor(s) will, when presenting his Bid, disclose any and all payments he has made, is committed to or intends to make to agents, brokers or any other intermediaries in connection with the award of the Contract.

f) Bidder(s) / Contractor(s) who have signed the Integrity Pact shall not approach the courts while representing the matter to IEMs and shall wait for their decision in the matter.

3. The Bidder(s)/Contractor(s) will not instigate third persons to commit offences outlined above or be an accessory to such offences.

4. The Bidder(s)/Contractor(s) will not, directly or through any other person or firm indulge in fraudulent practice, wilful misrepresentation or omission of facts or submission of fake/forged documents in order to induce public official to act in reliance thereof, with the purpose of obtaining unjust advantage by or causing damage to justified interest of others and/or to influence the procurement process to the detriment of the Government interests.

5. The Bidder(s)/Contractor(s) will not, directly or through any other person or firm use coercive practices (which shall include the act of obtaining something, compelling an action or influencing a decision through intimidation, threat or the use of force directly or indirectly, where potential or actual injury may befall upon a person, his/ her reputation or property) to influence their participation in the tendering process.

Article 3: Consequences of Breach

Without prejudice to any rights that may be available to the Principal under law or the contract or its established policies and laid down procedures, the Principal shall have the following rights in case of breach of this Integrity Pact by the Bi d der(s)/Contractor(s) and the Bidder/ Contractor accepts and undertakes to respect and uphold the Principal absolute right:

1. If the Bidder(s)/Contractor(s), either before award or during execution of Contract has committed a transgression through a violation of Article 2 above or in any other form, such as to put his reliability or credibility in question, the Principal after giving 14 day's notice to the contractor shall have powers to disqualify the Bidder(s)/Contractor(s) from the Tender process or terminate/determine the Contract, if already executed or exclude the Bidder/Contract or from future contract award processes. The imposition and duration of the exclusion will be determined by this verity of transgression and determined by the Principal. Such exclusion may be forever or for a limited period as decided by the Principal.

2. Forfeiture of Earnest Money Deposit/Performance Bank Guarantee/Security Deposit: If the Principal has disqualified the Bidder(s) from the Tender process prior to the award of the Contract or terminated/determined the Contract or has accrued the right to

terminate/determine the Contract according to Article 3(1), the Principal apart from exercising any legal rights that may have accrued to the Principal, may in its considered opinion forfeit the entire amount of Earnest Money Deposit/Performance Bank Guarantee and Security Deposit of the Bidder/Contractor.

3. Criminal Liability: If the Principal obtains knowledge of conduct of a Bidder or Contractor, or of an employee or a representative or an associate of a Bidder or Contractor which constitutes corruption within the meaning of PC Act, or if the Principal has substantive suspicion in this regard, the Principal will inform the same to law enforcing agencies for further investigation.

Article 4: Previous Transgression

1. The Bidder declares that no previous transgressions occurred in the last 3 years with any other Company in any country confirming to the anticorruption approach or with Central Government or State Government or any other Central/State Public Sector Enterprises in India that could justify his exclusion from the tender process.
2. If the Bidder makes incorrect statement on this subject, he can be disqualified from the tender process or action can be taken for banning of business dealings/holiday listing of the Bidder/Contractor as deemed fit by the Principal.
3. If the Bidder/Contractor can prove that he has resorted/recouped the damage caused by him and has installed a suitable corruption prevention system, the Principal may, at its own discretion, revoke the exclusion prematurely.

Article 5: Equal Treatment of all Bidders/Contractors/Subcontractors

1. The Bidder(s)/Contractor(s) undertake(s) to demand from all subcontractors a commitment in conformity with this Integrity Pact. The Bidder/Contractor shall be responsible for any violation(s) of the principles laid down in this agreement by any of its Subcontractors/ sub-vendors.
2. The Principal will enter into pacts on identical terms as this one with all Bidders and Contractors.
3. The Principal will disqualify Bidders who do not submit the duly signed Integrity Pact

between the Principal and the Bidder along with the Tender or violate its provisions at any stage of the Tender process.

Article 6- Duration of the Pact

This Integrity Pact begins when both the parties have legally signed it. It expires for the Contractor 12 months after the completion of work under the contract or expiry of defect liability period or last payment made under the contract, whichever is later and for all other Bidders, 6 months after the Contract has been awarded.

If any claim is made/lodged during this time, the same shall be binding and continue to be valid despite the lapse of this Integrity Pact as specified above, unless it is discharged/determined by the ADA.

Article 7- Other Provisions

1. This Integrity Pact is subject to Indian Law, place of performance and jurisdiction is the Headquarters of the Division of the Principal, who has floated the tender.
2. Changes and supplements as well as termination notice need to be made in writing.
3. If the Contractor is a partnership or a consortium, this Integrity Pact must be signed by all the partners or by one or more partner holding power of attorney signed by all partners and consortium members. In case of a Company, the Integrity Pact must be signed by a representative duly authorized by board resolution.
4. Should one or several provisions of this Integrity Pact turn out to be invalid; the remainder of this Pact remains valid. In this case, the parties will strive to come to an agreement to their original intensions.
5. Issues like Warranty/Guarantee etc. shall be outside the purview of IEMs.
6. It is agreed term and condition that any dispute or difference arising between the parties with regard to the terms of this Integrity Pact, any action taken by the Principal in accordance with this Integrity Pact or interpretation thereof shall not be subject to arbitration.
7. In view of the nature of integrity pact, the Integrity Pact is irrevocable and shall remain valid even if the main tender/contract is terminated till the currency of the integrity pact.

8. If any complaint regarding violation of IP is received directly by the Principal in respect of the contract, the same shall be referred to the IEM for comments/recommendations.

Article 8 –Independent External Monitor (IEM)

1. The Principal appoints competent and credible Independent External Monitor for this Pact after approval by Central Vigilance Commission (Names and address of IEMs are as mentioned in Schedule-F). The task of the Monitor is to review independently and objectively, whether and to what extent the parties comply with the obligations under this agreement.
2. The Monitor is not subject to instructions by the representatives of the parties and performs his/her functions neutrally and independently. The Monitor would have access to all contract documents, whenever required. It will be obligatory for him/her to treat the information and documents of the Bidders / Contractors as confidential.
3. The Bidder(s)/Contractor(s) accepts that the IEM has the right to access without restriction to all project documentation of the Principal including that provided by the Contractor, The Contractor will also grant the IEM, upon his/her request and demonstration of a valid interest, unrestricted and unconditional access to their project documentation. The same is applicable to subcontractors.
4. The IEM is under contractual obligation to treat the information and documents of the Bidder{s}/Contractor(s)/Sub- contractor(s) with confidentiality. The IEM has also signed 'Non-Disclosure of Confidential Information' and 'absence of Conflict of Interest'. In case if any conflict of interest arising at a later date, the IEM shall inform the Engineer-in-Charge and recuse himself / herself from that case.
5. As soon as the IEM notices, or believes to notice, a violation of this agreement, he/she will so inform the Management of the Principal and request the Management to discontinue or take corrective action, or to take other relevant action. The IEM can in this regard submit non-binding recommendations. Beyond this, the IEM has no right to demand from the parties that they act in a specific manner, refrain from action or tolerate action.
6. The IEM will submit a written report to the SDG/ADG concerned within 8 to 10 weeks from the date of reference or intimation to him by the Principal and, should the occasion arise, submit proposals for correcting problematic situations.

7. If the IEM has reported to the ADG/SDG concerned, a substantiated suspicion of an offence under relevant IPC/PC Act, and the ADG/SDG concerned has, within a reasonable time, not taken visible action to proceed against such offence or reported it to the Chief Vigilance Officer, the IEM may also transmit this information directly to the Central Vigilance Commissioner.

8. The Principal will provide to the IEM sufficient information about all meetings among the parties related to the project provided such meetings could have impact on contractual relations between the Principal and the contractor. The parties will offer to the IEM the option to participate in such meetings.

9. The word IEM or monitor would include both singular and plural.

Article 9- Legal and Prior Rights

All rights and remedies of the parties hereto shall be in addition to all the other legal rights and remedies belonging to such parties under the Contract and/or law and the same shall be deemed to be cumulative and not alternative to such legal rights and remedies aforesaid. For the sake of brevity, both the Parties agree that this Integrity Pact will have precedence over the Tender/Contact documents with regard to any of the provisions covered under this Integrity Pact.

IN WITNESS WHERE OF the parties have signed and executed this Integrity Pact at the place and date first above mentioned in the presence of following witnesses:

.....

(For and on behalf of Principal)

.....

(For and on behalf of Bidder/Contractor)

WITNESSES:

1 .....

(signature, name and address)

2 .....

(signature, name and address)

Place:

Dated:

Note: To be signed by the Bidder and the Engineer-in-Charge.

Provision of IEMs

IEMs (Independent External Monitors) have been appointed to monitor IP (Integrity pact) for works having estimated cost as mentioned in Schedule F. Details (names, address, number etc.) of IEMs are available in the Schedule F.

CPWD SAFETY CODE

1. Suitable scaffolds should be provided for workmen for all works that cannot safely be done from the ground, or from solid construction except such short period work as can be done safely from ladders. When a ladder is used, an extra mazdoor shall be engaged for holding the ladder and if the ladder is used for carrying materials as well suitable footholds and handhold shall be provided on the ladder and the ladder shall be given an inclination not steeper than ¼ to 1(¼ horizontal and 1 vertical.)

2. Scaffolding of staging more than 3.6 m (12ft.) above the ground or floor, swung or suspended from an overhead support or erected with stationary support shall have a guard rail properly attached or bolted, braced and otherwise secured at least 90 cm. (3ft.) high above the floor or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such opening as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying from the building or structure.

3. Working platforms, gangways and stairways should be so constructed that they should not sag unduly or unequally, and if the height of the platform or the gangway or the stairway is more than 3.6 m (12ft.) above ground level or floor level, they should be closely boarded, should have adequate width and should be suitably fastened as described in (2) above.

4. Every opening in the floor of a building or in a working platform shall be provided with suitable means to prevent the fall of person or materials by providing suitable fencing or railing whose minimum height shall be 90 cm. (3ft.)

5. Safe means of access shall be provided to all working platforms and other working places. Every ladder shall be securely fixed.

   No portable single ladder shall be over 9m. (30ft.) in length while the width between side rails inrung ladder shall in no case be less than 29 cm. (11½") for ladder up to and including 3 m. (10 ft.) in length. For longer ladders, this width should be increased at least ¼" for each additional 30 cm. (1 foot) of length. Uniform step spacing of not more than 30 cm shall be kept. Adequate precautions shall be taken to prevent danger from electrical equipment. No materials on any of the sites or work shall be so stacked or placed as to cause danger or inconvenience to any person or the public. The contractor shall provide all necessary fencing and lights to protect the public from

accident and shall be bound to bear the expenses of defence of every suit, action or other proceedings at law that may be brought by any person for injury sustained owing to neglect of the above precautions and to pay any damages and cost which may be awarded in any such suit; action or proceedings to any such person or which may, with the consent of the contractor, be paid to compensate any claim by any such person.

6. (a) Excavation and Trenching - All trenches 1.2 m. (4ft.) or more in depth, shall at all times be supplied with at least one ladder for each 30 m. (100 ft.) in length or fraction thereof, Ladder shall extend from bottom of the trench to at least 90 cm. (3ft.) above the surface of the ground. The side of the trenches which are 1.5 m.(5ft.) or more in depth shall be stepped back to give suitable slope or securely held by timber bracing, so as to avoid the danger of sides collapsing. The excavated materials shall not be placed within 1.5 m. (5ft.) of the edges of the trench or half of the depth of the trench whichever is more. Cutting shall be done from top to bottom. Under no circumstances, undermining or undercutting shall be done.

(b) Safety Measures for digging bore holes: -

i. If the bore well is successful, it should be safely capped to avoid caving and collapse of the bore well. The failed and the abandoned ones should be completely refilled to avoid caving and collapse;
ii. During drilling, Sign boards should be erected near the site with the address of the drilling contractor and the Engineer in-charge of the work;
iii. Suitable fencing should be erected around the well during the drilling and after the installation of the rig on the point of drilling, flags shall be put 50m alround the point of drilling to avoid entry of people;
iv. After drilling the borewell, a cement platform (0.50m x 0.50m x 1.20m) 0.60m above ground level and0.60m below ground level should be constructed around the well casing;
v. After the completion of the borewell, the contractor should cap the bore well properly by welding steel plate, cover the bore well with the drilled wet soil and fix thorny shrubs over the soil. This should be done even while repairing the pump;
vi. After the borewell is drilled the entire site should be brought to the ground level.

7. **Demolition** - Before any demolition work is commenced and also during the progress of the work,

i. All roads and open areas adjacent to the work site shall either be closed or suitably protected.

ii. No electric cable or apparatus which is liable to be a source of danger or a cable or apparatus used by the operator shall remain electrically charged.

iii. All practical steps shall be taken to prevent danger to persons employed from risk of fire or explosion or flooding. No floor, roof or other part of the building shall be so overloaded with debris or materials as to render it unsafe.

8. All necessary personal safety equipment as considered adequate by the Engineer-in-Charge should be kept available for the use of the person employed on the site and maintained in a condition suitable for immediate use, and the contractor should take adequate steps to ensure proper use of equipment by those concerned. The following safety equipment shall invariably be provided.

i. Workers employed on mixing asphaltic materials, cement and lime mortars shall be provided with protective footwear and protective goggles.

ii. Those engaged in white washing and mixing or stacking of cement bags or any material which is injurious to the eyes, shall be provided with protective goggles.

iii. Those engaged in welding works shall be provided with welder's protective eye shields.

iv. Stone breaker shall be provided with protective goggles and protective clothing and seated at sufficiently safe intervals.

v. When workers are employed in sewers and manholes, which are in active use, the contractors shall ensure that the manhole covers are opened and ventilated atleast for an hour before the workers are allowed to get into the manholes, and the manholes so opened shall be cordoned off with suitable railing and provided with warning signals or boards to prevent accident to the public. In addition, the contractor shall ensure that the following safety measure are adhered to:-

a) Entry for workers into the line shall not be allowed except under supervision of the JE or any other higher officer.

b) At least 5 to 6 manholes upstream and downstream should be kept open for at least 2 to 3 hours before any man is allowed to enter into the manhole for working inside.

c) Before entry, presence of Toxic gases should be tested by inserting wet lead acetate paper which changes colour in the presence of such gases and gives indication of their presence.

d) Presence of Oxygen should be verified by lowering a detector lamp into the manhole. In case, no Oxygen is found inside the sewer line, workers should be sent only with Oxygen kit.

e) Safety belt with rope should be provided to the workers. While working inside the manholes, such rope should be handled by two men standing outside to enable him to be pulled out during emergency.

f) The area should be barricaded or cordoned of by suitable means to avoid mishaps of any kind. Proper warning signs should be displayed for the safety of the public whenever cleaning works are undertaken during night or day.

g) No smoking or open flames shall be allowed near the blocked manhole being cleaned.

h) The malba obtained on account of cleaning of blocked manholes and sewer lines should be immediately removed to avoid accidents on account of slippery nature of the malba.

i) Workers should not be allowed to work inside the manhole continuously. He should be given rest intermittently. The Engineer-in-Charge shall decide the time up to which a worker may be allowed to work continuously inside the manhole.

j) Gas masks with Oxygen Cylinder should be kept at site for use in emergency.

k) Air-blowers should be used for flow of fresh air through the manholes. Whenever called for, portable air blowers are recommended for ventilating the manholes. The Motors for these shall be vapour proof and of totally enclosed type. Non sparking gas engines also could be used but they should be placed at least 2 metres away from the opening and on the leeward side protected from wind so that they will not be a source of friction on any inflammable gas that might be present.

l) The workers engaged for cleaning the manholes/sewers should be properly trained before allowing to work in the manhole.

m) The workers shall be provided with Gumboots or non-sparking shoes bump helmets and gloves non-sparking tools safety lights and gas masks and portable air blowers (when necessary). They must be supplied with barrier cream for anointing the limbs before working inside the sewer lines.

n) Workmen descending a manhole shall try each ladder stop or rung carefully before putting his full weight on it to guard against insecure fastening due to corrosion of the rung fixed to manhole well.

o) If a man has received a physical injury, he should be brought out of the sewer immediately and adequate medical aid should be provided to him.

p) The extent to which these precautions are to be taken depend on individual situation but the decision of the Engineer-in-Charge regarding the steps to be taken in this regard in an individual case will be final.

vi. The Contractor shall not employ men and women below the age of 18 years on the work of painting with products containing lead in any form. Wherever men above the age of 18 are employed on the work of lead painting, the following precaution should be taken:-

a) No paint containing lead or lead products shall be used except in the form of paste or readymade paint.

b) Suitable face masks should be supplied for use by the workers when paint is applied in the form of spray or a surface having lead paint is dry rubbed and scrapped.

c) Overalls shall be supplied by the contractors to the workmen and adequate facilities shall be provided to enable the working painters to wash during and on the cessation of work.

vii. Workmen executing work on scaffolds or other structures above specified height shall be provided with full body harness and fall arresters.

9. An additional clause (viii)(i) of Central Public Works Department Safety Code (iv) the Contractor shall not employ women and men below the age of 18 on the work of painting with product containing lead in any form, wherever men above the age of 18 are employed on the work of lead painting, the following principles must be observed for such use:

i. White lead, sulphate of lead or product containing this pigment, shall not be used in painting operation except in the form of pastes or paint ready for use.

ii. Measures shall be taken, wherever required in order to prevent danger arising from the application of a paint in the form of spray.

iii. Measures shall be taken, wherever practicable, to prevent danger arising out of from dust caused by dry rubbing down and scraping.

iv. Adequate facilities shall be provided to enable working painters to wash during and on cessation of work.

v. Overall, shall be worn by working painters during the whole of working period.

vi. Suitable arrangement shall be made to prevent clothing put off during working hours being spoiled13 by painting materials.

vii. Cases of lead poisoning and suspected lead poisoning shall be notified and shall be subsequently verified by medical man appointed by competent authority of ADA.

viii. ADA may require, when necessary medical examination of workers.

ix. Instructions with regard to special hygienic precautions to be taken in the painting trade shall be distributed to working painters.

10. When the work is done near any place where there is risk of drowning, all necessary equipments should be provided and kept ready for use and all necessary steps taken for prompt rescue of any person in danger and adequate provision, should be made for prompt first aid treatment of all injuries likely to be obtained during the course of the work.

11. Use of hoisting machines and tackle including their attachments, anchorage and supports shall conform to the following standards or conditions:-

(i) (a) These shall be of good mechanical construction, sound materials and adequate strength and free from patent defects and shall be kept repaired and in good working order.

(b) Every rope used in hoisting or lowering materials or as a means of suspension shall be of durable quality and adequate strength, and free from patent defects.

(ii) Every crane driver or hoisting appliance operator, shall be properly qualified and no person under the age of 21 years should be in charge of any hoisting machine including any scaffolding winch or give signals to operator.

(iii) In case of every hoisting machine and of every chain ring hook, shackle swivel and pulley block used in hoisting or as means of suspension, the safe working load shall be ascertained by adequate means. Every hoisting machine and all gear referred to above shall be plainly marked with the safe working load. In case of a hoisting machine having a variable safe working load each safe working load and the condition under which it is applicable shall be clearly indicated. No part of any machine or any gear referred to above in this paragraph shall be loaded beyond the safe working load except for the purpose of testing.

(iv) In case of departmental machines, the safe working load shall be notified by the Electrical Engineer-in- Charge. As regards contractor's machines the contractors shall notify the safe working load of the machine to the Engineer-in- Charge whenever he brings any machinery to site of work and get it verified by the Electrical Engineer concerned.

12. Motors, gearing, transmission, electric wiring and other dangerous parts of hoisting appliances should be provided with efficient safeguards. Hoisting appliances should be provided with such means as will reduce to the minimum the risk of accidental descent of the load. Adequate precautions should be taken to reduce to the minimum the risk of any part of a suspended load becoming accidentally displaced. When workers are employed on electrical installations which are already energized, insulating mats, wearing apparel, such as gloves, sleeves and boots as may be necessary should be provided. The worker should not wear any rings, watches and carry keys or other materials which are good conductors of electricity.

13. All scaffolds, ladders and other safety devices mentioned or described herein shall be maintained in safe condition and no scaffold, ladder or equipment shall be altered or removed while it is in use. Adequate washing facilities should be provided at or near places of work.

14. These safety provisions should be brought to the notice of all concerned by display on a notice board at a prominent place at work spot. The person responsible for compliance of the safety code shall be named therein by the contractor.

15. To ensure effective enforcement of the rules and regulations relating to safety precautions the arrangements made by the contractor shall be open to inspection by the Labour Officer or Engineer-in-Charge of the department or their representatives.

16. Notwithstanding the above clauses from (1) to (15), there is nothing in these to exempt the contractor from the operations of any other Act or Rule in force in the Republic of India.

Model Rules for the Protection of Health and Sanitary Arrangements for Workers Employed by NIYOJAN VIBHAG/UPPWD or its Contractors

1. APPLICATION

These rules shall apply to all buildings and construction works in charge of Central Public Works Department/PWD (DA) in which twenty or more workers are ordinarily employed or are proposed to be employed in any day during the period during which the contract work is in progress.

2. DEFINITION

Work place means a place where twenty or more workers are ordinarily employed in connection with construction work on any day during the period during which the contract work is in progress.

3. FIRST-AID FACILITIES

i. At every work place, there shall be provided and maintained, so as to be easily accessible during working hours, first- aid boxes at the rate of not less than one box for 150 contract labour or part thereof ordinarily employed.

ii. The first-aid box shall be distinctly marked with a red cross on white back ground and shall contain the following equipment:-

(a) For work places in which the number of contract labour employed does not exceed 50-Each first- aid box shall contain the following equipments:-

1. 6 small sterilised dressings.
2. 3 medium size sterilised dressings.
3. 3 large size sterilised dressings.
4. 3 large sterilised burn dressings.
5. 1 (30 ml.) bottle containing a two per cent alcoholic solution of iodine.
6. 1 (30 ml.) bottle containing salvolatile having the dose and mode of administration indicated on the label.
7. 1 snakebite lancet.
8. 1 (30 gms.) bottle of potassium permanganate crystals.
9. 1 pair scissors.
10. 1 copy of the first-aid leaflet issued by the Director General, Factory Advice Service and Labour Institutes, Government of India.
11. 1 bottle containing 100 tablets (each of 5 gms.) of aspirin.
12. Ointment for burns.
13. A bottle of suitable surgical antiseptic solution.\]

(b) For work places in which the number of contract labour exceed 50. Each first-aid box shall contain the following equipment.

1. 12 small sterilised dressings.
2. 6 medium size sterilised dressings.
3. 6 large size sterilised dressings.

4. 6 large size sterilised burn dressings.
5. 6 (15 gms.) packets sterilised cotton wool.
6. 1 (60 ml.) bottle containing a two per cent alcoholic solution iodine.
7. 1 (60 ml.) bottle containing salvolatile having the dose and mode of administration indicated onthe label.
8. 1 roll of adhesive plaster.
9. 1 snake bite lancet.
10. 1 (30 gms.) bottle of potassium permanganate crystals.
11. 1 pair scissors.
12. 1 copy of the first-aid leaflet issued by the Director General Factory Advice Service and Labour Institutes /Government of India.
13. A bottle containing 100 tablets (each of 5 gms.) of aspirin.
14. Ointment for burns.
15. A bottle of suitable surgical antiseptic solution.

iii. Adequate arrangements shall be made for immediate recoupment of the equipment when necessary.

iv. Nothing except the prescribed contents shall be kept in the First-aid box.

v. The first-aid box shall be kept in charge of a responsible person who shall always be readily available during the working hours of the work place.

vi. A person in charge of the First-aid box shall be a person trained in First-aid treatment in the work places where the number of contract labour employed is 150 or more.

vii. In work places where the number of contract labour employed is 500 or more and hospital facilities are not available within easy distance from the works. First-aid posts shall be established and run by a trained compounder. The compounder shall be on duty and shall be available at all hours when the workers are at work.

viii. Where work places are situated in places which are not towns or cities, a suitable motor transport shall be kept readily available to carry injured person or person suddenly taken ill to the nearest hospital.

4. DRINKING WATER

(i) In every work place, there shall be provided and maintained at suitable places, easily accessible to labour, a sufficient supply of cold water fit for drinking.

(ii) Where drinking water is obtained from an Intermittent public water supply, each work place shall be provided with storage where such drinking water shall be stored.

(iii) Every water supply or storage shall be at a distance of not less than 50 feet from any latrine drain or other source of pollution. Where water has to be drawn from an existing well which is within such proximity of latrine, drain or any other source of pollution, the well shall be properly chlorinated before water is drawn from it for drinking. All such wells shall be entirely closed in and be provided with a trap door which shall be dust and waterproof.

(iv) A reliable pump shall be fitted to each covered well, the trap door shall be kept locked and opened only for cleaning or inspection which shall be done at least once a month.

5. WASHING FACILITIES

(i) In every work place adequate and suitable facilities for washing shall be provided and maintained for the use of contract labour employed therein.

(ii) Separate and adequate cleaning facilities shall be provided for the use of male and female workers.

(iii) Such facilities shall be conveniently accessible and shall be kept in clean and hygienic condition.

6. LATRINES AND URINALS

(i) Latrines shall be provided in every work place on the following scale namely :-

(a) Where females are employed, there shall be at least one latrine for every 25 females.

(b) Where males are employed, there shall be at least one latrine for every 25 males.

Provided that, where the number of males or females exceeds 100, it shall be sufficient if there is one latrine for 25 males or females as the case may be upto the first 100, and one for every 50 thereafter.

(ii) Every latrine shall be under cover and so partitioned off as to secure privacy, and shall have a proper door and fastenings.

(iii) Construction of latrines: The inside walls shall be constructed of masonry or some suitable heat-resisting non-absorbent materials and shall be cement washed inside and outside at least once a year, Latrines shall not be of a standard lower than borehole system.

(iv) (a) Where workers of both sexes are employed, there shall be displayed outside each block of latrine and urinal, a notice in the language understood by the majority of the workers “For Men only” or “For Women Only” as the case may be.

(b) The notice shall also bear the figure of a man or of a woman, as the case may be.

(v) There shall be at least one urinal for male workers upto 50 and one for female workers upto fifty employed at a time, provided that where the number of male or female workmen, as the case may be exceeded 500, it shall be sufficient if there is one urinal for every 50 males or females upto the first 500 and one for every 100 or part thereafter.

(vi) (a) The latrines and urinals shall be adequately lighted and shall be maintained in a clean and sanitary condition at all times.

(b) Latrines and urinals other than those connected with a flush sewage system shall comply with the requirements of the Public Health Authorities.

(vii) Water shall be provided by means of tap or otherwise so as to be conveniently accessible in or near the latrines and urinals.

(viii) Disposal of excreta:- Unless otherwise arranged for by the local sanitary authority, arrangements for proper disposal of excreta by incineration at the work place shall be made by means of a suitable incinerator. Alternately excreta may be disposed of by putting a layer of night soil at the bottom of a pucca tank prepared for the purpose and covering it with a 15 cm. layer of waste or refuse and then covering it with a layer of earth for a fortnight (when it will turn to manure).

(ix) The contractor shall at his own expense, carry out all instructions issued to him by the Engineer-in-Charge to effect proper disposal of night soil and other conservancy work in respect of the contractor’s workmen or employees on the site. The contractor shall be

responsible for payment of any charges which may be levied by Municipal or Cantonment Authority for execution of such on his behalf.

7. PROVISION OF SHELTER DURING REST

At every place there shall be provided, free of cost, four suitable sheds, two for meals and the other two for rest separately for the use of men and women labour. The height of each shelter shall not be less than 3 metres (10ft.) from the floor level to the lowest part of the roof. These shall be kept clean and the space provided shall be on the basis of 0.6 sq.m. (6 sq.ft) per head.

Provided that the Engineer-in-Charge may permit subject to his satisfaction, a portion of the building under construction or other alternative accommodation to be used for the purpose.

8. CRECHES

(i) At every work place, at which 20 or more women worker are ordinarily employed, there shall be provided two rooms of reasonable dimensions for the use of their children under the age of six years. One room shall be used as a play room for the children and the other as their bedroom. The rooms shall be constructed with specifications as per clause 19H

(ii) a, b & c.

(ii) The rooms shall be provided with suitable and sufficient openings for light and ventilation. There shall be adequate provision of sweepers to keep the places clean.

(iii) The contractor shall supply adequate number of toys and games in the play room and sufficient number of cots and beddings in the bed room.

(iv) The contractor shall provide one ayaa to look after the children in the creche when the number of women workers does not exceed 50 and two when the number of women workers exceed 50.

(v) The use of the rooms earmarked as creches shall be restricted to children, their attendants and mothers of the children.

9. CANTEENS

(i) In every work place where the work regarding the employment of contract labour is likely to continue for six months and where in contract labour numbering one hundred or more are ordinarily employed, an adequate canteen shall be provided by the contractor for the use of such contract labour.

(ii) The canteen shall be maintained by the contractor in an efficient manner.

(iii) The canteen shall consist of at least a dining hall, kitchen, storeroom, pantry and washing places separately for workers and utensils.

(iv) The canteen shall be sufficiently lighted at all times when any person has access to it.

(v) The floor shall be made of smooth and impervious materials and inside walls shall be lime-washed or colour washed at least once in each year.

Provided that the inside walls of the kitchen shall be lime-washed every four months.

(vi) The premises of the canteen shall be maintained in a clean and sanitary condition.

(vii) Waste water shall be carried away in suitable covered drains and shall not be allowed to accumulate so as to cause a nuisance.

(viii) Suitable arrangements shall be made for the collection and disposal of garbage.

(ix) The dining hall shall accommodate at a time 30 per cent of the contract labour working at a time.

(x) The floor area of the dining hall, excluding the area occupied by the service counter and any furniture except tables and chairs shall not be less than one square metre (10 sq.ft.) per diner to be accommodated as prescribed in sub-Rule 9.

(xi) (a) A portion of the dining hall and service counter shall be partitioned off and reserved for women workers in proportion to their number.

(b) Washing places for women shall be separate and screened to secure privacy.

(xii) Sufficient tables stools, chair or benches shall be available for the number of diners to be accommodated as prescribed in sub-Rule 9.

(xiii) (a) 1. There shall be provided and maintained sufficient utensils crockery, furniture and any other reequipments necessary for the efficient running of the canteen.

2. The furniture utensils and other equipment shall be maintained in a clean and hygienic condition.

(b) 1. Suitable clean clothes for the employees serving in the canteen shall be provided and maintained.

2. A service counter, if provided, shall have top of smooth and impervious material.

3. Suitable facilities including an adequate supply of hot water shall be provided for the cleaning of utensils and equipments.

(xiv) The food stuffs and other items to be served in the canteen shall be in conformity with the normal habits of the contract labour.

(xv) The charges for food stuffs, beverages and any other items served in the canteen shall be based on 'No profit, No loss' and shall be conspicuously displayed in the canteen.

(xvi) In arriving at the price of foodstuffs, and other article served in the canteen, the following items shall not be taken into consideration as expenditure namely:-

(a) The rent of land and building.

(b) The depreciation and maintenance charges for the building and equipments provided for the canteen.

(c) The cost of purchase, repairs and replacement of equipments including furniture, crockery, cutlery and utensils.

(d) The water charges and other charges incurred for lighting and ventilation.

(e) The interest and amounts spent on the provision and maintenance of equipments provided for the canteen.

(xvii) The accounts pertaining to the canteen shall be audited once every 12 months by registered accountants and auditors.

10. ANTI-MALARIAL PRECAUTIONS

The contractor shall at his own expense, conform to all anti-malarial instructions given to him by the Engineer-in-Charge including the filling up of any borrow pits which may have been dug by him.

11. The above rules shall be incorporated in the contracts and in notices inviting tenders and shall form an integral part of the contracts.

12. AMENDMENTS

Government may, from time to time, add to or amend these rules and issue directions - it may consider necessary for the purpose of removing any difficulty which may arise in the administration thereof.

13. EPIDEMIC SITUATION

In such situation contractor shall deploy special labour to keep the site, worker's hutments, rest rooms etc. neat and clean including sanitization. Contractor shall provide all epidemic related arrangements (at his cost following the guidelines issued by State/ Central Government in this regard.

NIYOJAN VIBHAG/UPPWD Contractor's Labour Regulations

1. SHORT TITLE

These regulations may be called the NIYOJAN VIBHAG/UPPWD/PWD Delhi Contractors Labour Regulations.

2. DEFINITIONS

(i) Workman means any person employed by NIYOJAN VIBHAG/ UPPWD/ PWD Delhi or its contractor directly or indirectly through a subcontractor with or without the knowledge of the Central Public Works Department/PWD Delhi to do any skilled, semiskilled or unskilled manual, supervisory, technical or clerical work for hire or reward, whether the terms of employment are expressed or implied but does not include any person:-

(a) Who is employed mainly in a managerial or administrative capacity: or

(b) Who, being employed in a supervisory capacity draws wages exceeding five hundred rupees per mensem or exercises either by the nature of the duties attached to the office or by reason of powers vested in him, functions mainly of managerial nature: or

(c) Who is an out worker, that is to say, person to whom any article or materials are given out by or on behalf of the principal employers to be made up cleaned, washed, altered, ornamental finished, repaired adopted or otherwise processed for sale for the purpose of the trade or business of the principal employers and the process is to be carried out either in the home of the out worker or in some other premises, not being premises under the control and management of the principal employer.

No person below the age of 18 years shall be employed to act as a workman.

(ii) Fair Wages means wages whether for time or piece work fixed and notified under the provisions of the Minimum Wages Act from time to time.

(iii) Contractors shall include every person who undertakes to produce a given result other than a mere supply of goods or articles of manufacture through contract labour or who supplies contract labour for any work and includes a subcontractor.

(iv) Wages shall have the same meaning as defined in the Payment of Wages Act.

3. WORKING HOURS

(i) Normally working hours of an adult employee should not exceed 9 hours a day. The working day shall be so arranged that inclusive of interval for rest, if any, it shall not spread over more than 12 hours on any day.

(ii) When an adult worker is made to work for more than 9 hours on any day or for more than 48 hours in any week, he shall be paid over time for the extra hours put in by him at double the ordinary rate of wages.

(iii) (a) Every worker shall be given a weekly holiday normally on a Sunday, in accordance with the provisions of the Minimum Wages (Central) Rules 1960 as amended from time to time irrespective of whether such worker is governed by the Minimum Wages Act or not.

(b) Where the minimum wages prescribed by the Government under the Minimum Wages Act are not inclusive of the wages for the weekly day of rest, the worker shall be entitled to rest day wages at the rate applicable to the next preceding day, provided he has worked under the same contractor for a continuous period of not less than 6 days.

(c) Where a contractor is permitted by the Engineer-in-Charge to allow a worker to work on a normal weekly holiday, he shall grant a substituted holiday to him for the whole day on one of the five days immediately before or after the normal weekly holiday and pay wages to such worker for the work per formed on the normal weekly holiday at overtime rate.

4. DISPLAY OF NOTICE REGARDING WAGES ETC.

The contractor shall before he commences his work on contract, display and correctly maintain and continue to display and correctly maintain in a clear and legible condition in conspicuous places on the work, notices in English and in the local Indian languages spoken by the majority of the workers giving the minimum rates of wages fixed under Minimum Wages Act, the actual wages being paid, the hours of work for which such wage are earned, wages periods, dates of payments of wages and other relevant information as per Appendix 'III'.

5. PAYMENT OF WAGES

(i) The contractor shall fix wage periods in respect of which wages shall be payable.

(ii) No wage period shall exceed one month.

(iii) The wages of every person employed as contract labour in an establishment or by a contractor where less than one thousand such persons are employed shall be paid before the expiry of seventh day and in other cases before the expiry of tenth day after the last day of the wage period in respect of which the wages are payable.

(iv) Where the employment of any worker is terminated by or on behalf of the contractor the wages earned by him shall be paid before the expiry of the second working day from the date on which his employment is terminated.

(v) All payment of wages shall be made on a working day at the work premises and during the working time and on a date notified in advance and in case the work is completed before the expiry of the wage period, final payment shall be made within 48 hours of the last working day.

(vi) Wages due to every worker shall be paid to him direct by contractor through Bank or ECS or online transfer to his bank account.

(vii) All wages shall be paid through Bank or ECS or online transfer.

(viii) Wages shall be paid without any deductions of any kind except those specified by the Central Government by general or special order in this behalf or permissible under the Payment of Wages Act 1956.

(ix) A notice showing the wages period and the place and time of disbursement of wages shall be displayed at the place of work and a copy sent by the contractor to the Engineer-in-Charge under acknowledgment.

(x) It shall be the duty of the contractor to ensure the disbursement of wages through bank account of labour.

(xi) The contractor shall obtain from the Junior Engineer or any other authorised representative of the Engineer- in-Charge as the case may be, a certificate under his signature at the end of the entries in the "Register of Wages" or the "Wage-cum-Muster Roll" as the case may be in the following form:-

(xii) "Certified that the amount shown in column No ..... has been paid to the workman concerned through bank account of labour on ..... at……"

FINES AND DEDUCTIONS WHICH MAY BE MADE FROM WAGES

(i) The wages of a worker shall be paid to him without any deduction of any kind except the following: -

(a) Fines

(b) Deductions for absence from duty i.e. from the place or the places where by the terms of his employment he is required to work. The amount of deduction shall be in proportion to the period for which he was absent.

(c) Deduction for damage to or loss of goods expressly entrusted to the employed person for custody or for loss of money or any other deduction which he is required to account, where such damage or loss is directly attributable to his neglect or default.

(d) Deduction for recovery of advances or for adjustment of overpayment of wages, advances granted shall be entered in a register.

(e) Any other deduction which the Central Government may from time to time allow.

(ii) No fines should be imposed on any worker save in respect of such acts and omissions on his part as have been approved of by the Chief Labour Commissioner.

Note:- An approved list of Acts and Omissions for which fines can be imposed is enclosed at Appendix-X

(iii) No fine shall be imposed on a worker and no deduction for damage or

loss shall be made from his wages until the worker has been given an opportunity of showing cause against such fines or deductions.

(iv) The total amount of fine which may be imposed in any one wage period on a worker shall not exceed an amount equal to three paise in a rupee of the total wages, payable to him in respect of that wage period.

(v) No fine imposed on any worker shall be recovered from him by instalment, or after the expiry of sixty days from the date on which it was imposed.

(vi) Every fine shall be deemed to have been imposed on the day of the act or omission in respect of which it was imposed.

LABOUR RECORDS

(i) The contractor shall maintain a Register of persons employed on work on contract in Form XIII of the CL(R&A) Central Rules 1971 (Appendix IV)

(ii) The contractor shall maintain a Muster Roll register in respect of all workmen employed by him on the work under Contract in Form XVI of the CL (R&A) Rules 1971 (Appendix V).

(iii) The contractor shall maintain a Wage Register in respect of all workmen employed by him on the work under contract in Form XVII of the CL (R&A) Rules 1971 (Appendix VI).

(iv) Register of accident - The contractor shall maintain a register of accidents in such form as may be convenient at the work place but the same shall include the following particulars:

(a) Full particulars of the labourers who met with accident.

(b) Rate of Wages.

(c) Sex

(d) Age

(e) Nature of accident and cause of accident.

(f) Time and date of accident.

(g) Date and time when admitted in Hospital,

(h) Date of discharge from the Hospital.

(i) Period of treatment and result of treatment.

(j) Percentage of loss of earning capacity and disability as assessed by Medical Officer.

(k) Claim required to be paid under Workmen's Compensation Act.

(l) Date of payment of compensation.

(m) Amount paid with details of the person to whom the same was paid.

(n) Authority by whom the compensation was assessed.

(o) Remarks

(v) The contractor shall maintain a Register of Fines in the Form XII of the CL (R&A) Rules 1971 (Appendix-XI)

(vi) The contractor shall display in a good condition and in a conspicuous place of work the approved list of acts and omissions for which fines can be imposed (Appendix-X)

(vii) The contractor shall maintain a Register of deductions for damage or loss in Form XX of the CL (R&A) Rules 1971 (Appendix-XII)

(viii) The contractor shall maintain a Register of Advances in Form XXIII of the CL (R&A) Rules 1971 (Appendix-XIII)

(ix) The contractor shall maintain a Register of Overtime in Form XXIII of the CL (R&A) Rules 1971 (Appendix-XIV)

6. ATTENDANCECARD-CUM-WAGE SLIP

(i) The contractor shall issue an Attendance card-cum-wage slip to each workman employed by him in the specimen form at (Appendix-VII)

(ii) The card shall be valid for each wage period.

(iii) The contractor shall mark the attendance of each workman on the card twice each day, once at the commencement of the day and again after the rest interval, before he actually starts work.

(iv) The card shall remain in possession of the worker during the wage period under reference.

(v) The contractor shall complete the wage slip portion on the reverse of the

card at least a day prior to the disbursement of wages in respect of the wage period under reference.

(vi) The contractor shall obtain the signature or thumb impression of the worker on the wage slip at the time of disbursement of wages and retain the card with himself.

7. EMPLOYMENT CARD

The contractor shall issue an Employment Card in Form XIV of the CL (R&A) Central Rules 1971 to each worker within three days of the employment of the worker (Appendix-VIII).

8. SERVICE CERTIFICATE

On termination of employment for any reason whatsoever the contractor shall issue to the workman whose services have been terminated, a Service certificate in Form XV of the CL (R&A) Central Rules 1971 (Appendix-IX).

9. PRESERVATION OF LABOUR RECORDS

All records required to be maintained under Regulations Nos. 6 & 7 shall be preserved in original for a period of three years from the date of last entries made in them and shall be made available for inspection by the Engineer-in-Charge or Labour Officer or any other officers authorized by the Ministry of Urban Development in this behalf.

10. POWER OF LABOUR OFFICER TO MAKE INVESTIGATIONS OR ENQUIRY

The Labour Officer or any person authorized by Central Government on their behalf shall have power to make enquires with a view to ascertaining and enforcing due and proper observance of Fair Wage Clauses and the Provisions of these Regulations. He shall investigate into any complaint regarding the default made by the contractor or subcontractor in regard to such provision.

11. REPORT OF LABOUROFFICER

The Labour Officer or other persons authorized as aforesaid shall submit a report of result of his investigation ore enquiry to the Executive Engineer concerned indicating the extent, if any, to which the default has been committed with a note that necessary deductions from the contractor's bill be made and the wages and other dues be paid to the labourers concerned. In case an appeal is made by the contractor under Clause 13 of these regulations, actual payment to labourers will be made by the Executive Engineer after the Superintending Engineer has given his decision on such appeal.

(i) The Executive Engineer shall arrange payments to the labour concerned within 45 days from the receipt of the report form the Labour Officer or the Superintending Engineer as the case may be.

12. APPEAL AGAINST THE DECISION OF LABOUR OFFICER

Any person aggrieved by the decision and recommendations of the Labour Officer or other person so authorized may appeal against such decision to the Superintending Engineer concerned within 30 days from the date of decision,

forwarding simultaneously a copy of his appeal to the Executive Engineer concerned but subject to such appeal, the decision of the officer shall be final and binding upon the contractor.

13. PROHIBITION REGARDING REPRESENTATION THROUGH LAWYER

(i) A workman shall be entitled to be represented in any investigation or enquiry under these regulations by:-

(a) An officer of a registered trade union of which he is a member.

(b) An officer of a federation of trade unions to which the trade union referred to in clause (a) is affiliated.

(c) Where the employer is not a member of any registered trade union, by an officer of a registered trade union, connected with the industry in which the worker is employed or by any other workman employed in the industry in which the worker is employed.

(ii) An employer shall be entitled to be represented in any investigation or enquiry under these regulations by :-

(a) An officer of an association of employers of which he is a member.

(b) An officer of a federation of associations of employers to which association referred to in clause (a) is affiliated.

(c) Where the employers are not a member of any association of employers, by an officer of association of employer connected with the industry in which the employer is engaged or by any other employer, engaged in the industry in which the employer is engaged.

(iii) No party shall be entitled to be represented by a legal practitioner in any investigation or enquiry under these regulations.

14. INSPECTION OF BOOKS AND SLIPS

The contractor shall allow inspection of all the prescribed labour records to any of his workers or to his agent at a convenient time and place after due notice is received or to the Labour Officer or any other person, authorized by the Central Government on his behalf.

15. SUBMISSIONS OF RETURNS

The contractor shall submit periodical returns as may be specified from time to time.

16. AMENDMENTS

The Central Government may from time to time add to or amend the regulations and on any question as to the application/Interpretation or effect of those regulations the decision of the Superintending Engineer concerned shall be final.

Appendix 'I'

REGISTER OF MATERNITY BENEFITS (Clause 19F)

Name and address of the contractor_____

Name and Location of the work_____

Name of the Employee	Father's/ husband's name	Nature of Employment	Period of actual confinement	Date on which notice of confinement given
1	2	3	4	5

Date on which maternity leave commenced and ended				
Date of Delivery/ Miscarriage	In case of delivery		In case of miscarriage	
	Commenced	Ended	Commenced	Ended
6	7	8	9	10

Leave pay paid to the employee				Remarks
In case of delivery		In case of miscarriage		
Rate of leave pay	Amount paid	Rate of leave pay	Amount paid	
11	12	13	14	15

Appendix 'II'

SPECIMEN FORM OF THE REGISTER, REGARDING MATERNITY BENEFIT ADMISSIBLE TO THE CONTRACTOR'S LABOUR

Name and address of the contractor_____

Name and location of the work_____

1. Name of the woman and her husband's name.
2. Designation
3. Date of appointment.
4. Date with months and years in which she is employed.
5. Date of discharge / dismissal, if any.
6. Date of production of certificates in respect of pregnancy.
7. Date on which the woman informs about the expected delivery.
8. Date of delivery / miscarriage / death.
9. Date of production of certificates in respect of delivery / miscarriage.
10. Date with the amount of maternity/ death benefit paid in advance of expected delivery.
11. Date with amount of subsequent payment of maternity benefit.
12. Name of the person nominated by the woman to receive the payment of the maternity benefit after her death.
13. If the woman dies, the date of death, the name of the person to whom maternity benefit amount was paid, the month thereof and the date of payment.
14. Signature of the contractor authenticating entries in the register.
15. Remarks column for the use of inspecting officer.

Appendix 'III'

LABOUR BOARD

Name of work:_____

Name of Contractor:_____

Address of Contractor:_____

Name and address of Construction divn./unit _____

Name of Labour Officer:_____

Address of Labour Officer:_____

Name of Labour Enforcement Officer:_____

Address of Labour Enforcement Officer:_____

Sl.No	Category	Minimum Wage Fixed	Actual wage paid	Number Present	Remarks

Weekly holiday_____

Wage period _____

Date of payment of Wages_____

Working hours_____

Rest interval_____

Appendix 'IV'

Register of Workmen Employed by Contractor

Name and address of contractor _____

Name and address of establishment under which Contract is carried on_____ _____

Name and location of work _____

Name and address of principal Employer _____

SN	Name and surname of Workman	Age and Sex	Father's/ Husband's Name	Nature of employment / designation.	Permanent home address of the workman (Village and Tehsil,	Local Address	Date of commencement of employment	Signature or thumb impression of the workman	Date of Termination of employment.	Reasons For	Remarks
1	2	3	4	5	6	7	8	9	10	11	12

Appendix 'V'

Muster Roll

Name and address of the contractor_____

Name and address of establishment under which contract is carried on_____

Nature and location of work_____

Name and address of Principal Employer_____

For the month of fortnight_____

Sl. No.	Name of workman	Sex	Father's/ Husband's Name	Dates					Remarks
1	2	3	4	5					6
				1	2	3	4	5	

Appendix 'VI'

Form –XVII (See Rule 78(2)(a)) Register of Wages

Name and address of the contractor_____

Name and address of establishment under which contract is carried on_____

Nature and location of work _____

Name and address of Principal Employer_____

Wages period_____Monthly/fortnightly.

SN	Name of Workman	Serial No.in the register of workman	Designation Nature of work done	No. of days worked	Units of work done	Daily rate of wages/piece rate	Basic Wages
1	2	3	4	5	6	7	8

Dearness allowances	Overtime	Other cash payments (Indicate nature)	Total	Deductions if any, (indicate nature)	Net amount paid	Signature or thumb impression of	Initial of contractor or his representative
9	10	11	12	13	14	15	16

Appendix 'VII'

(Observe)

Wage Card No._____

Wage Card

Name and address of the contractor_____. Date of issue_____

Name and location of work_____. Designation_____

Name of Workman_____. Month/fortnight_____

Rate of Wages _____

DATE																														
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31
Morning																															
Evening																															
Initial																															

Rate_____ Amount _____

Received from_____ the sum of Rs. _____ on account of my wages.

Signature

The wage card is valid for one month from the date of issue.

Appendix 'VII'

(Reverse)

Wages Slip

Name and address of the contractor_____

Name and Father's/Husband's name of workman_____

Nature and location of work_____

For the Week/Fortnight/Month ending_____

1. No. of days worked _____
2. No. of units worked in case of piece rate workers_____
3. Rate of daily wages/piece rate_____
4. Amount of overtime wages_____
5. Gross wages payable_____
6. Deduction, if any_____
7. Net amount of wages paid_____

Initials of the Contractors or his representative

Employment Card

Name and address of the contractor_____

Name and address of establishment under which contract is_____

carried on Nature of work and location of work_____

Name and address of Principal Employer_____

1. Name of Workman_____
2. Sl No. in the register of workman employed_____
3. Nature of employment/designation_____
4. Wage rate (with particulars of unit in case of piece work)_____
5. Wages period_____
6. Tenure of employment_____
7. Remarks_____

Signature of contractor

Service Certificate

Name and address of the contractor_____

Nature and location of work_____

Name and Address of workman_____

Age or date of birth_____

Identification marks_____

Father's/Husband's name_____

Name and address of establishment in under which contract is carried on_____

Name and address of Principal Employer_____

Sl. No.	Total period for which employed		Nature of work done	Rate of Wages (with particulars of unit in case of piece work)	Remarks
	From	To			
1	2	3	4	5	6

Signature |

LIST OF ACTS AND OMISSIONS FOR WHICH FINES CAN BE IMPOSED

In accordance with rule 7 (v) of the Niyojan Vibhag/UPPWD to be displayed prominently at the site of work both in English and local Language.

1. Wilful insubordination or disobedience, whether along or in combination with other.
2. Theft fraud or dishonestly in connection with the contractors beside a business or property of Niyojan Vibhag/UPPWD.
3. Taking or giving bribes or any illegal gratifications.
4. Habitual late attendance.
5. Drunkenness fighting, riotous or disorderly or indifferent behaviour.
6. Habitual negligence.
7. Smoking near or around the area where combustible or other materials are locked.
8. Habitual indiscipline.
9. Causing damage to work in the progress or to property of the Niyojan Vibhag/UPPWD or of the contractor.
10. Sleeping on duty.
11. Malingering or slowing down work.
12. Giving of false information regarding name, age, father's name etc.
13. Habitual loss of wage cards supplied by the employers.
14. Unauthorized use of employer's property of manufacturing or making of unauthorized particles at the work place.
15. Bad workmanship in construction and maintenance by skilled workers which is not approved by the Department and for which the contractors are compelled to undertake rectification.
16. Making false complaints and/or misleading statements.
17. Engaging on trade within the premises of the establishments.
18. Any unauthorized divulgence of business affairs of the employees.
19. Collection or canvassing for the collection of any money within the premises of an

establishment unless authorized by the employer.

20. Holding meeting inside the premises without previous sanction of the employers.

21. Threatening or intimidating any workman or employer during the working hours within the premises.

Appendix 'XI'

Register of Fines

Name and address of the contractor_____

Name and address of establishment in under which contract is carried on_____

Nature and location of work_____

Name and address of Principal Employer_____

Sl. No.	Name of workman	Father's/Husband's name	Designation/nature of employment	Act/Omission For which fine imposed	Date of Offence
1	2	3	4	5	6

Whether workman Showed cause against fine	Name of person in whose presence employee's explanation was heard	Wage period and wages payable	Amount of fine imposed	Date on which fine realized	Remarks.
7	8	9	10	11	12

Appendix 'XII'

Register of Deduction for Damage or Loss

Name and address of the contractor_____

Name and address of establishment in under which contract is carried on_____

Nature and location of work_____

Name and address of Principal Employer_____

Sl No.	Name of workman	Father's/Husband's name	Designation/ nature of employment	Particulars of damage or loss	Date of damage or loss
1	2	3	4	5	6

Whether workman showed cause against fine	Name of person in whose presence employees explanation was heard	Amount of deduction imposed	No. of installments	Date of recovery		Remarks
				First installment	Last installment	
7	8	9	10	11	12	13

Appendix

Register of Advances

Name and address of the contractor

Name and address of establishment in under which contract is carried on_

Nature and location of work

Name and address of Principal Employer_____

Sl. No.	Name of workman	Father' s/Husband'	Designation nature of employment	Wage period and wages payable	Date and Amount of Advance given	Purpose(s) for which Advance made	Number of Installments by which advance to be repaid	Date and amount of each installments repaid	Date on which last Installments was repaid	Remarks
1	2	3	4	5	6	7	8	9	10	11

Appendix

Register of Overtime

Name and address of the contractor

Name and address of establishment in under which contract is carried on

Nature and location of work

Name and address of Principal Employer _____

Sl.No.	Name of workman	Father' s/husband' s	Sex	Designation /nature of employment	Date on which Overtime worked	Total overtime worked or production in case of piece rated	Normal rate of wages	Overtime rate of wages	Overtime earnings	Rate on which overtime wages paid	Remarks
1	2	3	4	5	6	7	8	9	10	11	12

PROFORMA OF SCHEDULES

(Operative Schedules)

SCHEDULE 'A'		
	Schedule of quantities (BOQ)	Attached as Volume –7, Financial Bid.
SCHEDULE 'B'		
	Schedule of materials to be issued to the Contractor	**NIL**
SCHEDULE 'C'		
	Tools and plants to be hired to the contractor	**NIL**
SCHEDULE 'D'		
	Extra schedule for specific requirements/ document for the work, if any.	**NIL**
SCHEDULE 'E'		
	Reference to General Conditions of Contract as per Vol-2	
	Name of work:-	Selection of Contractor for Integrated Infrastructure Development Works, in Atal Puram Township at Agra in the State of Uttar Pradesh on EPC basis
	Estimated cost of work:	Rs. 413.15 /- Cr. (Rupees Four Hundred Thirteen Crore & Fifteen Lakh) only including O&M
	Earnest money:	Rs 4.13/- Cr (Rupees Four Crore Thirteen Lakh) only.
	Performance Bank Guarantee:	**3% of Tendered Value**
	Security Deposit:	**2.5% of Tendered Value**
SCHEDULE 'F'		
	GENERAL RULES & DIRECTIONS	
		Chief Engineer, Agra Development Authority
	Officer inviting Bid	Chief Engineer, Agra Development Authority
	General Rules & Directions	Tender on EPC Item Rate Basis
	Pseudo static Reversed Cyclic Test	Deleted

	DEFINITIONS	
1	Authority executing the agreement on behalf of the ADA	Chief Engineer, Agra Development Authority
2(vi)	Engineer-in-Charge	Executive Engineer, Agra Development Authority
2(vii)	Accepting Authority of the ADA	Engineer-in-charge, Agra Development Authority,
2(x)	Percentage on cost of materials and labour to cover all Overheads and profits.	15%
8.1		Deleted
9	Sign the Contract consisting of:	Volume – 1 (Notice Inviting e-Tenders (NIT) &

		Instructions to Bidders (ITB) Volume – 2 (General Conditions of Contract) Volume - 3 (Specific Conditions of Contract) Volume – 4 (Design Basis Report) Volume – 5 (Technical Specifications) Volume– 6 (Tender Drawings) Volume – 7 (Financial Bid) All amendments(s)/ corrigendum, Make List, Reply to Prebid Meeting if any.
Clause 1	**CLAUSES OF CONTRACT**	
Clause 1	(i) Time allowed for submission of Performance Bank Guarantee of 3% (Three percent) of the tendered value plus the additional security for unbalanced Bids as per Go no. 622/23-12-2012-2 Audit/08 TC-2, dated 08.06.2012, Programme Chart (Time & Progress) and applicable labour licenses, registration with EPFO, ESIC & BOCW Welfare Board or proof of applying thereof from the date of issue of letter of acceptance	10 days
Clause 1(a)	Note 1, 2 & 3	Deleted
Clause 2	(i) Compensation for delay of work	@ 0.5% of accepted tendered amount per month of delay (to be computed on per day basis). Provided further that the total amount of compensation for delay to be paid under this condition shall not exceed 5% (five percent) of the accepted Tendered Value of work or of the accepted Tendered Value
Clause 5	Authority for fixing compensation under Clause 2.	Chief Engineer, Agra Development Authority, ADA, Agra on recommendation by Engineer-in-Charge
	Number of days from the date of issue of letter of acceptance for reckoning date of Start	22 (Twenty-two) days

Table of Milestones:

Mile Stone	Description of Milestone	Time allowed in months (from date of issue of Letter of Award)	Amount to be withheld from non-achieving of each milestone (% of total awarded value)
1	Survey, Investigation, collect all primary and secondary data, Designing	2 Months	0.50%
2	Road Work including Culverts, Bridges, VUP	27 Months	1%
3	Storm Water Drainage System with Outfall(s)	22 Months	1%
5	Utility Duct	18 Months	1%
6	Sewage System with Sewage Pumping Station including STP	20 Months	1%
7	Potable Water Supply System including Water Treatment Plant, construction of Borewell, Raw Water Reservoir, Pumping Station (Civil, MEP works)	16 Months	1%
8	Recycled Water Supply System including treated waste Water Reservoir, Pumping Station (Civil, MEP works)	16 Months	1%
9	Footpath & Tracks	16 Months	0.50%
10	Rainwater Harvesting	18 Months	0.50%
11	Power Infrastructure, Smart Street Lighting System	22 Months	1%
12	Safety & Security	15 Months	0.50%
13	Landscaping and Urban design	27 Months	1%
12	Handing Over and Commissioning	30 Months	1%

NOTE –

1. Withheld amount shall be released if and when subsequent milestones are achieved Within respective time specified. However, in case milestones are not achieved by the contractor for the work, the amount shown against milestones shall be withheld.
2. The milestone which are 95% complete shall also be considered as completed for the purpose of milestone under clause-5, except for the penultimate milestone and the last/ultimate milestone under each category.

Intending Bidder may submit phasing of activities/milestones based on their resources and methodology at the time of Bidding corresponding to physical milestones/stages indicated in the above table. These shall be formed part of agreement after approval of the accepting authority, otherwise it would be assumed that agency agrees with the above-mentioned milestones. Time allowed for execution of work: 30 Months (2 months for Survey, Investigation, Collect all primary and secondary data, Designing & 26 months for execution of original work & 2 months for trial runs).

Authority to decide:

(i)	Extension of time	Chief Engineer, after approval from the Employer and recommendations by Engineer-in-Charge.
(ii)	Rescheduling of Milestones	Chief Engineer, after approval from the Employer and recommendations by Engineer-in-Charge.
(iii)	Shifting of date of start in case of delay in handing over of site	Chief Engineer, after approval from the Employer and recommendations by Engineer-in-Charge.

Clause 7

Gross work to be done together with net payment /adjustment of advances for material collected, if any, since the last such payment for being eligible to interim payment	Rs. 100 lakhs for all monthly bills, or part thereof, if required (Except Final Bill)

Clause 7A

No Running Account Bill shall be paid for the work till the applicable labour licenses, registration with EPFO, ESIC and BOCW Welfare Board, whatever applicable as submitted by the Bidder to the Engineer-in Charge.	Yes

Clause 8A: Authority to decide compensation on account if contractor fails to submit completion plans:

Chief Engineer, **.....**, ADA…… on recommendation by Engineer-in-Charge.

Clause 10B (ii): Whether Clause 10 B (ii) shall be applicable **Yes**

Note*: Mobilisation advance will not be given for any material for which secured advance is payable, T & P advance will not be given for tools & plants equipment, owned by the agency as intimated in the eligibility documents. Instalments of Mobilization advance except the first instalment shall be released only after receiving the utilization certificate supported by bank statement of the said account showing the disbursement of mobilization advance by the agency as per clause 10B(ii) of GCC.

Clause 10B (iii): Whether Clause 10 B (iii) shall be applicable **Yes**

Clause 10C: NOT APPLICABLE

Clause 10CA: NOT APPLICABLE

Clause 10CC: NOT APPLICABLE

Clause 11 :

Specifications to be followed for execution of work	1. Civil work: CPWD Specifications 2019 Volume- I & II with corrections slips up to the last date of submission of Bid. MORTH Specifications for Road and Bridge work.
	Electrical work (amended up to date):
	1. CPWD General Specification for Electrical Works Part I Internal - 2013. 2. CPWD General Specification for Electrical Works Part II (External – 1994) 3. General Specification for Electrical Works (Part III Lifts & Escalators)- 2003 4. CPWD General Specification for Electrical Works Part IV Substation - 2013. 5. CPWD General Specification for Electrical Works Part V Wet riser & sprinkler system-2006 6. CPWD General Specifications for Electrical Works Part VI Fire Detection and Alarm System – 2018. 7. CPWD General Specification for Electrical Works Part VII DG Sets - 2013.

	8. CPWD General Specification for Electrical Works Part VIII Gas Based Fire Extinguishing System - 2013. 9. General Specification for Heating Ventilation & Air- Conditioning-2017. 10. All above specifications shall be applicable with corrections slips up to the last date of submission/uploading of Bid. 11. CPWD Horticulture Work 2018.

Clause 12.2 & 12.3:

Deviation Limit beyond which clauses 12.2 & 12.3 shall apply	Applicable for only extra items/substitute items not covered under scope of work as required in the opinion of the ADA.

Clause 16:

Competent Authority for deciding reduced rates.	Chief Engineer, after approval from the ADA and recommendations by Engineer-in-Charge.

Clause 19C / Clause 19D / Clause 19G / Clause 19K

Authority to decide penalty for each default:	Chief Engineer, after approval from the ADA and recommendations by Engineer-in-Charge.

Clause 19L:

Contribution of EPF & ESI	The entire responsibility of all EPF & ESI contribution for the workers, employees employed by the contractor lies on the contractor only.

Clause 25:

Conciliator shall be:	
For disputed amount less than 100 cr.	Vice Chairman Agra Development Authority
For disputed amount above 100 cr.	Divisional Commissioner, Agra Division

Place of Arbitration: Agra, Uttar Pradesh, India

Clause 29: Employment of Coal mining or controlled area labour – Deleted

Clause 32: (i) Requirement of Technical Representative(s) and Recovery Rates:

Sl.	Type of Personnel	Nos	Minimum Experience and Qualification	Rate of recovery per persons if provision of clause 32(i) not fulfilled
1.	Project Manager	1	Graduate in civil engineering with 15 years of experience in (EPC projects) including 7 years in large township projects.	Rs. 60,000/- per month
2.	Geotechnical Engineer	1	Graduate in Civil Engineering with 7 years of experience including 5 years in Geotechnical field.	Rs. 40,000/- per month
3.	Civil Engineer	3	Graduate in Civil Engineering with 10 years of experience including 7 years in Design of structures/ roads / PHE structures. (should be comfortable with design software and field experience)	Rs. 40,000/- per month
	Civil Engineer (Highway)	3	Graduate in Civil Engineering with 10 years of experience including 7 years in Construction of roads / Road structures (Bridges, Culverts, VUP, etc.). (should be comfortable with design software and field experience)	Rs. 40,000/- per month
4.	Planning Engineer	1	Graduate in civil engineering with 10 years of experience in large construction projects.	Rs. 30,000/- per month
5.	Public Health Engineer	3	Graduate in Civil Engineering with 10 years of experience in water supply, sewerage works, storm water drainage system.	Rs. 40,000/- per month
6.	Electrical Engineer (Design)	2	Graduate in Electrical Engineer with 10 years of deign experience with power distribution.	Rs. 40,000/- per month
	Electrical Engineer	3	Graduate in Electrical Engineer with 10 years of field experience with distribution.	Rs. 40,000/- per month
7.	Mechanical Engineer	2	Graduate in Mechanical Engineer with 10 years of field experience in Construction projects.	Rs. 30,000/- per month
8.	MEP Engineer	2	Graduate in Civil Engineering with 10 years of experience including 7 years in Design of MEP Works. (should be comfortable with design software and field experience)	Rs. 30,000/- per month
9.	SCADA Expert	1	Graduate in Electrical/ E&C/ Computer/IT Engineer / with 7 years' experience in automation/ SCADA with sound knowledge of related software.	Rs. 30,000/- per month
10.	Safety Manager	1	Graduate or Diploma or recognized course in Safety / Safety Audit (preferably with Health) with 10 years of experience including 5 years in Road Safety audit	Rs. 30,000/- per month

Sl.	Type of Personnel	Nos	Minimum Experience and Qualification	Rate of recovery per persons if provision of clause 32(i) not fulfilled
11.	Quality Manager	2	Graduate in civil engineering with 10 years of experience including 7 years of Quality Control works large construction projects. .	Rs. 30,000/- per month
12.	Architect	1	Degree in Country/ town planning / Architecture with 7 years of field experience of Landscaping / Public Arts	Rs. 25,000/- per month
13.	Billing Officer	2	Graduate in Civil Engineering with 10 years of experience in executing similar works.	Rs. 30,000/- per month
14.	Site Engineer	10	Graduate in Civil Engineering with 10 years of experience in executing similar works.	Rs. 30,000/- per month
15.	Surveyor/ Store In charge	5	Graduation/Diploma/ITI with 5/10 years of experience in executing similar works.	Rs. 25,000/- per month

- Assistant Engineers retired from Government services that are holding Diploma will be treated at par with Graduate Engineer.
- Diploma holder with minimum 10 years relevant experience with a reputed construction company can be treated at par with Graduate Engineers for the purpose of such deployment subject to the condition that such diploma holders should not exceed 50% of requirement of degree engineers.
- No change of key personnel as above shall be allowed during the currency of the project.

Clause 38:

i	Schedule/statement for determining theoretical quantity of cement & bitumen based on Delhi Schedule of Rates	UP PWD SOR/ CPWD/ Delhi Schedule of Rates 2021 with amendments upto the date of submission of Bid.
ii	Variations permissible on theoretical quantities.	
a	Cement	3% Plus/Minus
b	Bitumen for all works.	2.5% Plus only and nil on minus side.
c	Steel reinforcement and structural steel	2% Plus/minus side sections for each diameter, section and category.
d	All other materials	Nil

Clause 5.1.1, 5.1.2,6,7,8,9, 12.3, 13, 19C, 19G, 19H, 22.2, 22.5, 2.9, 22.10(i), 22.10, 22.15, 32(i) with Para, 38:	Engineer-in-Charge to be read as Engineer-in-Charge or the PMC appointed to assist the Engineer-in-Charge

Article 8 of Integrity Pact : **Deleted**

Appendix 'XVI'

SUGGESTIVE LIST OF PLANT AND EQUIPMENT AT SITE

Sl. No.	Equipment	Numbers
1.	Builders hoist	4
2.	Centralized concrete batch mix plant of minimum capacity 30 cum per hour (fully automatic with computerized control)	As per requirement
3.	Excavator cum loader (JCB 3D model or equivalent).	4
4.	Compressor machine minimum 20 CFM with rock Breaker.	4
5.	DG set of minimum capacity 62.5 KVA.	3
6.	Mini batching plant (6 cum./hr.).	2
7.	Transit mixers.	As per requirement
8.	Concrete pump	4
9.	Needle Vibrators.	10
10.	Screed leveler.	5
11.	Plate Vibrator	10
12.	Automatic Ring making machine (Reinforcement)	8
13.	Dumper/Tipper	8
14.	Reinforcement bending machine.	8
15.	Reinforcement cutting machine.	8
16.	Power driven earth rammer (Soil compactor).	4
17.	Total station.	2
18.	Water tanker (Minimum capacity of 5000 liters)	4
19.	Welding machine 400 Ampere	5
20.	Screener for coarse sand and fine sand	5

21.	Centrifugal mono block water pump minimum capacity 2 HP	5
22.	Road roller 8 to 10 tons	1
23.	Vibratory roller	1
24.	Drilling machine	5 Nos.
25.	Shuttering with necessary props	50000 sq.mt.
26.	Double steel scaffolding and staging materials	20000 sq.mt.
27.	Air compressor	3Nos.
28.	Floor grinding/polishing machines	5Nos.
29.	Granite cutting machine	4 Nos.
30.	Ceramic tile cutting machine	10 Nos.
31.	Granite polishing machine	4Nos.
32.	Granite hand polishing machine	4 Nos.
33.	Mobile tower crane	6 Nos.
34.	Desktop Computers (All in one),	6 Nos.
35.	Laptop / IPAD for recording measurements at site.	4 Nos
36.	Inspection Vehicle for coordination with various agencies and delivery of samples for Third Party Labs.	2 Nos.
37.	Mobile Phones (with camera) for communication and instant photos	8 Nos.
38.	Good quality Camera for taking photographs and video recording of major activities for record purpose and for quality assurance.	2 Nos.
39.	Any other machinery required for completion of the work as per decision of Engineer-in-charge.	As per Actual requirement

Note: 1. The above list is only indicative and not exhaustive. The Bidder may be required to deploy more T&P as per requirement of work and as and when directed by Engineer-in-Charge.

1. All the above plants & equipment are to be deployed as and when required or directed by Engineer-in-Charge.

Appendix-XV (FORM 31)

INDENTURE FOR SECURED ADVANCES

(Referred to in paragraphs 10.2.20 and 10.2.22 of CPW A Code)

(For use in cases in which the contract is for finished work and the contractor has entered into an agreement for the execution of a certain specified quantity of work in a given time)

THIS INDENTURE made the…… day of……...20……. BETWEEN…… (hereinafter called the Contractor which expression shall where the context so admits or implies be deemed to include his executors administrators and assigns) of the one part and the AGRA DEVELOPMENT AUTHORITY (hereinafter called the ADA which expression shall where the context so admits or implies be deemed to include his successors in office and assigns) of the other part.

WHEREAS by an agreement dated..... (hereinafter called the said agreement) the Contractor Has agreed AND WHEREAS the Contractor has applied to the President that he may be allowed advances on the security of materials absolutely belonging to him and brought by him to the site of the works the subject of the said agreement for use in the construction of such of the works as he has undertaken to execute at rates fixed for the finished work(inclusive of the cost of materials and labour and other charges) AND WHEREAS the President has agreed to advance to the Contractor the sum of Rupees on the security of materials the quantities and other particulars of which are detailed in Accounts of Secured Advances attached to the Running Account Bill for the said works signed by the Contractor on ..... and the President has reserved to himself the option of making any further advance or advances on the security of other materials brought by the Contractor to the site of the said works. Now THIS INDENTURE WITNESSETH that in pursuance of the said agreement and in consideration of the sum of Rupees .....on or before the execution of these presents paid to the Contractor by the President (the receipt whereof the Contractor does hereby acknowledge) and of such further advances (if any) as may be made to him as aforesaid the Contractor does hereby covenant and agree with the President and declare as follows: -

1) That the said sum of Rupees..... so advanced by the ADAto the Contractor as aforesaid and all or any further sum or sums advanced as aforesaid shall be employed by the Contractor in or towards expediting the execution of the said works and for no other purpose whatsoever.
2) That the materials detailed in the said Account of Secured Advances which have been offered to and accepted by the ADA as security are absolutely the Contractor's own property and free from encumbrances of any kind and the contractor will not make any

application for or receive a further advance on the security of materials which are not absolutely his own property and free from encumbrances of any kind and the Contractor indemnifies the President against all claims to any materials in respect of which an advance has been made to him as aforesaid.

3) That the materials detailed in the said Account of Secured Advances and all other materials on the security of which any further advance or advances may hereafter be made as aforesaid (hereinafter called the said materials) shall be used by the Contractor solely in the execution of the said works in accordance with the directions of the Engineer-in-charge and in the term of the said agreement.

4) That the Contractor shall make at his own cost all necessary and adequate arrangements for the proper watch, safe custody and protection against all risks of the said materials and that until used in construction as aforesaid the said materials shall remain at the site of the said works in the Contractor's custody and on his own responsibility and shall at all times be open to inspection by the Engineer-in-charge or any officer authorised by him. In the event of the said materials or any part thereof being stolen, destroyed or damaged or becoming deteriorated in a greater degree than is due to reasonable use and wear thereof the Contractor will forth with replace the same with other materials of like quality or repair and make good the same as required by the Engineer-in-charge.

5) That the said materials shall not on any account be removed from the site of the said works except with the written permission of the Engineer-in-charge or an officer authorised by him on that behalf.

6) That the advances shall be repayable in full when or before the Contractor receives payment from the ADA of the price payable to him for the said works under the terms and provisions of the said agreement. Provided that if any intermediate payments are made to the Contractor on account of work done than on the occasion of each such payment the President will be at liberty to make a recovery from the Contractor's bill for such payment by deducting there from the value of the said materials then actually used in the construction and in respect of which recovery has not been made previously, the value for this purpose being determined in respect of each description of materials at the rates at which the amounts of the advances made under these presents were calculated.

7) That if the Contractor shall at any time make any default in the performance or observance in any respect of any of the terms and provisions of the said agreement or of these presents the total amount of the advance or advances that may still be owing

to the President shall immediately on the happening of such default be repayable by the Contractor to the President together with interest thereon at twelve per cent per annum from the date or respective dates of such advance or advances to the date of repayment and with all costs charges, damages and expenses incurred by the President in or for the recovery thereof or the enforcement of this security or otherwise by reason of the default of the Contractor and the Contractor hereby covenants and agrees with the President to repay and pay the same respectively to him accordingly.

8) That the Contractor hereby charges all the said materials with the repayment to the President of the said sum of Rupees and any further sum or sums advanced as aforesaid and all costs charges, damages and expenses payable under these presents PROVIDED ALWAYS and it is hereby agreed and declared that notwithstanding anything in the said agreement and without prejudice to the powers contained therein if and whenever the covenant for payment and repayment herein before contained shall become enforceable and the money owing shall not be paid in accordance therewith the President may at any time thereafter adopt all or any of the following courses as he may deem best :-

(a) Sieze and utilize the said materials or any part thereof in the completion of the said works on behalf of the Contractor in accordance with the provisions in that behalf contained in the said agreement debiting the Contractor with the actual cost of effecting such completion and the amount due in respect of advances under these presents and crediting the Contractor with the value of work done as if he had carried it out in accordance with the said agreement and at the rates thereby provided. If the balance is against the Contractor, he is to pay same to the President on demand.

(b) Remove and sell by public auction the seized materials or any part thereof and out of the moneys arising from the sale retain all the sums aforesaid repayable or payable to the President under these presents and pay over the surplus (if any) to the Contractor.

(c) Deduct all or any part of the moneys owing out of the security deposit or any sum due to the Contractor under the said agreement.

9) That except in the event of such default on the part of the Contractor as aforesaid interest on the said advance shall not be payable.

10) That in the event of any conflict between the provisions of these presents and the said agreement the provisions of these presents shall prevail and in the event of any dispute or difference arising over the construction or effect of these presents the settlement of

which has not been herein before expressly provided for the same shall be finally resolved as per provisions of clause 25 of the contract.

In witness whereof the said ……and ..... by the order and under the direction of The ADA have hereunto set their respective hands the day and year first above written.

Signed, sealed and delivered by…..... the said contractor in the presence of
.....
.....

Signature ……
Witness Name ……
Address ……
Signed by……..
by the order and direction of the ADA in the presence of

Signature ……
Witness Name ……
Address ……

Appendix XVI

(Refer Clause 5)

FORM OF APPLICATION BY THE CONTRACTOR FOR SEEKING RESCHEDULING OFMILESTONE/EXTENSION OF TIME

1. Name of contractor
2. Name of work as given in the agreement
3. Agreement no
4. Estimated cost put to tender
5. Date of commencement of work as per agreement
6. Period allowed for completion of work as per agreement
7. Date of completion stipulated in agreement
8. Period for which extension of time has been given by authority in Schedule 'F' previously

letter no. and date	Extension granted	
	Months	Days
a) 1st extension		
b) 2nd extension		
c) 3rd extension		
d) 4th extension		
Total extension previously given		

9. Reasons for which extension have been previously given (copies of the previous applications should be attached)
10. Period for which extension applied for
11. Hindrances on account of which extension is applied for with dates on which hindrances occurred and the period for which these are likely to last (for causes under clause 5.2/ and 5.3).

Submitted to the Authority indicated in Schedule F With copy to the Engineer-in-charge and Sub Divisional Officer

Signature of Contractor
Date

Appendix XVII

Reference of disputes and amount claimed for each dispute to the Conciliator.

[Refer Clause 25]

To

The DC / VC
..... (Region) ……
.....

Subject: Reference of disputes and amount claimed for each dispute to the Conciliator for settlement of disputes relating to agreement number: ……..

Dear Sir,
In terms of clause 25 of the aforesaid agreement, particulars of which are given below, I/We hereby refer my / our disputes and amount claimed for each dispute to you for settlement in your capacity as Conciliator.

1. Name of applicant:
2. Whether applicant is Individual/Proprietorship Firm/Partnership Firm/Company:
3. Full address of the applicant:
4. Name of the work and contract number for which arbitration is sought:
5. Name of the Division which entered into contract:
6. Contract amount:
7. Date of contract:
8. Stipulated date of start of work:
9. Stipulated date of completion of work:
10. Actual date of completion of work (if completed):
11. Total number of claims made:
12. Total amount claimed:
13. Date of intimation of final bill (if work is completed):
14. Date of payment of final bill (if work is completed):
15. Amount of final bill (if work is completed):
16. Date of claim made to Engineer-in-Charge:
17. Date of receipt of decision from Engineer-in-Charge:

I/We certify that the information given above is true to the best of my/our knowledge. I/We enclose the statement of claims with amount of each claim.

Yours faithfully,
Signature of the applicant
(Only the person/authority who signed the contract should sign here)

Copy to:

The Chief Engineer ADA …….

The Executive Engineer ADA

VOLUME -3

SPECIFIC CONDITIONS OF CONTRACT

SPECIFIC CONDITIONS OF CONTRACT

The following Specific Conditions of Contract shall be read in conjunction with General Conditions of Contract.

1. Scope of Work.

1.1. General: -

The scope of work includes Survey, Investigation and Collect all primary and secondary data to undertake Detailed Engineering, Procurement, Construction, Testing and Commissioning of All Components of Atal Puram Township in Agra which include, Road, Minor Bridge, Culvert, Road Side Plantation & Arboriculture, Storm Water Drainage, Potable Water Supply & Recycle Water System, Waste Water System, Power Infrastructure, Smart Street Lighting System, Utility Ducts, Solid Waste Management, Site Grading & Levelling, Rain Water Harvesting, Security & Surveillance, landscape for parks and boundary wall in Atal Puram Township at Agra in the State of Uttar Pradesh on Design, Engineering, Procurement and Construction (EPC) basis, followed by 3 years of Defect Liability, 5 years of operation and maintenance for roads, footpath, tracks, arboriculture, street lights, ICT, Parks, plazas and gardens, networks of water, sewer, recycled water, storm drain and rain water harvesting and 10 years of operation and maintenance of WTP and STP after commissioning. The power system network and substation operation and maintenance are excluded. The total time for completion of the above mention scope shall be 30 months from the project start date.

- Land: - A contiguous land parcel of approximate 140.5 Ha has been acquired by ADA for the project in the Kakua Bhandai village area.
- Access:- The approach road to the site is from the Agra Gwalior Road located on the eastern side which provides optimal accessibility for through movement of traffic from Agra. The Site has direct access to the Agra bypass road from the southern side. Additionally, there is an egress point on to Agra Bypass Road which facilitates the movement towards Agra city through the proposed LVUP.
- The contractor shall refer the Front-End Engineering Design (FEED) for undertaking all detailed engineering works.
- Good For Construction (GFC) Drawings: - The EPC contractor shall prepare their designs & good for construction drawings based on the FEED provided in the tender document.

  The FEED provided to the contractor is to ensure a clear understanding of the design standards and other associated parameters that the Authority wishes to achieve for different components of the project. Whilst the Authority is keen to see innovation, but the required standards of design must be achieved. Contractors shall outline the means by which they will ensure design quality and the design objectives, which have influenced their scheme. This shall include details of how the Authority's objectives are to be achieved.

  The Contractor shall undertake the following works in conformity with the Front-End Engineering Design and other standards set forth in the contract document subject to applicable statutory bye-laws/ regulations.

  1. Planning, designing and laying Flexible Pavement Roads
  2. Planning, designing and construction of Minor Bridges, LVUP

3. Planning, designing and construction of footpath and tracks
4. Planning, designing, supplying and laying of pumping main pipeline for potable water supply
5. Planning, designing, supplying and laying of Pipe for sewerage
6. Planning, designing, construction & commissioning of STP
7. Planning, designing, construction & commissioning of WTP
8. Planning, designing, supply & installation / laying of underground MV & LV cables (including Testing & Commissioning)
9. Planning, designing, installation, testing & commissioning of Indoor substation, Distribution Transformer substation, street lighting
10. Planning, designing, supplying & Laying of DWC and HDPE Cable Duct for Power/ ICT
11. Planning, designing and construction of RCC Utility Duct for
12. Planning, designing and installing SCADA system
    - xii. Control Valves Bulk & Water flow metres
    - xiii. Level /Pressure Transmitters
    - xiv. Digital Panel Meter
    - xv. Server with Interface switches
    - xvi. Storage & Security device
    - xvii. Switches & Routers
    - xviii. Control & Instrumentation
    - xix. RTUs
    - xx. PLC System with SCADA Software.
    - xxi. Web application
    - xxii. Smart Controller for Individual light fixture control & monitoring System.
13. Planning, designing and development of parks, main gate (2nos), arboriculture and external boundary wall (1192 running meter) along with supply and installation of items mentioned in the indicative BoQ.

- Conduct all necessary surveys and site investigations and submit the report to the Engineer-in-charge.
- Planning and designing of all infrastructure components like water supply, system for recycling of waste water, installation of borewells, sewerage, drainage system, rainwater harvesting (including pits), roads, footpath, HT/LT Electrical works, STP/WTP and all other components mentioned in the scope as per bye-laws and norms of the local bodies including making connections with the peripheral services after getting the services design approved from the local bodies/statutory bodies. ADA's role shall be limited only to sign the application / drawings / documents for submission to the local bodies in the capacity of the owner for approval. In case of water supply, sewerage and drainage, the cost of getting the scheme approved from service provider is included in the scope of work/bid. The cost of connection of water supply lines/sewer lines from peripheral connection point/outfall sewer shall also be borne by the Contractor apart from internal and external water supply/sewerage lines to be laid to make the system of water supply and sewerage functional/complete. However, statutory charges, if levied by the service provider towards cost of laying of their peripheral services shall only be reimbursed by ADA on production of relevant documents by the Contractor to the satisfaction of Engineer-in-charge.

- The necessary arrangements are to be provided for supply of water through dual pipe system i.e. recycled water duly treated pumped through underground tanks to overhead tanks and piped to flushing in each location/utility as directed by the Engineer- in-charge.
- Planning and designing of bore wells, underground tanks, pump houses for water supply, including installing of pumps, standby pumps, rainwater harvesting pits, as per approved drawings/ specifications or as directed by Engineer-in-charge on recommendation of PMC.
- Planning and designing of 3 Electrical substations (ESS). ESS-1 and ESS-3 each with 1X10 MVA transformer and ESS-2 with 2X10 MVA transformer. (EXCLUDED from this contract: one transformer each at ESS-1 and ESS-3, one 33KV incoming line for ESS-1 and ESS-3, 33KV and 11KV interconnections between ESS-1 and ESS-3)
- Preparation & submission of Detailed design & drawings for Landscaping & Horticulture work, Main Entrance Gates, Drains, Culverts, Compound walls, External lighting arrangements, Under Ground Tanks, Signage's, etcetera complete.
- Preparation of landscaping plan including planters and other details etcetera for the horticulture works and execution of same including providing unfiltered/recycled water supply lines, construction of pump houses and installation of pumps therein etcetera complete will be responsibility of Contractor. Development of parks, if required, construction of its boundary wall, providing MS railings (including painting), wicket gates, water hydrants, the grassing, creepers and planting trees etcetera shall be completed as per the specification and drawing approved by the Engineer-in-charge.
- Planning and designing of the telecommunication and ICT network, safety and security system and connection with the Agra Smart City command and control centre.
- All infrastructure shall be SCADA enabled and fulfil the requirement of the Namami Gange Programme.
- Vetting of design & drawings: - The contractor shall ensure vetting of designs and drawings from IIT/NITs, after approval of the design, drawings by Engineer-in-Charge.
- Setting up a Testing Laboratory at site equipped with the necessary apparatus needed for day-to-day testing of construction materials during construction period as directed by the Engineer-in-charge.
- Obtaining approval of Engineer-in-charge for all the Detailed/Preliminary Architectural, Structural & Services drawings & designs.
- Prepare and submit three-dimensional model(s) of suitable scale as and when required by the Engineer-in-charge at no extra cost.

1.2. Deleted

1.3. General Standards

The facilities shall be completed to high standards of construction and specification. The facilities shall be technically sound and functionally suitable in line with the provisions given in the FEED and to meet the Authority 's objectives:

- Statutory, Industry and Local Standards:

  The following standards shall apply unless otherwise stated:

  i. Water Supply, Drainage & Sewerage as per CPHEEO Manuals.

ii. Standards set out in National Building Code of India 2016.
iii. Standards set out in latest IRC Codes & MoRTH Manual.
iv. Standards set out in I.S. Codes.
v. Relevant Development Control Rules/Planning Act/Development Act/ Municipal Act/ any other applicable statutes and local bye-laws
vi. National Electrical Code,1985
vii. Indian Electricity Act 2003
viii. Requirements of the local Water Supply Company, Electricity Supply Company/Department.
ix. Requirements of the Pollution Control Board, Fire Department, Aviation authorities and other statutory authorities, as applicable.
x. Requirements of UP building bye laws as applicable.
xi. Requirements of the Agra Development Authority
xii. Requirements of any other relevant codes and standards.

1.4. Statutory Approvals

The Contractor shall obtain all required statutory approvals including pre- construction from Municipal and other local bodies, Water supply agencies concerned, Electric Supply and Inspectorate Agencies concerned, Police and Security Agencies, Environmental Agencies, Chief Controller of Explosives, Fire Department, Civil Aviation Department, in accordance to prevailing rules, Building Bye-Laws, tree replantation etcetera, as the case may be with related to/ required for Construction/ Completion. If required then the contractor shall also assist and liaison for obtaining EIA approval. These approvals shall include: -

1. Obtaining consent to establish
2. Obtaining consent to operate
3. Obtaining approval of all the competent authorities and other statutory bodies like Air Force, civil aviation, railways and local development bodies etcetera as applicable necessary according to the local Acts, Laws, Regulations, etcetera and make any changes desired by such authorities at no extra cost.
4. Obtaining NOCs (No Objection Certificates) from Fire Department, Storm water drainage & sewerage department, Municipal Corporation / Local Bodies, Civil Aviation, any other statutory body on completion and / or occupancy certificates etcetera
5. Obtaining approval of electrical drawings from Central/State Electrical Inspectorate, as applicable.
6. Any other approval required from the appropriate Statutory Authorities/Local Bodies.
7. The original documents of approval/certificates etcetera shall be submitted to the Authority.

7.1.1. Deleted

7.1.2. Deleted

7.2. Shop drawings and Design

The Contractor shall furnish for approval of the Engineer-in-charge requisite sets of detailed Shop drawings as stipulated/requirements of the contract. All other services, equipment and materials required to complete the work as per specifications well in advance. These drawings/documents shall contain details of construction, size, arrangement, operating clearances, performance characteristics, and capacity of all

items of equipment, as also the details of all related items of work of other trades. The work will be executed by the contractor based on the approved shop drawings from the Engineer-in-charge and accordingly contractor will be responsible for obtaining all required final NOC / clearance from concerned authorities. All shop drawings are to be made in accordance with latest fire safety norms and IS codes.

- All drawings necessary for assembly, erection, maintenance, repair and operation of the equipment shall be furnished and different parts shall be suitably numbered for identification and ordering of spare parts.
- For any amendments proposed by Engineer-in-charge/ concerned authority in the above drawings, the Contractor shall supply fresh sets of drawings with the amendments duly incorporated, along with the drawings on which corrections were indicated.
- No material or equipment may be brought at Site until the Contractor has the approved Shop drawings for that particular material or equipment.
- After approval of the drawings by the Engineer-in-charge, the Contractor shall further furnish six sets of Shop drawings for the exclusive use of and retention by the Engineer-in-charge.
- Approval of drawings by the Engineer-in-charge shall not relieve the Contractor of any obligation to meet all the requirements of the Contract or of the correctness of his drawings. The Engineer-in-charge's approval of specific item shall not mean the approval of the assembly of which it is a component. The Contractor shall be responsible for and is to bear the cost for all alternations of the works due to discrepancies or omission in the drawings or other particulars supplied by him, whether such drawings have been approved by the Engineer- in-charge or not.
- Where the work of the Contractor has to be installed in close proximity to, or will interfere with the work of other trades, the Contractor shall assist in working out the space conditions to make a satisfactory adjustment. If so directed by the Engineer-in- charge, the Contractor shall prepare composite working drawings and sections to a suitable scale not less than 1:50, clearly showing how his work is to be installed in relation to the work of other trades. If the Contractor installs his work before coordinating with other trades, and it is cause for any interference with the work of other trades, he shall make all the necessary changes without extra cost.
- All shop drawings and detail drawings will be made as per requirements of local authorities and tender drawings incorporating all latest regulations and requirements. No separate drawings will be, issued for making shop drawings.
- Unless otherwise prescribed, the contractor shall submit two sets of shop drawings/technical submittals/data sheets/any other details required for approval of the Engineer-In-Charge. The contractor, after incorporating modifications / deletions/observations/ amendments suggested by the Engineer-In-Charge, shall submit six corrected sets of such documents for final approval and issuance.

7.3. Approved Makes:

- Specification/brands names of materials/equipment to be used or supplied as per the scope of work are listed separately. For all other materials /equipment the same shall conform to the relevant Indian Standards or in

their absence conform to any International Standards and as approved by the Engineer-in- Charge.

- All material and equipment shall conform to the relevant Indian Standards/ IEC codes and bear IS marking where ever applicable. Where interfacing is involved, such equipment's shall be mutually compatible in all respects.
- Where an item of equipment, other than as specified or detailed on the drawings, is approved by Engineer-in-charge, requires any re-design of the structure, partitions, foundation, piping, etcetera or any other part of the mechanical, electrical or architectural layout, all such re-design, and all new drawings and detailing required therefore, shall be prepared by the Contractor at his own expense and approval obtained from the Engineer-in-charge.
- All similar equipment, materials, removable parts of similar equipment etcetera shall be inter-changeable with one another.
- The contractor shall submit to the Engineer-in-charge for approval details of all proposed materials, equipment, accessories, equipment characteristics and capacity details of all equipment, accessories and devices etcetera as per the specifications and obtain approval of the Committee.

7.4. Project/ Work Execution/Construction:

7.4.1. Handing Over and Clearing of Site:

a) The site of work is available. However, in case of any underground services, part of foundations of such structures are encountered during excavation or otherwise during the execution of the project, the contractor shall clear the same and maintain the operational services, without any extra cost.

b) The contractor should note that there may be some existing structures and/or operational building in the campus. The contractor shall ensure that the services and approach to these Buildings & all the infrastructure is not hampered, without any extra cost. The work shall be carried out in such a way that the traffic, people movement, if any, is kept operative and nothing extra shall be payable to the contractor due to restrictive working. Dedicated access corridors and roadways have been planned for allowing movement of the inhabitants to enter and exit the Buildings & all the Infrastructure. The contractor is required to arrange the resources to complete the entire project within the total stipulated time. Traffic diversion, if required, is to be done and maintained as per requirement of the traffic police and / or as per specifications, by the contractor at his own cost and the contractor shall not be entitled for any extra payment, whatsoever, in this regard.

c) There may be some services crossing the construction area of the proposed new block. The scope of work includes dismantling of services falling in the construction area and supporting/shifting & making functional existing services/sewerage and water supply lines etcetera. The contractor shall properly take care & safeguard all the existing services in the area affected by the construction of the complex.

d) Necessary arrangement including its maintenance is to be made by the contractor for temporary diversion of flow of existing services, drain(s) and road(s) etcetera, as the case may be. The existing services, drain(s) and road(s) etcetera, would be demolished, wherever required with the progress of work under the scope of proposed project. The existing services, drain(s) and road(s) etcetera, which are not in the alignment of the said project but are affected and/or need to demolished during execution for smooth progress of the project, shall be rehabilitated to its original status and condition (including black topping) by the contractor at his own cost. The cost to be incurred by contractor in this regard shall be deemed to be included in the quoted rates and contractor shall not be entitled for any extra payment whatsoever in this regard.

e) The information about the public utilities (whether over ground or underground) like electrical/telephone/water supply/sewerage lines, OFC Cables, open drain etcetera is the responsibility of contractor to ascertain the utilities that are to be affected by the works through the site investigation.

f) The contractor shall be responsible to obtain necessary approval from the respective authorities for shifting/re-alignment of existing public utilities. Engineer-in- charge/ADA shall only assist the contractor for liaising in obtaining the approval from the concerned authorities.

g) Any services affected by the works must be temporarily supported by the contractor who must also take all measures reasonably required by the various bodies to protect their service and property during the progress of works. It shall be deemed to be the part of the contract and no extra payment shall be made to the contractor for the same.

h) If the work is carried out in more than one shift or during night, no claim on this account shall be entertained. The Contractor must take permission from the different statutory/ Govt. authorities etcetera if required for work during night hours. No claim / hindrance on this account shall be considered if work is not allowed during night time.

i) The Contractor shall be responsible for the watch and ward / guard of the building's safety, fittings and fixtures provided by him against pilferage and breakage during the period of installations and thereafter till the building is physically handed over to the department. No extra payment shall be made on this account.

j) Any utility covered under the sanctioned cost of the project shall be taken care by the Client Department / U. The above-mentioned clause (a) to (i) mentioned are over & above to the sanctioned cost of utility shifting. In case of any unforeseen circumstances if the contractor claims regarding above, it shall be considered & finalized by the ADA with due diligence.

7.4.2. Deleted: -

7.5. The scope of work is only indicative and not exhaustive. In additions to the above the Contractor shall be responsible for executing all the works/items required for completing all the building and other services in all respect to make the premises in UP habitable and ready for occupation as per direction of Engineer-in-charge.

7.6. Approval of Engineer-in-Charge at any stage of planning, design and construction of the project will not absolve the ingrained responsibility of the Contractor to execute the construction flawless and at par excellence and, if any aspect contrary to this owning up of responsibility is glaring, the Contractor will be held liable for such gross deviation.

7.7. The work shall be executed in accordance with the drawings/design approved by Engineer -in-Charge () which are prepared by the Contractor in conformity with the scope of the project & specifications, standards and statutory requirements. The Contractor shall carry out and complete the said work in every respect in accordance with this Contract and with the directions of and to the satisfaction of the Engineer-in-charge.

7.8. The Engineer-in-charge may in his absolute discretion and from time to time review the drawings/ designs & approve drawings/designs and/or written instructions, details, directions and explanations, in regard to:

a) The variation or modification of the drawings, design, quality or requirement of works or the addition or omissions or substitution of any item.
b) Any discrepancy in the drawings or between the requirement of work sand/or drawings and/or specifications.
c) The removal from the site of any material brought thereon by the contractor and the substitution of any other material thereof.
d) The removal and/or re-execution of any works executed by the contractor.
e) The removal of any persons employed by the contractor on the site after obtaining approval from Engineer-in-Charge.
f) The opening up for inspection of any work covered up.
g) The amending and making good of any defects noticed during or after execution of the work.

7.9. The contractor shall be solely responsible for the means, methods, techniques sequence and procedure of construction. The Contractor shall be responsible to see the completed work complies accurately with the Contract requirements. The Contractor shall provide all necessary superintendence during the execution of the Works as per contractual provisions.

a) The Contractor shall be responsible for the correct positioning of all parts of the Works, and shall rectify any error in the positions, levels, dimensions or alignment of the Works. Contractor agrees and undertakes that the construction shall be completed within the Project Completion Schedule and any extension of time granted according to the provisions of this Agreement.
b) The Contractor shall, subject to the provisions of the Contract, and with due care and diligence, execute and complete the Works & remedy any defects

therein in accordance with the Contract. The Contractor shall provide all labour, including the supervision thereof, materials, Constructional Plant and Machineries and all other things, whether of a temporary or permanent nature, required in and for such execution, completion, maintenance and remedying of any defects, so far as the necessity for providing the same is specified in or is reasonably to be inferred from the Contract.

c) The Contractor must bear in mind that all the work shall be carried out strictly in accordance with the specifications as given in these documents and also in compliance of the requirements of the local public authorities and to the requirements/ satisfaction/ direction of the Engineer-in-charge and no deviation of any account will be permitted.

d) The Contractor shall have to use materials from the makes / manufacturers specified in the list of materials of approved brand and/or manufacture contained in the contract documents and as approved by the Engineer - in-Charge. Wherever different pattern/ Design/ Quality of materials with same specification/ make as specified in the contract, is available in the market, Engineer-in-Charge with the help of representative of the Client Department will approve the pattern/ Design/Quality of the material/ item which shall be final and binding on the contractor. The contractor shall supply samples of all the materials / fittings / fixtures proposed to be used in the work and obtain approval of the Engineer - in- Charge. These samples shall be retained at site till completion of the work. If subsequently it is found that approved material upon testing does not meet the requirement as specified in the contract the contractor shall get approval of alternate material.

e) The work shall be carried out in conformity with the relevant drawings and the requirement of architectural, electrical, structural, and other specialized service drawings.

f) The Contractor shall make provision of hangers, sleeves, structural openings and other requirements during construction to avoid holding up progress of the construction schedule. The Contractor should ensure that the structure is designed for additional loads or cut outs. Subsequent Cutting of holes in the RCC structural members /slab shall not be allowed.

g) The contract items comprise of furnishing of all materials, equipment, labour& transportation etcetera necessary to render the installation / item fully operational as per the intent of specifications and drawings, including any necessary adjustment or corrections. Further the installation / item shall be in conformity with local laws and manufacturer's instructions applicable.

7.10. Operation & Maintenance:

Upon completion of supply, installation, testing & commissioning of all works, the Contractor shall furnish the necessary skilled/unskilled/semi-skilled personnel for operating the entire installations for a period of ninety (90) working days i.e. till the handing over after issuance of completion.

7.11. Training & orientation of ADA's Personnel: -

The contractor shall provide necessary training and orientation to the technical personnel deployed by ADA. The contractor shall arrange visits of the technical personnel / technicians of respective OEM /vendors involved in installation of various electrical and mechanical works under this contract. The duration of training period shall be 15 days or as directed by Chief Engineer, ADA, Agra with respect to various installed system like STP, WTP, LV Works, pumping system, SCADA and any other system installed under this contract.

SPECIFIC CONDITIONS OF CONTRACT-GENERAL

8. General:

1.1. Force Majeure:

Any failure or delay in the performance by either party hereto of its obligations under his Contract shall not constitute a breach thereof or give rise to any claims for damages if, and to the extent that it is caused by occurrences beyond the control of the party affected, namely, acts of God, floods, explosions, wars, riots, storms, earthquakes, insurrection, epidemic or other natural disasters. The party so affected shall continue to take all actions reasonably within its power to comply as far as possible with its obligations under this Contract. The affected party shall promptly notify the other party after the occurrence of the relevant event and shall use every reasonable effort to minimize the effects of such event and act in all good faith with due care and diligence.

1.2. Compliance with Statutes, Regulations, etcetera:

The contractor shall conform to the provisions of all statutes, ordinance, laws, acts of the legislature relating to the works, and to the regulations and by-laws of any local or other duly constituted authority and of any water, electric supply and other companies and/or authorities with whose systems the structure is proposed to be connected. The Contractor shall keep the ADA indemnified against all fines or penalties or liability of every kind for breach of any such statutory ordinance, law act of the legislation, regulations, and byelaws as aforesaid.

The contractor shall before make any variations from the drawings or specifications that may be necessitated by such regulations, give to the Engineer- in-charge written notice, specifying the variation proposed to be made and the reasons for making it and apply for instructions thereon. The contractor will not execute any work without written permission from the Engineer-in-charge.

The contractor shall bring to the attention of the Engineer-in-charge any specific requirement of the local authorities or any notice required for execution by virtue of such acts, regulations or bye-laws of such authority, or public office. All fees that may be chargeable in respect of these works shall be reimbursed by the ADA on production of authorized receipts.

1.3. Boreholes & Exploratory Excavation

If, at any time during the execution of the Works, the Engineer-in-charge shall require the Contractor to make boreholes or to carry out exploratory excavation, such requirement shall be ordered in writing and shall be deemed to be an additional ordered under the provisions unless a provisional sum in respect of such anticipated work shall have been included in the schedule of items.

1.4. Fossils, Etcetera

All fossils, coins, articles of value or antiquity and structures and other remains or things of geological or archaeological interest discovered on the site of the works shall be the property of the ADA.

1.5. Absence of Specifications

If the user requirements, specifications etcetera, do not contain particulars of materials and works which are necessary for its proper execution, all such materials shall be supplied and item shall be executed by the Contractor without extra charge and if the Contractor requires any information, he shall request in writing well in advance to commencement of the particular work to the Engineer-in-charge who will clarify the issue within a reasonable time.

1.6. Works by Other Agencies

The Engineer-in-charge reserves the right to use premises and any portion of the site for the execution of any work not included in this contract which it may desire to have carried out by other persons simultaneously, and the contractor shall allow the reasonable facilities for the execution of such work, but shall not be required to provide any plant or material for the execution of such work except by special arrangement with the other agency. Such work shall be carried out in a manner so as not to impede the progress of the works included in the contract, the contractor shall not be responsible for any damage or delay which may happen to or occasioned by such work.

The contractor shall co-operate with other agencies working in the same project, and coordinate his plans and time schedules so that there will be no interference. The Contractor shall forward to the Engineer-in-charge all correspondences and drawings exchanged. Failure to check plans for conditions will render the Contractor responsible for bearing the cost of any subsequent changes found necessary or damages done.

The Engineer-in-charge shall not entertain any claim on account of the Contractor affording necessary facilities to execute the work simultaneously with other agencies executing the works for the same project.

1.7. Quality Assurance

1.7.1. Quality Assurance Programme

The Contractor shall ensure that the Construction, Plants, Goods & Materials and workmanship are in accordance with the requirements specified in this Agreement, Specifications and Standards and Good Industry Practice.

Sources of Materials being supplied shall be intimated to the Engineer and are subject to his approval. Materials that are not specified in the Contract document shall conform to the relevant Indian Standards or in their absence conform to any International Standard approved by the Engineer.

To ensure that the equipment and services under the scope of this Contract whether manufactured or performed within the Contractor’s works or at his sub-contractor’s premises or at the ADA’s site or at any other place of work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points necessary. Such programme shall be outlined by the Contractor and shall be finally accepted by the Engineer-in- Charge after recommendations and discussions with ADA, just after the award of Contract. A quality assurance programme of the contractor shall generally cover the following:

- His organization structure for the management and implementation of the proposed quality assurance programme.
- Documentation control system.

- Qualification data for Bidder's key personnel.
- The procedure for purchases of materials, parts components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etcetera.
- System for shop manufacturing and site erection controls including process controls and fabrication and assembly control.
- Control of non-conforming items and system for corrective actions.
- Inspection and test procedure both for manufacture and field activities.
- Control of calibration and testing of measuring instruments and field activities.
- System for indication and appraisal of inspection status.
- System for quality audits.
- System for authorizing release of manufactured product to the ADA.
- System for maintenance of records.
- System for handling storage and delivery.
- A quality plan-detailing out the specific quality control measures and procedures adopted for controlling the quality characteristics relevant to each item of equipment furnished and/or services rendered.

The ADA or their duly authorized representative reserves the right to carry out quality audit and quality surveillance of the system and procedure of the Contractor/his vendor's quality management and control activities.

1.8. Tree cutting / Felling / Relocation

The project site falls within Taj Trapezium Zone (TTZ) and is governed by the TTZ policy, which specifies that any cutting/ felling/relocation of tree will require special permission from The Hon'ble Supreme Court of India. The Authority has decided that Atal Puram township project will be undertaken without cutting/ felling/relocation of a single tree within the site.

The contractor shall ensure strict adherence to the above directions and take all necessary actions to protect the trees within the site during construction. Any violation or unauthorised cutting/ felling/relocation of tree/trees will lead to heavy penalty and legal action.

Definition of 'Tree' as per the UP Tree Protection Act 1976

"tree" means any woody plant whose branches spring from and are supported upon a trunk or body and whose trunk or body is not less than five centimetre in diameter at a height of thirty centimetres from the ground level and is not less than one metre in height from the ground level.

1.9. Additional Conditions of National Green Tribunal

i. The Contractor shall not store/ dump construction material or debris on the metalled road.
ii. The Contractor shall get prior approval from Engineer-in-Charge for the area where the construction material or debris can be stored beyond the metalled road.
iii. This area shall not cause any obstruction to the free flow of traffic /inconvenience to the pedestrians. It should be ensured by the Contractor that no accidents occur on account of such permissible storage.

iv. The Contractor shall take appropriate protection measures like raising wind breakers of appropriate height on all sides of the plot/area using CGI sheets or plastic and/or other similar material to ensure that no construction material dust fly outside the plot area.

v. The Contractor shall ensure that all the trucks or vehicles of any kind which are used for construction purposes/or are carrying construction material like material like cement, sand and other allied material are fully covered. The Contractor shall take every necessary precaution that the vehicles are properly cleaned and dust free to ensure that en-route their destination, the dust, sand or any other particles are not released in air/contaminate air.

vi. The Contractor shall provide mask to every worker working on the construction site and involving in loading, unloading and carriage of construction material and construction debris to prevent inhalation of dust particles.

vii. The Contractor shall ensure that C&D waste site only and due record shall be maintained by the Contractor.

viii. The Contractor shall compulsorily use wet jet in grinding and stone cutting.

ix. The Contractor shall comply with all the preventive and protective environmental steps as stated in the MoEF guidelines, 2006.

x. The Contractor shall carry out on- Road-Inspection for black smoke generating machinery. The Contractor shall use cleaner fuel.

xi. The Contractor shall use vehicles having pollution under control certificate. The emissions can be reduced by a large extent by reducing the speed of a vehicle to 20 Km.ph. Speed bumps shall be used to ensure speed reduction. In case where speed reduction cannot effectively reduce fugitive dust, the Contractor shall divert traffic to nearby paved areas.

xii. The Contractor shall ensure that the construction material is covered by tarpaulin.

xiii. The Contractor shall take all other precaution to ensure that no dust particles are permitted to pollute air quality as a result of such storage.

xiv. The paving of the path for plying of vehicles carrying construction material is more permanent solution to dust control and suitable for longer duration projects.

xv. It is mandatory to use of wet jet in grinding and stonecutting.

xvi. Wind breaking wall around construction site.

xvii. The Contractor shall take appropriate protection measures like raising wind breakers of appropriate height on all sides of the plot/area using CGI sheets or plastic and / or other similar material to ensure that no construction material dust fly outside the plot area.

xviii. It shall be ensured that C& D waste is transported from the site in after keeping due record on behalf of Engineer-in-charge. The C& D waste shall only be dumped at sites declared as Dumping ground and having arrangements for recycling of C& D waste by local administration.

xix. If any violation of orders of MoEF including guidelines of State Government, SPCB or any officer of any department shall lead to stoppage of work for which Contractor shall be responsible and no hindrance shall be accounted in this regard.

1.9.1. Intellectual Property Rights and Royalties

i. Insofar as the patent, copyright or other intellectual property rights in any Plant, Design Data, plans, calculations, drawings, documents, Materials, know-how and information relating to the Works shall be vested in the Contractor, the Contractor shall grant to the Engineer-in-Charge or their successors and assignees a royalty free, non-exclusive and irrevocable

license (carrying the right to grant sublicenses) to use and reproduce any of the works, designs or inventions incorporated and referred to in such Plant, documents or Materials and any such know-how and information for all purposes relating to the Works (including without limitation the design, manufacture, installation, reconstruction, Testing, commissioning, completion, reinstatement, extension, repair and operation of the Works).

ii. If any patent, registered design or software is developed by the Contractor specifically for the Works, the title thereto shall vest in the ADA and the Contractor shall grant to the ADA a non-exclusive irrevocable and royalty-free license (carrying the right to grant sub-license) to use, repair, copy, modify, enhance, adapt and translate in any form such Software for his own use.

iii. If the Contractor uses proprietary software for the purpose of storing or utilizing records the Contractor shall obtain at his own expense the grant of a license or sub-license to use such software in favour of the ADA and shall pay such license fee or other payment as the grantor of such license may require provided that the use of such software under the license may be restricted to use relating to the design, construction, reconstruction, manufacture, completion, reinstatement, extension, repair and operation of the Works or any part thereof.

iv. The Contractor's permission referred to above shall be given, inter alia, to enable the ADA to disclose (under conditions of confidentiality satisfactory to the Contractor) programmes and documentation for a third party to undertake the performance of services for the ADA in respect of such programmes and documentation.

v. Any software is developed under the Contract or used by the Contractor for the purposes of storing or utilizing records over which the Contractor or a third party holds title or other rights, the Contractor shall permit or obtain for the ADA (as the case may require) the right to use and apply that Software free of additional charge (together with any modifications, improvements and developments thereof) for the purpose of the design, manufacture, installation, reconstruction, testing, commissioning, completion, reinstatement, extension, repair, modification or operation of the Works, or any part thereof, or for the purpose of any Dispute.

vi. The ADA reserves the right to use other Software on or in connection with the Works.

1.10. Obtaining Information's related to Execution of work:

No claim by the Contractor for additional payment will be entertained which in consequent upon failure on his part to obtain correct information as to any matter affecting the execution of the works, nor will any misunderstandings or the obtaining of incorrect information or the failure to obtain information relieve him from any risks or from the entire responsibility for the fulfilment of the contract.

1.11. Examination of Work before covering up:

a. RFI (Request for Inspection) system shall be followed at site. The RFI shall be raised to the Engineer-in-Charge. No part of the works shall be covered up or

put out of view without the written RFI approval by Engineer-in- Charge. The contractor shall give due notice to the Engineer in- charge whenever any such work is or ready or about to be ready for examination and the Engineer-in-charge shall, examine and measure any work before it is covered up or put out of view and to examine foundations before further work is placed thereon.

b. Uncovering and making openings
The contractor shall uncover any part or parts of the works or make openings in or through the same as the Engineer-in-charge may direct from time to time and shall reinstate and make good such part or parts to the satisfaction of the Engineer-in charge at his own cost.

1.12. Miscellaneous:

a) Tax Deduction at Source
All Taxes and surcharge as applicable on date shall be deducted from the amount due to the Contractor towards the value of the work done. TDS certificate thereof shall be issued to the Contractor.

b) By-Laws of Statutory Authorities
The Contractor and his labour shall not violate municipal /sanitation /health or any other byelaws.

c) Delay in starting the work
For compensation shall be allowed for any delay caused in the starting of the work on account of acquisition of land, encroachment or in the case of clearance of works, on account of any delay in according sanction to estimates in issue of drawings, decisions etcetera However, the extension of time shall be granted as per relevant conditions of Contract.

d) Site instruction book
For the purpose of quick communication between, Engineer-in-charge, PMC and the Contractor or his representative, site instruction book shall be maintained at site as described below:

Any communication, relating the works may be conveyed through instructions in the site instruction book. Such a communication from Engineer-in-charge, PMC to the Contractor shall be deemed to have been adequately served in terms of the contract once the entries are made and signed by the authorized representative of the contractor. For this purpose, the contractor should authorize one of his employees on the site itself. Site instruction book shall have machine numbered pages and shall be carefully maintained and remain under custody of Engineer-in-charge. The contractor can also avail of the site instructions book for urgent communication with Engineer in-charge. Any instruction which Engineer-in-charge may like to issue to the Contractor may be recorded by the Engineer-in-charge in site instruction book.

e) Signage
The Contractor shall provide at his own cost, sign board(s) at directed location(s) having overall size preferably 2 metres by 4 metres, or any other size, indicating name of the project, and a 3-D view of the project as well as the name of the Contractor, PMC & ADA with addresses, cost of the Project, date of start & completion, as approved by Engineer-In-Charge. The signboard should be illuminated during night.

f) No idling charges or compensation shall be paid for idling of the contractor's labour, staff or P&M etcetera on any ground or due to any reason whatsoever.

g) The Contractor shall mobilize and employ sufficient resources for completion of all the works within the stipulated time period as per agreement and as indicated in the approved Bar Chart/ Network. No additional payment will be made to the contractor for any multiple shift work or other incentive methods contemplated by him in his work schedule even though the time schedule is approved by Engineer-in-charge.

Contract Price and Payments

1.13. The Bidder shall quote their rates in the prescribed format as per "FINANCIAL Bid" of the tender documents. The quoted rates shall be inclusive of all costs towards site visits, planning, designing , site surveys, soil investigations all material, labour, plant and machinery, tools and tackles, batching plant etcetera including water & electricity, overhead charges, all taxes (including GST), duties, levies statutory charges / levies applicable from time to time and others as specified etcetera, incidental works and all other charges for items contingent to the work, such as, packing, forwarding, insurance, freight and delivery at Site, watch and ward of all materials & successful installation, testing & commissioning at site etcetera, including handing over of the works to the Administrative department during the DLP period etcetera complete as per Scope of Work. The quoted rates shall also include cost of all other inputs required in the execution of the item, all taxes and duties including Goods & Services Tax. The fee paid by the contractor for obtaining various statutory approvals shall be reimbursed to him after submission of payment receipts and other relevant documents by the contractor.

i. Rates quoted shall be firm and shall not be subject to any price variations except as specifically provided in the contract.
ii. The quantities given in the Schedule of Quantities are liable to variations. Such variations in quantities shall not, however, vitiate the contract in any way whatsoever. Contractor shall be paid for the actual measured quantities of work executed by the Bidder.
iii. Unless otherwise specified the rates tendered by the contractor shall be all inclusive and shall apply to all shapes, heights, lifts, leads and depth of the building and nothing extra shall be payable to him on any account.
iv. Royalty, whenever payable, shall be borne by the contractor on the boulders, metal, shingle, sand and bajri etcetera, or any other materials collected by him for the work direct to the revenue authority of the District / State Government concerned and nothing extra shall be payable on this account.
v. The words "as specified", "as described", "as shown", "as directed", or "as approved", shall mean as described in the specifications, Schedule of Quantities and other Contract documents as shown on the drawings or as directed by Engineer-in-Charge.

1.14. The payments shall be made on the length basis w.r.t infrastructure and area basis w.r.t buildings and both length and area w.r.t landscaping. The length for the purpose of payment shall be running meter of length of infrastructure actually laid on ground, area for purposes of payment shall be the plinth area actually constructed. For landscaping components, the actual area or length of any landscaping work done on ground shall be considered for the purpose of payment.

Clause Deleted.

1.15. Clause Deleted.

1.16. All running / intermediate & final payments shall be made to the contractor in accordance with the following schedule and on pro-rata basis:

1.17. Schedule of Payment

Note:

(a) Payment for the Works shall be made on the basis of work performed and payment schedule.

(b) The contractor shall pay all taxes, duties and fees required to be paid by him under the contract, and the contract price shall be adjusted for any of these costs.

(c) After award of work to successful bidder, the bidder shall furnish detailed estimates, BOQs based on drawings approved by the ADA. The above-mentioned payments schedule can be sub divided into various sub components/stages with appropriate percentage break up as per the estimate and BOQs approved by the ADA but within the overall percentage break up of each component as approved by the ADA. The O&M costs will be paid on quarterly pro-rata basis.

(d) The interim payments made to the contractor will be quantity linked as per the approved BOQ.

(e) The Contractor shall submit a Statement in triplicate to the Engineer-in-charge after the end of each month, in a form approved by the Engineer-in-charge, showing in detail the amounts to which the Contractor considers himself to be entitled, together with supporting documents which shall include the report on the progress during this month in accordance with Clause 5 Sub-Clause 5.1.3 [Progress Reports].

The Statement shall include the following items, as applicable, which shall be expressed in the various currencies in which the Contract Price is payable, in the sequence listed:

(a) the estimated contract value of the Works executed and the Contractor's Documents produced up to the end of the month (including Variations but excluding items described below;)

(b) any amounts to be added and deducted for changes in GST.

(c) any amount to be deducted for retention, calculated by applying the percentage of retention stated in the Contract Data to the total of the above amounts, until the amount so retained by the Employer reaches the limit of Retention Money (if any) stated in the Contract Data;

(d) any other additions or deductions which may have become due under the Contract or otherwise, including those under Claims, Disputes and Arbitration; and

(e) the deduction of amounts certified in all previous Payment Certificates.

Payment Schedule: The Amount quoted by Contractor shall be derived as follows:

The Contract includes a schedule of payments given in the Contract Data in tabular form and note thereupon which is also given below;

1. The entire work in Atal Puram Township area has been vided into four sets Viz; Set-1, Set-2, Set-3 and Set-4. These sets are as follows:

a. Set 1: Network Infrastructure (along the Road Right of Way)
b. Set-2: Standalone Infrastructure within utility plots
c. Set-3: Landscaping and urban design
d. Set-4: Operation & Maintenance (including Defect Liability)

2. The work which has been envisaged under these three sets are as follows:

Percentage figure against each is in fact computed based upon the estimate prepared by ADA, which can give the bidder an idea of the quantum of work involved; the details of which can be inferred from the indicative BOQ.

a. Sub components of Set 1

Set- 1 – Network Infrastructure (along the road right of way)		**Payment Percentage**
1	Investigation & Survey, Design, Approval of detailed engineering drawings, Preparation of BOQ, Estimates, Good for construction drawings for the all the network infrastructure components and O&M plan thereof satisfying the deliverables.	1% of the total cost
2	Site Grading	2.86%
3	Road pavement, culverts and minor bridges	15.91%
4	Footpath & Track	4.38%
5	Storm water drainage	3.05%
6	Potable water supply	2.67%
7	Sewerage system	4.95%
8	Recycle water supply	2.53%
9	Rain water Harvesting	0.52%
10	Solid Waste Management	1.45%
11	Power Infrastructure	19.43%
12	Street Lighting	2.41%
13	Utility Duct	7.62%
	Sub Total CAPEX – Set- 1	**67.78%**

a. Sub components of Set 2

Set-2: Standalone Infrastructure within utility plots		**Payment Percentage**
14	Investigation & Survey, Design, Approval of detailed engineering drawings, Preparation of BOQs, Estimates, Good for construction drawings for all the stand-alone infrastructure and O&M plan thereof satisfying the deliverables.	1% of the total cost
15	13 MLD Sewerage Treatment Plant using SBR technology and SCADA	7.24%

16	33/11 kV AIS Indoor Sub Station (3 in number) and SCADA	8.48%
17	Water - Clear water reservoir, Elevated service reservoir, Recycled water reservoir, Pump house and equipment and SCADA	0.84%
	Sub Total CAPEX – Set- 2	**16.56%**

b. Sub components of Set 3

Set-3: Landscaping and urban design		**Payment Percentage**
18	Investigation & Survey, Design, Approval of detailed engineering drawings, Preparation of BOQs, Estimates, Good for construction drawings for all the stand-alone infrastructure and O&M plan thereof satisfying the deliverables.	1% of the total cost
19	Parks, gardens and arboriculture	7.52%
20	Boundary wall and gate	
21	Safety and security (ICT)	3.28%
	Sub Total CAPEX – Set- 3	**10.80%**

c. Sub components of Set 4

Set-4: Operation & Maintenance (including Defect Liability)		**Payment Percentage**
22	Operation & Maintenance of all infrastructure (except power)	4.86%
	Sub Total CAPEX – Set- 4	**4.86%**

Note:

i. Payment of 1% from each of the components under Set 1: Network Infrastructure, Set-2: Standalone Infrastructure within utility plots and Set-3: Landscaping and urban design will be adjusted for Detailed designing works i.e. *Investigation & Survey, Design, Approval of detailed engineering drawings, Preparation of BOQ, Estimates, Good for construction drawings for the all the network infrastructure components and O&M plan thereof satisfying the deliverables.*

ii. A total payment of 1.0 Crore on a pro rata basis will be withheld from each component and will be paid after the submission of 'as built' drawings by the contractor.

3. The bidders shall quote cost against all the items of all the three sets in the Financial Bid, and the summation of them will be taken as the total cost. This cost shall be inclusive of Labour cess, taxes, royalties and so on.
4. The successful bidders is supposed to furnish the detailed designs and drawings after referring to the Front End Engineering Design (FEED) drawings and BOQ provided by the ADA.
5. While doing so they have to keep the specifications indicated in the BOQ given by ADA as the bare minimum specifications. This is to say, that any specification below the one indicated in the technical specifications shall not be acceptable.
6. After approval of the design and drawings, the Contractor shall prepare their own BoQ and milestones for payment under different items in all the four sets, these milestones will be subject to revisions by the employer, whose decision shall be final and binding on the contractor.
7. Payment shall be made to the contractor based on these milestones of different items

falling under four sets.

8. The running bills will be considered for disbursement based on the approved BOQ by Engineer-in-charge in proportion to the Supply, Installation, Testing and Commissioning (SITC).
9. For understanding and guidance of bidders indicative BOQ is attached for nomenclature and items of Respective subheads Items not covered in indicative BOQ nomenclature but required for successful implementation and commissioning deemed to be included in bidders quoted Price.
10. The total fee of third party (or parties) for the inspection of the works executed on Quality & financial audit shall not exceed 1.0% of the agreement cost of the work and will be paid under the same contract value. No additional cost shall be reserved for the fee of Third-Party Inspection. All the fee of third party (or parties) for the inspection, factory visit by ADA etc. shall be borne by the contractor. The fees amount will be deducted from RA bills raised by the contractor.
11. Being a EPC contract value engineering in terms of qty to be done by bidders within NBC 2016/CODAL Provision/statutory requirement without Compromising With functional requirement and scope of work Payment to contractor in respective subheads will be Done on pro-rata basis of work done / micro payment Schedule within allocated percentage to be Submitted to engineer in-charge within 15 days of Award of work or prior to start of physical Execution of work at site, with proper Calculation backup.

Issue of Interim Payment Certificates

12. No amount will be paid until the Employer has received and approved the Performance Security. Thereafter, the ADA shall within 28 days after receiving a Statement and supporting documents, give to the Contractor notice of any items in the Statement with which the ADA disagrees, with supporting particulars. Payments due shall not be withheld, except that: if anything supplied or work done by the Contractor is not in accordance with the Contract, the cost of rectification or replacement may be withheld until rectification or replacement has been completed; and/or
13. if the Contractor was or is failing to perform any work or obligation in accordance with the Contract, and had been so notified by the ADA, the value of this work or obligation may be withheld until the work or obligation has been performed. The ADA may, by any payment, make any correction or modification that should due. Payment shall not be deemed to indicate the ADA's acceptance, approval, consent or satisfaction.

Timing of Payment

14. Timing of payment is based upon the work done as indicated in the Schedule of Payment.

Delayed Payment

15. If the Contractor does not receive payment in accordance with Timing of Payments, the Contractor shall not be entitled to receive any financing charges for unpaid amount, however, ADA will make all efforts to clear the payment by stipulated time.
16. If the contractor feels the payment is unnecessary kept pending, they can give in writing their grievances to the Chief Engineer or the ADA's representative furnishing details.

2.1. Submission of bill Statement for Works

a) The ADA shall make interim payments to the Contractor as certified by the PMC Engineer on completion of a stage, as specified and valued in accordance with the proportion of the Contract Price assigned to each item and its stage in Volume -7 of the Contract Document.
b) The interim payment shall be made on "Pro rata basis" and shall be worked out on the percentage of work done out of total scope of work under their activity/item.

c) The Contractor shall base its claim for interim payment for completed till the end of the month for which the payment is claimed, valued in accordance with the above sub-Clause, supported with necessary particulars and documents in accordance with this Agreement.
d) The proportion assigned to an item will apply only to the Contract Price stated in this Agreement. It shall not apply to any additions or reductions to the Contract Price arising from the issue of any Order for Change of Scope.
e) The Contractor shall submit interim RA bill, within the time stipulated as per General Conditions of Contract to the PMC Engineer-In-Charge in the form as directed, showing the amount calculated to which the Contractor considers himself entitled for completed Works. The interim RA bill shall be accompanied with the required supporting documents.
f) The Contractor should submit a compliance certificate, as per Appendix A attached to GCC, in every bill as per provisions of the EPF and ESI Act as amended from time to time.

2.2. Production of Records

a) The Contractor shall, whenever required by the Engineer-in-Charge or ADA, produce or cause to be produced for examination by the Engineer, any quotation, invoice, cost or other account books, vouchers, receipts, letters, memoranda or any copy of or extract from any such documents and also furnish information and returns, as may be required, relating to the execution of this Contract or relevant for verifying or ascertaining the cost of execution of this Contract or ascertaining the Materials supplied by the Contractor are in accordance with the Specifications laid down in the Contract. The Engineer's decision on the question of relevancy of any documents, information or returns shall be final and binding on the parties.
b) If any part or item of the work is allowed to be carried out by a subcontractor, assignee or any subsidiary or allied firm, the Engineer shall have power to secure the books of such sub-Contractor, assignee or any subsidiary or allied firm through the Contractor, and shall have power to examine and inspect the same. The above obligations are without prejudice to the obligations of the Contractor under any statute, rules or order.

3. Site Management

3.1. The contractor may construct temporary office, storage, accommodation and labour huts within the site premises where the space is available at site. In case, where surplus land is not available within the site and/or not permitted by the ADA, the contractor shall arrange the land for temporary office, storage, accommodation and labour huts at his own cost and is responsible for taking the clearance of local authorities, if required, for setting up / construction for labour camp and same is deemed to be included in the rates quoted by the contractor for the works. The contractor shall check the availability of land before tendering and no claim whatsoever in this regard shall be entertained. The contractor shall ensure that the area of labour huts is kept clean and sanitary conditions are maintained as laid down by the local authorities controlling the area. The land for the above purposes shall be so placed that it does not hinder the progress of work or access to the worksite. The vacant possession of the land used, for the purpose shall be given back by contractor after completion of the work.

3.2. Contractor's Working Area

Suitable working space will be provided by the Contractor to the Engineer-in- Charge & PMC as per site conditions and availability. The Contractor may have to carry out some cutting / filling work for making this area workable. The cost of all such Works shall be deemed to have been included in the contract price quoted for the Works and no payment shall be made on this account.

Before commencement of the work, the Contractor shall obtain approval of the Engineer-in charge for the location of cement godown, steel stacking and fabrication yard, site office and shall from time to time take instructions from the Engineer – in charge regarding collection and stacking of materials at the site. No excavated earth or building material shall be stacked on areas where other Buildings & all the infrastructure, roads, services or compound wall or any other structure are to be constructed.

3.3. Site Office:

A. The Contractor shall construct/provide one site office (semi-permanent structure) for use by Engineer-in-charge & his subordinate staff i.e. PMC and his staff consisting of 2 rooms with toilet and one conference Room (30-seater) with toilet having area not less than 350 Sqm for PMC/ADA officers & staff. The location and plan shall be got approved from Engineer-in-Charge. Specification for the site office shall be suitable and matching for running an office which shall be got approved from Engineer-in-charge. The Contractor shall provide a typical plan of site office & conference room (having light fixtures, wiring &, AC etcetera) with specification within 15 days of award of work. The site office shall have a sample room, A.C conference room, staff rooms along with toilets & pantry with file storage facility, computers (8 Nos.), Broad band (2 Nos.) and printers (2 Nos.) with their consumables, a telephone, licensed version Primavera software, Auto- CAD etcetera All running cost & charges for office including Electricity bill, water supply bills, RO/drinking water bills etcetera shall be borne by the Contractor. The Contractor shall provide the following furniture (new) for use of PMC & ADA officers & staff at site office.

B. Surveillance System shall also be provided for surveillance of different locations of project site & site office. In the surveillance system, the cameras shall be provided at different locations of the project site so that the output is available at the Corporate/Regional office of ADA. The system shall be able to work on both wired as well as wireless network. The recording shall be preferably stored for at least 30 days. Along with video surveillance system, video conference facility, complete in all respects

with necessary required equipment and software shall be provided at site office for frequent/periodical interaction between project site office and Corporate /Regional office of ADA/PMC.

C. Electricity & drinking water shall also be provided by the contractor free of cost for such period.

3.4. Contractor's Temporary Structures

i. The Contractor may, at his own expense and subject to the approval of the Engineer-in-charge and statutory authorities, as required, construct temporary structures for its site office, stores; Workshop etcetera in the working area allocated to him as above and remove the same on completion of Works. The Contractor shall furnish such details of his Temporary Works as may be called for by the Engineer-in-charge and the Contractor shall satisfy the Engineer-in-charge as to their structural safety. The Contractor shall be solely responsible for the stability and structural safety of all temporary works including obtaining statutory approvals and payment of statutory fees, if any. Should it be necessary to shift the temporary works to some other place during the execution of the works, the Contractor shall do so, at his own cost.

S. No.	Articles	Quantity
1.	Executive table (wooden) with side racks	03 Nos.
2.	Executive Chair	03 Nos.
3.	Office Tables	08 Nos.
4.	Office Chairs	24 Nos.
5.	Almirah	06 Nos.
6.	Conference table with Chairs (for 30 seats)	01 Set i/c chairs
7.	Digital display arrangement & sound system	01 Set
8.	Telephone	02 Nos
9.	RO Drinking water	01 Nos

ii. Initial and Final Clearance of site for temporary works: The Contractor shall be responsible for the clearance of the site of all scrub, debris, rubbish, etcetera to be removed off site to a location to be provided by the contractor and approved by the Engineer- in-charge. However, no trees shall be removed without the prior permission of the Engineer-in-charge. The structures, services and works required to be demolished and removed shall also be removed off site to a location as mentioned above. The Contractor shall obtain necessary permissions and approvals from the local authorities for such disposals. The demolition shall include digging, excavating and removal of substructures, foundations and buried works. The cost of all this shall be borne by the Contractor. The above is applicable for all site offices, labour camps, and godowns etcetera, which are not required after the work is completed.

iii. Storage, Cleaning and Dewatering

The Contractor shall at all the times during construction keep the Site clean and free from all debris and unwanted materials on a daily basis as per instructions of the Engineer-in-charge.

Storage of materials shall be in an organized manner and in proper compartments as directed by the Engineer - in- Charge. Storage on suspended floors shall not be permitted unless specifically approved in writing by the Engineer-in-charge for specific materials in specific locations and in approved manner. The Engineer-in charge shall be furnished with load details, if requested, before seeking approval for storage.

Regular cleaning operations shall be undertaken to remove all dust, debris, waste materials etcetera A cleaning schedule shall be maintained.

The Contractor shall make his own arrangement for storage of those materials, which can be accommodated at site. Contractor shall be fully responsible for safe custody of the same. Materials shall be considered as "Delivered at Site" only after the physical presence of materials at site are verified by the Engineer-in-charge. Storage of materials / equipment elsewhere shall not be considered as "Delivered at Site."

The Contractor shall be responsible to keep entire site free from water due to water coming from any source at any level and shall protect all materials and works from being damaged by the water from any source. Contractor shall make proper arrangements for drainage prior to use of water for curing, testing, cleaning etcetera.

Any expenditure incurred by the Contractor in fulfilment of his obligations under this sub-clause shall be deemed to have been included in the financial Bid and subsequent contract.

iv. The security deposit of the contractor shall be released only after contractor demolishes all structures including foundations and gives back clear vacant possession of this land.

3.5. Care of Works

From the commencement to the certified completion of the whole of works, the contractor shall be responsible for the care, safety and maintenance of the works executed under the contract thereof and of all temporary works. In case of any damage/ loss or injury shall happen to the works or to any part thereof or to any temporary works from any cause whatsoever save and except the expected risks, the contractor shall at his own cost repair and make good the same, so that on completion the works shall be in good order and condition in conformity to every respect with the requirements of the contract. The contractor shall also be liable for any damage to the works occasioned by him including his subcontractors in the course of any operations carried out by him for the purpose of completing any outstanding work and complying with his obligations under the Contract. In case of failure on the part of the contractor the damage/ loss/ injury shall be made good by the ADA at the risk and cost of the contractor.

3.6. Safety in Construction

The contractor shall adhere to the safety, health & environmental guidelines as prescribed in the tender document. The contractor shall employ only such methods of construction, tools and plant as are appropriate for the type of work or as approved by Engineer-in-Charge in writing.

The contractor shall take all precautions and measures to ensure safety of works and workmen and shall be fully responsible for the same. Safety pertaining to construction works such as excavation, centring and shuttering, trenching, blasting, demolition, electric connections, scaffolds, ladders, working platforms, gangway, mixing of bituminous materials, electric and gas welding, use of hoisting and construction machinery shall be governed by the Safety code, relevant safety codes and the direction of Engineer-in-Charge.

The Contractor shall be fully responsible for the adequacy, stability and safety of all site operations and methods of construction, the contractor shall ensure that all safety norms are followed as per contractual and other statutory requirements.

3.7. Contractor's Labour Camp

The Contractor shall make arrangements at his own expense for labour camp / accommodation for labour and staff to be employed for execution of the work and their conveyance to Site. Proper ID Cards shall be got approved /authorized by the

contractor from the Engineer-in-charge to authorise the Contractor's staff and workers to enter the Site.

3.8. Mobilization of Resources:

Contractor shall not mobilize his resources in terms of materials, machinery, tools & plants, facilities required to implement the project and shall not pay any advances to any party unless he receives letter of Award from ADA. Contractor shall himself be responsible for such cost incurred without receipt of notice to proceed and no such claim of contractor shall be entertained by the ADA.

3.9. Water Supply & Power Supply

The Contractor shall make his own arrangement for water supply at Site for drinking as well as construction purposes & Power Supply at his own cost. Non- availability of power supply and /or water from whatever source shall not entail any additional claims or extension of Contract period in this account.

3.10. Watch & Ward and Lighting

The Contractor shall throughout the execution and completion of the Works and the remedying of the site and the Works and the remedying of any defects therein have full regard for the safety of all persons entitled to be on the site and keep the site and the Works in an orderly state to avoid any accident or danger and provide safety measures, lights, guards, fencing and barricades where ever necessary or required by the Engineer-in-charge, or by any duly constituted authority, for the execution and for the protection of the Work, and/or for the safety and convenience of the public or others and take all reasonable steps to protect the environment on and off the site and to avoid damage or nuisance to person or property of the public or others resulting from pollution, noise and other causes etcetera at his own cost.

3.11. Temporary Barricading

The Contractor shall at his own expense, erect and maintain in good condition temporary barricades all around the working area as per directions of the Engineer-in charge. The barricading shall be as required or at least 3 meter high approx., whichever is higher. The specifications of barricading shall be got approved from Engineer-in charge.

a. The contractor shall make, till completion of the project arrangements for/of:

i. Proper pumping for removing water from the basement or elsewhere at site.
ii. Proper security, safety, transportation, manpower, lighting arrangement for execution of works at night.
iii. Tower crane, batching plant and other plants &machinery, tools and tackles required for timely execution of work.
iv. Proper barricading around site so that surrounding area is made free from disturbances.
v. Diversion of underground services with the approval of Engineer-in charge.

b. Restriction in work areas.

i. The contractor must see the site of the work, its approaches carefully before tendering, No claim of any sort shall be entertained on account of any site conditions. f any approach from main road is required or existing approach is to be improved and maintained, for cartage and materials by the contractor, the same shall be done by the contractor his own cost.
ii. No Entry/exit/roads other than specified by the Engineer-in-charge for purpose of construction activities will be allowed to be used for construction activity purposes or movement of trucks/lorries/load- carriers and nothing extra/ delay whatsoever will be accounted for on this part.

iii. The Contractor shall take all necessary precautions to prevent any nuisance to inconvenience to the owners, tenants or occupiers of adjacent properties and to the public in general and to prevent any damage to such properties and any pollution of smoke, streams and water-ways. He shall make good at his cost and to the satisfaction of the Engineer-in-Charge, any damage to roads, paths, cross drainage works or public or private property whatsoever caused thereon by the Contractor. All waste or superfluous materials shall be removed by the Contractor without any reservation entirely to the satisfaction of the Engineer in-Charge.

iv. In the event of any restrictions being imposed by the Security agency, ADA, Traffic or any other authority having jurisdiction in the area on the working or movement of labour /material, the Contractor shall strictly follow such restrictions and nothing extra shall be payable to the Contractor on this account.

v. In case the contractor is not permitted to erect the huts for labour at the site of work, the contractor will have to make his own arrangement to provide such accommodation elsewhere and nothing extra shall be paid on this account.

vi. The contractor shall obtain approval of the PMC/Engineer-in-Charge to erect the hutments for labour etcetera at the site of work; denial of approval shall not affect the construction activities.

vii. The contractor shall take all precautions to avoid accidents by exhibiting necessary caution boards such as day and night boards, speed limit boards, red lights and providing barriers. He shall be responsible for all damages and accidents caused due to negligence on his part. No hindrance shall be caused to traffic during the execution of the work.

c. Site Data

The Contractor, with the Tender documents, has been made available such relevant data in ADA's possession on hydrological and sub-surface conditions. The accuracy or reliability of the data/studies/reports and of any other information supplied at any time by the ADA is not warranted with respect to the viability of his design and execution of Works and the Contractor shall be responsible for interpreting all such data. The Contractor shall conduct further investigations considered necessary by him at his own cost and any error, discrepancies if found in ADA's data at any stage will not constitute ground for any claim for extra time and costs.

The Contractor shall be deemed to have obtained all necessary information as to risks, contingencies and other circumstances which may influence or affect the Tender or Works.

The Contractor shall also be deemed to have inspected and examined the Site, its surroundings, the above data and other available information with respect to the viability of his design and execution of Works and to have satisfied himself before submitting the Tender, as to all the relevant matters including without limitation:

i. the form and nature of the Site, type of soil including the sub-surface conditions;
ii. the hydrological and climatic conditions;
iii. the extent and nature of the work, Plant, and Materials necessary for the execution and completion of the Works and the remedying of any defects;
iv. the applicable laws, procedures and labour practices.

d. site and provide suitable replacements. The decision of the Engineer-in-charge shall be final and binding on the contractor. The contractor shall not be allowed any compensation on this account.

e. Contractor's Authorized Representative shall take joint measurements and sign the measurement books / bills. Any direction, explanations, instructions or notices given by the Engineer-in-charge to such representative shall be held to be given to the Contractor.

In case of absence of said Representative other alternative representative should also be mentioned having same responsibilities.

f. No unauthorized persons shall be allowed on the site. The contractor shall provide complete security arrangement for the campus during construction to avoid trespassing. The Contractor shall ensure all such persons are kept out and shall take steps to prevent trespassing. However, the contractor will make sure to provide free access at any time for Engineer-in-charge to the site and other working places.

g. In case the Contractor is required to employ foreign nationals for execution of work, then the employment of foreign personnel by the Contractor and/or its Sub-contractors and their sub. Contractors shall be subject to grant of requisite regulatory permits and approvals including employment/residential visas and work permits, if any required, and the obligation to apply for and obtain the same shall and will always be of the Contractor. Notwithstanding anything to the contrary contained in this Contract, refusal of or inability to obtain any such permits and approvals by the Contractor or any of its Sub- contractors or their sub-contractors shall not constitute Force Majeure Event, and shall not in any manner excuse the Contractor from the performance and discharge of its obligations and liabilities under this Contract**.**

4. Safety, Health and Environment

Over and above the provisions made in Safety Code (part of General Conditions of Contract) the following will also be applicable:

4.1. In respect of all workmen directly or indirectly employed in the work for the performance of the contractor's part of this agreement, the contractor shall at his expense arrange for the safety provisions as per Indian Standard Safety codes shown below and shall at his own expense provide for all facilities in connection there with. In case the contractor fails to make arrangement and provide necessary facilities, he shall be liable to pay compensations prescribed under Workmen Compensation Act 1923 as amended from time to time for each default and in addition the Engineer-in- charge shall be at liberty to make arrangement and provide facilities as aforesaid and recover the cost incurred on that behalf from the contractor, and no claims what so ever shall been pertained.

4.2. Details regarding some special provisions to be followed by contractor are as follows:

a. **Usage of quality Personal Protection Equipments (PPEs)** through approved vendors. PPEs would include amongst others the following items:

i. Safety Helmets.

ii. Hearing Protection.

iii. Respiratory Protection.

iv. Eye Protection.

v. Protective Gloves.

vi. Safety Footwear.

vii. High Visibility Clothing (Jacket) with approved Logo

All the items should be got approved before issued to the use in the work. The contractor shall provide all the PPE (Personnel Protective Equipment) and safety appliances required to carry out the job to all the workmen deployed by the contractor and also ensure that his workmen use those PPE and safety appliances while on the job. The contractor shall not pay any cash amount in lieu of PPE to the workers/sub-contractors and expect them to buy and use during work. If the contractor fails to ensure provision of safety appliances and its workmen do not use the PPE and safety appliances as needed for safe working, the owner may ask the contractor to stop the work and comply with safety requirements first. The contractor shall at all time maintain a minimum of 10% spare PPEs and safety appliances and properly record and show to the Engineer-in-Charge during the inspections. Failing to do so shall invite appropriate compensations as per the provisions of under Workmen's Compensation Act 1923 as amended from time to time.

It is always the duty of the contractor to provide required PPEs for all visitors.

Towards this required quantity of PPEs shall be kept always at the security post.

b. Colour coding for helmets

Safety Helmet Color Code (Every Helmet should have the LOGO affixed /painted)	Person to use
White	ADA/Engineer-in-Charge staffs, All Designers, Architect, Consultants, etcetera
Violet	Contractor (Engineers / Supervisors)
Blue	All Sub-contractors (Engineers Supervisors)
Red	Electricians (Both Contractor and Sub-contractor)
Green	Safety Professionals (Both Contractor and Sub-contractor)
Orange	Security Guards / Traffic marshals
Yellow	All workmen
White (with "VISITOR" sticker)	Visitors

i. Logo shall have its outer dimension 2"X2" and shall be conspicuous.
ii. Logo shall be either painted or affixed.
iii. No words shall come either on Top / Bottom of Logo.

c. Working at Heights

Contractor shall ensure that work at height is properly planned for any emergencies and rescue appropriately supervised, and carried out in a manner, which is reasonably practicable safe. Contractor shall ensure that work at height is carried out only when the weather conditions do not jeopardize the health or safety of persons involved in the work. Guardrail, Toe-board, Barrier or similar collective means of protection shall be of sufficient dimensions, of sufficient strength and rigidity for the purposes for which they are being used, and otherwise suitable.

Working Platform shall be of sufficient dimensions to permit the safe passage of persons and the safe use of any plant or materials required to be used and to provide a safe working area-having regard to the work being carried out there. Possess a suitable surface and, in particular, be so constructed that the surface of the working platform has no gap through which a person, material or object could fall and injure a person. A working platform and any supporting structure shall not be loaded so as to give rise to a risk of collapse or to any deformation, which could affect its safe use. Strength and stability calculations for scaffolding shall be carried out by the contractor. The dimensions form and layout of scaffolding decks shall be appropriate to the nature of the work to be performed and suitable for the loads to be carried and permit work and passage in safety.

A personal fall protection system designed for use with an anchor shall be securely attached to at least one anchor, and each anchor and the means of attachment thereto shall be suitable and of sufficient strength and stability for the purpose of supporting any foreseeable loading. Suitable and sufficient steps shall be taken to prevent any person falling or slipping from a personal fall protection system. Any other steps in the opinion of engineer-in-charge suggested will also be taken in Protection system

Only metal ladders shall be allowed. Any surface upon which a ladder rests shall be stable, firm, of sufficient strength and of suitable composition safely to support the ladder so that its rungs or steps remain horizontal, and any loading intended to be placed on it. A ladder shall be so positioned as to ensure its stability during use. A suspended ladder shall be attached in a secure manner and so that, with the exception of a flexible ladder, it cannot be displaced and swinging is prevented. No interlocking or extension ladder shall be used unless its sections are prevented from moving relative to each other while in use.

d. Lifting appliances and gears.

The contractor shall maintain a register for record of examinations and test details of all lifting appliances. This register should also contain a system of identification of all tools and tackles, its date of purchase, safe working load etcetera Contractors can utilize the services of any competent person as defined in Factories Act, 1948 and approved by Chief Inspector of Factories with the permission of the Engineer- in-Charge.

e. Automatic safe load indicators

Every lifting appliance and gear like cranes, hydras etcetera, if so constructed that the safe working load may be varied by raising or lowering of the jib or otherwise shall be attached with an automatic indicator of safe working loads approved by Bureau of Indian standards/ International certifying bodies which gives a warning to the operator and arrests further movements of the lifting parts.

f. Qualification of operator of lifting appliances and of signaler etcetera

The contractor shall not employ any person to drive or operate a lifting machine like crane, hydra etcetera whether driven by mechanical power or otherwise or to give signals to work as a operator of a rigger or derricks unless he is above twenty- one years of age and possesses a valid heavy transport vehicle driving license as per Motor Vehicle Act and Rules, is absolutely competent and reliable, possesses the knowledge of the inherent risks involved in the operation of lifting appliances by undergoing a formal training at any institution of national importance, is medically examined periodically.

5. Requirements for Planning & Design Capabilities

5.1. For planning and design, the Bidder should have in- house design capacity to carryout comprehensive planning and design of this project as per requirements and the Bidder with his in-house design capacity should have satisfactorily completed planning & design of at least one similar completed by him with his in-house design capacity.

5.2. In case, the Bidder does not have in house capacity to carryout comprehensive planning and design of this project, then the Bidder shall engage a Firm/ Consultant which shall provide the required comprehensive consultancy services for planning and design from commencement to completion of the project based on the Master plan & Concept designs and DBR provided to the Bidder as a part of Bidding documents. The criteria for engagement of such Firm/Consultant shall be asunder:

a. The Firm/ Consultant which should be an Indian Consultancy firm and should have in-house design capabilities with minimum experience of 7 years in the field of Consultancy.
b. The Firm / Consultant should have provided the consultancy services for the planning & design of at-least one similar completed work including finishing works, water supply and sanitary installations, electrical works, fire-fighting, LV works during the last 10 years ending the previous day to the last date of submission of tender.
c. The Bidder shall within 7 days of award of work shall submit the details with the design capabilities along with documentary evidence of the Firm/Consultant proposed to be engaged by him and meeting the criteria as given in a & b above for approval by Engineer-In-Charge
d. The approved Firm/Consultant shall be associated with the project from commencement till completion.
e. Irrespective of the approval of Firm/Consultant as proposed by the Bidder and approved by Engineer-In-Charge, the entire responsibility for all coordination and providing the required design services is sole responsibility of the Contractor.
f. The Contractor's in house design personnel or approved Firm/Consultant design personnel (in case of outside agency) inclusive of Architects, Structural, MEP, Landscaping etcetera shall regularly visit the project site and other locations during execution of work for discussions, clarifications and attending various meetings with Engineer-in-Charge/ADA wr.t the project and as per directions of Engineer- In-Charge.

5.3. Design and Construction

5.3.1. Obligations prior to commencement of Works

Within 7 (seven) days of the Commencement Date, the Contractor shall:

(a) appoint its representative (the "Contractor's Representative") duly authorised to deal with the Engineer-in-Charge/ADA in respect of all matters under or arising out of or relating to this Agreement;

(b) appoint a design head (the "Design Head") who will head the Contractor's design units and shall be responsible for surveys, investigations, collection of data, and preparation of preliminary and detailed designs.

(c) undertake and perform all such acts, deeds and things as may be necessary or required before commencement of Works under and in accordance with this Agreement including approval from Statutory Authorities, Applicable Laws and Applicable Permits; and

(d) Make its own arrangements for procurement of materials needed for the Project under and in accordance with the Applicable Laws and Applicable Permits.

5.3.2. Project completion Schedule is set out in the contract document. Design shall be developed in conformity with the specifications and standards set forth in the contract document.

5.3.3. Engagement of Proof Checking Consultant

The Proof checking consultant for vetting/proof checking of structural designs shall be engaged by the Contractor and the same shall be from any Indian Institute of Technology/National Institute of Technology as approved by ADA for which the requisite request shall be submitted by the Contractor. The Contractor shall get the structural details / design & drawings proof checked from the approved proof checking consultant as per requirements and at his own cost. Nothing extra shall be payable to the contractor by ADA on this account.

5.3.4. The Contractor shall submit the designs and drawings, duly certified by the Proof Consultant, to the Engineer-in-Charge for review. Provided, however, that the contractor shall ensure and provide the Engineer-In-Charge additional drawings that may be required for its review in accordance with Good Industry Practice. The programmed for submission of the design shall be finalized in consultation with the Engineer-In-Charge.

5.3.5. Considering the need for complying the specific acoustics parameters w.r.t project the Contractor shall arrange to comply with required acoustical parameters in designs and construction of various facilities in line with the provisions of the DBR and as per scope of work.

5.3.6. Considering the need for specific green building parameters and to obtain the required GRIHA Green Building Rating Certification w.r.t project the Contractor shall arrange to comply with required Green Building parameters in designs and construction of various facilities in line with the provisions of the DBR and as per scope of work.

5.3.7. <u>Contractor's Warranty of Design</u>

(a) The Contractor shall be fully responsible, for the suitability, adequacy, integrity, durability and practicality of the Contractor's proposal.

(b) The Contractor warrants that the Works have been or will be designed, manufactured, installed and otherwise constructed and to the highest standards available using proven up-to-date good practice. By submitting the Drawings for review to the Engineer-in-charge, the Contractor shall be deemed to have represented that it has determined and verified that the design and engineering, including field construction criteria related thereto,

are in conformity with the Scope of the Project, the Specifications and Standards and the Applicable Laws.

(c) The Contractor warrants that the Contractor's Proposals meet the requirements and is fit for the purpose thereof. Where there is any inadequacy, insufficiency, impracticality or unsuitability in or of the Requirements or any part thereof, the Contractor's Proposal shall take into account, address or rectify such inadequacy, insufficiency, impracticality or unsuitability at Contractor's own cost.

(d) The Contractor warrants that the Works will, when completed, comply with enactments and regulations relevant to the Works.

(e) The Contractor warrants that the design of the Works and the manufacture of plant have taken or will have taken full account of the effects of the intended manufacturing and installation methods, Temporary Works and Contractor's Equipment.

(f) The Contractor shall also provide a guarantee from the Designer for the design for suitability, adequacy, and practicality of design for ADA's Requirements.

(g) The Contractor shall indemnify the ADA against any damage, expense, liability, loss or claim, which the ADA might incur, sustain or be subject to arising from any breach of the Contractor's design responsibility and/or warranty set out in this Clause.

(h) The Contractor further specifies and is deemed to have checked and accepted full responsibility 'for the Contractor' s Proposal and warrants absolutely that the same meets the ADA's Requirements:

The Contractor shall be fully responsible for the Plants, Materials, goods, workmanship, preparing, developing and coordinating all design Works to enable that part of the Works to be constructed and/or to be fully operational in accordance with the Contract's requirements.

Apart from the Contractor, the above warranty shall also be applicable for his designer. This warranty shall be a part of his sub contract with the designer and should be made available at the time of signing of the Agreement.

No claim for additional payment or extension of time shall be entertained and/or no review and/or observation of the Engineer-In-Charge and/or its failure to review and/or convey its observations on any Drawings shall relieve the Contractor of its obligations and liabilities under this Agreement in any manner nor shall the Engineer or the ADA be liable for the same in any manner; and if errors, omissions, ambiguities, inconsistencies, inadequacies or other Defects are found in the Drawings, they and the construction works shall be corrected at the Contractor's cost, notwithstanding any review under this section.

5.3.8. In respect of the Contractor's obligations with respect to the design and Drawings of the Project as set forth in tender document, the following shall apply:

(a) The contractor shall furnish design and drawings to Engineer-in-Charge /PMC and in such sequence as is consistent with the Project Completion Schedule, required number of copies of all Drawings, to the Engineer-in- Charge/PMC for review;

(b) Within 7 (seven) days of the receipt of the Drawings, the Engineer-in-charge shall review the same and convey its observations to the Contractor with particular reference to their conformity or otherwise with the Scope of

the Project and the Specifications and Standards. The Contractor shall not be obliged to await the observations of the Engineer-in-Charge/ on the Drawings submitted pursuant hereto beyond the said period of **21 (twenty-one) days** and may begin or continue Works at its own discretion and risk;

(c) If the aforesaid observations of the Engineer-in-Charge indicate that the Drawings are not in conformity with the Scope of the Project or the Specifications and Standards, such Drawings shall be revised by the Contractor and resubmitted to the Engineer-in-Charge for review within 7 days of receipt of communication from Engineer. The Engineer-in- Charge shall give its observations, if any, within 7 (seven) days of receipt of the revised Drawings; and

(d) the Contractor shall be responsible for delays in submitting the Drawing as set forth in Schedule-F caused by reason of delays in surveys and field investigations, and shall not be entitled to seek any relief in that regard from the ADA.

5.3.9. The Contractor's time and cost impacts of revisions arising from review by the Engineer-in-Charge of designs caused by the Contractor's non- compliance with the requirements of this Agreement shall be borne by the Contractor, unless there is a change in the Scope of the Works.

5.3.10. The Works shall be executed in accordance with the design reviewed by the Engineer-in-Charge, and shall not thereafter be amended or altered without the prior written approval of the Engineer-in-Charge. If Engineer-in- Charge becomes aware of an error or defect of a technical nature in the design that PMC/Engineer-in-Charge shall promptly give notice to the other Party of such error or defect. Such error or defect shall be rectified by the Contractor, without any cost to the PMC/Engineer-in-Charge.

6. Setting out of the Works

The contractor shall be responsible for the true and proper setting-out of the Works in relation to original points, lines and levels or reference issued by Engineer- in-charge in drawing or in writing and for the correctness, subject as above mentioned, of the position, levels, dimensions and alignment of all parts of works and for the provision of all necessary instruments, appliances and labour in connection therewith. If, at any time during the progress of the works, and during defects liability period, any error shall appear or arise in the position, levels, dimensions or alignment of any part of the Works, the Contractor, on being required to do by the Engineer-in-charge and/ or his authorized representative shall at his own cost, rectify such error to the satisfaction of the Engineer-in-charge. The checking of any setting out or of any line or level by the Engineer-in-charge not in any way relieve the Contractor of his responsibility for the correctness thereof. The Contractor shall carefully protect and preserve the benchmarks; sight-rails, pegs and other things used in setting-out the Works. Any rectification works required should be done by the Contractor at his own cost.

7. Quality of Materials & Equipment's, Workmanship and Test

7.1. All the materials used in the work shall be subjected to the mandatory tests as prescribed in the specifications detailed in Schedule F of the General Conditions of Contract and other specifications referred to in the contract and workmanship shall be the best of the respective kinds described in the Contract and in

accordance with the Engineer-in- charge's instructions and shall be subjected from time to time to such tests as the Engineer-in-charge may direct at the place of manufacture or fabrication or on the Site or at an approved testing laboratory. The source of supply and / or manufacturing within/ outside India may be inspected by the Engineer-in-charge or any representative as nominated by the ADA. All the expenditure towards travel, lodging, testing etcetera on this account is deemed to be included in the rate quoted.

The contractor shall upon the instruction of the Engineer-in-charge's representative furnish him with documentation to prove that the materials & goods comply with the requirements of contract and for requirement stated above. The Engineer-in- charge may issue instruction in regard to removal of material from site or any work, if these are not in accordance with the contract. The contractor shall provide such assistance, instruments, machinery, labour and materials as are required for examining, measuring, sampling, testing of material or part of work.

7.2. Audit Inspection/ Technical Examination/Third Party Inspection

The ADA / Engineer-In-Charge shall have the right to cause technical Audit Inspection by Audit team under Chief Technical Examiner Etcetera Third-Party Inspection of the works and the final bills of the contractor including all supporting vouchers, abstracts, etcetera to be made as per payments of the final bill. The Contractor shall provide all assistance and full access to site to carry out inspection and perform tests at site, to provide samples for testing in outside laboratories and to show site records and their records as asked for by the inspecting teams. Findings of such inspection shall be notified to contractor and contractor shall be bound to take remedial measures to the satisfaction of Engineer-in-charge. If as a result of such Technical Examination/Third Party Inspection, the sum is found to have been overpaid in respect of any work done by the contractor under the contract and found not to have been executed, the contractor shall be liable to refund the amount of over payment and it shall be lawful for the ADA / Engineer-in-charge to recover the same from the Security Deposit or Performance Security of the contractor or from any dues payable to the contractor. If it is found that the contractor was paid less than what was due to him under the contract in respect of any work executed by him under it, the amount of such under payment shall be duly paid.

In the case of any audit examination and recovery consequent on the same the contractor shall be given an opportunity to explain his case and the decision of the ADA / Engineer-in-charge shall be final. Payment on this account will be recovered from the contractor.

In the case of Technical Audit /Third Party Quality Assurance /Audit by an independent agency/ individual/firm/institute at any time, consequent upon which there is a recovery from the contractor, recovery shall be made with orders of the ADA / Engineer-in- charge whose decision shall be final.

7.3. Samples

i. The ADA will not supply any materials required for execution of the Works under this Contract. The Contractor must, therefore, make his own arrangements for timely procurement of various materials including steel and cement etcetera ii. Prior to ordering any equipment/ material/ system, the Contractor shall submit to the Engineer-in-charge the catalogues, along with samples from approved list of manufacturers. No material shall be procured without written approval of the Engineer-in-charge.

ii. All samples of materials and /or items of works in adequate numbers, sizes, shades & pattern as per specifications shall be supplied free of charge by the contractor without any extra charge. All other expenditure required to be incurred like conveyance for taking the samples for testing at the laboratory, packing, etcetera, shall be borne by the contractor. If the test results do not conform to the specifications and standards laid down, the materials shall be rejected, the contractor shall remove such materials from site. The laboratory for testing of samples shall be decided by ADA/Engineer – in- charge, whose decision shall be final and binding.

iii. Contractor shall submit Samples to the Engineer-in-charge for approval. If certain items proposed to be used are of such nature that samples cannot be presented or prepared at the site, detailed literature / test certificate of the same shall be provided to the satisfaction of the Engineer-in-charge. Each Sample will be identified clearly as to material, Supplier, pertinent data such as catalogue numbers and the use for which intended and otherwise as the Engineer-in-charge may require to review the submittals for the limited purposes required by paragraph (d) below. The numbers of each sample to be submitted will be as specified in the Specifications, or as shall be specified by the Engineer-in-charge.

iv. Submittal Procedures

a. Before submitting each Sample, Contractor shall have determined and verified all materials with respect to intended use, fabrication, shipping, handling, storage, assembling and installation pertaining to the performance of the Work and All information relative to Contractor's sole responsibilities in respect of means, methods, techniques, sequences and procedures of construction and safety precautions and programmes incident thereto.

b. Each submittal will bear a specific written indication that Contactor has satisfied Contractor's obligation under the Contract Documents with respect to Contractor's review and approval of that submittal.

c. At the time of each submission, contractor shall give the Engineer-in-charge specific written notice of such variations, if any; that the sample submitted may have from the requirements of the contract document. Such notice shall be separate from the submittal and in addition shall cause a specific notation to be made on each sample submitted for review and approval of each such variation

v. Review and Approval:

a. Sample shall be reviewed and approved only to determine if the items covered by the submittals will, after installation or incorporation in the

work, conform to the information given in the contract documents and be compatible with the design concept of the completed project functioning as a whole as indicated by the contract documents, drawings.

b. Review and approval will not extend to means, methods, techniques, sequences or procedures of construction. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions. Contractor shall make corrections required by Engineer-in- charge and shall submit as required new Samples for review and approval. Contractor shall direct specific attention in writing to revisions other than the corrections called for and by the Engineer- in-charge on previous submittals.

c. Above referred review and approval of Samples shall not relieve Contractor from responsibility for any o.25% from the requirements of the Contract Document unless Contractor has in writing called the Engineer-in-charge attention to each such variation at the time of submission as specified above and received written approval of each such variation by specific written notation thereof incorporated in or accompanying the Sample approval; nor will any approval by Engineer- in-charge relieve Contractor from responsibility for complying with the requirements of contract.

d. Only when the samples are approved in writing by the Engineer-in-charge, the contractor shall proceed with the procurement and installation of the particular material / equipment. The approved samples shall be signed by the Engineer-in-charge for identification and shall be kept on record at site office until the completion and acceptance of the work and shall be available at the site for inspection / comparison at any time. Samples approved shall be kept in the sample room till the complete ion of the work. The contractor shall keep with him a duplicate of such samples to enable him to process the matter.

e. For items of works where the samples are to be made at the site, the same procedure shall be followed. All such samples shall be prepared at a place where it can be left undisturbed until the completion of the project.

f. The Engineer-in-charge shall communicate his comments / approval to the Contractor to the samples at his earliest convenience. Any delay that might occur in approving of the samples for reasons of its not meeting with the specifications or other discrepancies, inadequacy in furnishing samples of appropriate quality from various manufacturers and such other aspects causing delay on the approval of the materials / equipment's etcetera, shall be ascribable to the account of the contractor. In this respect the decision of the Engineer-in-charge shall be the final.

vi. On delivery of the supplies of materials / equipment's for permanent works at the site, the contractor shall specifically arrange to get the supply inspected by the Engineer-in-charge and compared with the approved sample and his specific approval obtained before using the same in the work.

vii. Cost of Tests:

The cost of making any test shall be borne by the Contractor as intended by or provided for the Contract or as found necessary by the Engineer-in-charge for ascertaining whether the quality of materials intended to be used by the Contractor in the Works is acceptable, whether any finished or

partially finished work is appropriate for the purposes for which it was intended to fulfill.

viii. Testing facilities

The Contractor shall, at his own cost, provide testing facilities as per CPWD specifications and IS Codes at site as stipulated in the General Conditions of Contract (GCC) or as directed by the Engineer-in-charge including staff required for testing. The tests shall be carried out jointly in the presence of Engineer-in- charge or his representative and the contractor or his representative.
The contractor shall also provide suitable weighing and measuring arrangement and testing instruments and machines for testing of materials and cubes at site as per details given in GCC.

The contractor shall carryout all the mandatory tests and shall maintain records of testing & checks of material, in formats, checklists etcetera to be given by Engineer-in-charge. All such records shall be maintained jointly by the contractor and Engineer-in-charge these shall remain under the custody of the Engineer-in- charge.

The laboratory shall be connected to the main potable water, electricity and other Services.

Some of the mandatory tests for each item of work and /or materials shall be carried out in approved outside laboratory as directed by the Engineer- in-charge. The Contractor shall bear the entire cost of testing charges for samples of items of work and /or materials and also the other expenditure towards making samples, packaging, and transport etcetera

The materials brought at site of work shall not be used in the work before getting satisfactory test result as per relevant mandatory tests, detailed in the relevant CPWD specifications and BIS codes.

7.3. Manufacturer's Instructions

Where manufacturers have furnished specific instructions relating to the materials and equipment used, covering points not specifically mentioned in these documents, manufacturer’s instructions shall be followed with the approval of Engineer-in-charge.

7.4. Inspection & Testing during manufacturing of Equipment

The Engineer-in-charge shall be entitled to inspect, examine and test during manufacturing of the materials and workmanship and check the progress of manufacturing of all fabrication materials to be supplied under the contract on the contractor’s premises during working hours, and if part of the said materials is being manufactured on other premises, the contractor shall obtain Engineer- in-charge permission to inspect the same at such premises. This inspection, examination or testing shall not relieve the contractor from any obligation under the contract. Inspection Call for any equipment shall be given 15 days in advance from the actual date of Inspection.

Following Equipment shall be invariably offered for Inspection: -

1) HT & LT Panels
2) Bus Ducts & Rising Mains

In case of other equipment, the Contractor shall intimate Engineer-in-charge regarding their readiness so as to decide their inspection if any.

The Engineer-in-charge reserves the right to request inspection and testing at manufacturer's Works at all reasonable times during manufacture of items for this Contract.

The Engineer-in-charge (PMC) or his authorized representative& ADA shall have full power to inspect the materials and workmanship at the Contractor's Works or at any place from which the materials or equipment is obtained. Approval by the Engineer-in-charge of any material or equipment shall in no way relieve the Contractor of his responsibility for meeting the requirements of the specifications. The cost incurred towards boarding, lodging etcetera (inland/abroad) of inspection engineer/engineers deputed by ADA shall be fully borne by the contractor & all such costs shall be deemed to be included in the Bid. Nothing extra shall be paid on this account whatsoever. The inspection and testing shall cover, but not limited to, the following: -

i. Routine and typical tests for the various items of equipment shall be performed at the Manufacturer's/ Contractor's Workshop in the presence of Engineer-in- charge or his authorized representative, results recorded and test certificates issued.

ii. After installation has been virtually completed, the Contractor shall carry out under the direction and in the presence of the representative of the Engineer-in- charge such tests and inspections as have been specified, or as considered necessary to determine whether or not the requirements of the item, drawings and specifications have been fulfilled. In case the work does not meet the full intent of the drawings and specifications and further tests after making require changes and as considered necessary shall be done again, the Contractor shall carry them out and bear the expenses thereof. If tests fail to demonstrate the satisfactory nature of the installation or any part thereof, then no claims for the extra cost of modifications, replacement or retesting will be considered. The decision of the Engineer–in-charge shall be regarded as final as to what constitutes a satisfactory test.

iii. The Contractor shall provide all necessary instruments such as Theodolite, Dumpy level, steel tapes, weighing machine, plumb bobs, spirit levels, hammers, micro-meters, thermometers, hydraulic cube testing machine, smoke test machine and labour, etcetera for conducting tests. All such equipment's shall be tested for calibration by an approved laboratory. The Contractor shall make adequate records of the test procedures, readings and results to be maintained by the Engineer-in- charge who shall issue test certificates signed by the person authorized by him.

iv. The contractor shall arrange all necessary instruments, tools, tackles and testing facilities free of cost for such inspections. Contractor shall

arrange for inspection visit(s) and bear all inspection costs including Inland/ abroad travel

v. (Air/Rail/Road), lodging and boarding expenses etcetera free of cost for the Inspection Engineer(s) deputed by ADA.

vi. The above general requirements as to testing shall be read in conjunction with any particular requirements specified elsewhere

vii. Dates for Inspection &Testing

viii. The dates of Inspection & Testing, after receipt of written request by the Contractor, shall be mutually agreed by the Engineer-in-charge and the contractor.

ix. Facilities for Testing at Manufacturer's Works

Where the contract provides for tests on the premises of the contractor or of any sub-contractor the contractor shall provide such assistance, labour, materials, electricity, fuel, stores, apparatus and instruments as may be required and as may be reasonably demanded to carry out such tests.

x. Rejection

If as a result of such inspection, examination or test of the works (other than a Test on Completion the Engineer-in-charge shall decide that such material is defective or not in accordance with the contract he shall notify the contractor accordingly stating in writing his observations and reasons thereof. The contractors shall with due diligence make good the defect and ensure that the material complies with the Contract. Thereafter, if required by the Engineer-in- charge, the tests shall be repeated under the same terms and conditions till satisfactory results are made available.

xi. Delivery of Materials and Equipment

The contractor shall be responsible for all materials and equipment brought at site for the purposes of the contract. Unless the Engineer-in-charge directs, no material shall be brought to the site which is not required for execution of the work.

xii. Inspection & Testing and Re-inspection

All deficiencies revealed by testing and inspection shall be rectified by the contractor at his own expense and to the satisfaction and approval of the Engineer-in-charge. Rectified components shall be subject to re-testing till desired results are obtained.

xiii. Delayed Tests

If the Engineer-in-charge opines that Tests on Completion are being delayed by the Contractor, the Engineer may by notice require the Contractor to carry out such Tests within14 (fourteen) days after the receipt of the notice. The Contractor shall carry out such Tests on such day or days as the Contractor may fix and of which he shall give notice to the Engineer.

If the Contractor fails to carry out the Tests on Completion within14 (fourteen) days, the Engineer may proceed with such Tests at the risk and cost of the Contractor. The Tests on Completion then shall be deemed to have been carried out in the presence of the Contractor and the results of such Tests shall be accepted as accurate.

xiv. Inspection Reports

The contractor shall provide the Engineer - in- Charge with five copies of reports of all inspection and tests.

7.5. Access for Inspection

Persons nominated by Engineer-in-charge shall at all reasonable times have free access to work and/ or to the workshops, factories or other places where materials are lying or from which they are being obtained and the Contractor shall extend necessary service to Engineer-in-charge and their representatives every facility necessary for checking measurements, inspection and examination and test of the materials and workmanship.

8. Time Schedules

8.1. Time shall be the essence of the contract. Time allowed for carrying out the work as mentioned in the contract shall be strictly observed by the contractor and it shall be reckoned from the issue of the Date of letter for commencement of work. It may be noted that the **Construction of Infrastructure Development Work of Atal Puram Township at district Agra, Uttar Pradesh, INDIA" on EPC Basis** involves construction of various building including development of the complex as detailed in the detailed user requirement. The Buildings & all the Infrastructure are required to be handed over in phases as per the milestones detailed in schedule "F" of the General Condition of the Contract. The contractor shall before commence the work prepare a detailed work schedule. This schedule shall be strictly followed by the contractor. For completing the work in time, the contractor may have to work round the clock without interruption and no claim whatsoever shall be entertained on this account.

8.2. Commencement of Works

i. The Contractor shall commence the Works on the date specified in the Letter of Commencement for the work. Thereafter the Contractor shall proceed with due diligence, without delay, and in accordance with the programme or any revised or modified programme of the Works.

ii. The Contractor shall not commence the construction, manufacture or installation of the Works or of any part of the Works unless and until the Engineer has endorsed the relevant Drawings in accordance with the ADA's Requirements.

8.3. Time for Completion

i. Project completion Schedule including setting out date of completion in phases as defined under Schedule F.

ii. Time is the essence of Contract and will remain so at all times during the pendency of the Contract including the extended period of Contract.

The Contractor shall complete works as per completion schedule and ensure defect free completion and have passed the tests on the completion, including integrated testing where ever in the scope of work and commissioning of the whole of the Works and/or parts thereof before the same is taken over by the Administrative Department (Owner Department).

8.4. Mile Stones

i. The time allowed for execution of the Works and Mile Stones shall be as specified in the Schedule F. In case, the contractor does not achieve a particular milestone mentioned in or the re-scheduled milestone(s) by the Engineer-in-Charge/PMC, the amount shown against that milestone shall be retained and will be adjusted against the Liquidated Damages at the final grant of Extension of Time after completion of work.

ii. On failure to achieve a milestone, retaining of this amount from payments due to the contractor shall be automatic without any notice to the contractor. However, if the contractor catches up with the progress of work on the subsequent milestone(s), the entire retained amount shall be released. In case the contractor fails to make up for the delay in subsequent milestone(s), amount mentioned against each milestone missed subsequently also shall be retained. However, no interest, whatsoever, shall be payable on such amount retained by the ADA.

8.5. Operation & Maintenance of Buildings & all the infrastructure handed over/taken over prior to the stipulated date of completion for the complete project.

i. The “Construction of Buildings & all the Infrastructure of State Disaster Management Authority at district Lucknow, U.P., India, Uttar Pradesh involves Design, Engineering, Procurement and Construction (EPC) basis as per the Scope of work. The Buildings & all the Infrastructure and other services are required to be handed over in phases as per the milestones detailed in schedule

ii. “F” of the General Conditions of the Contract.

iii. In respect of the Buildings & all the Infrastructure handed over/taken over in phases, prior to the stipulated date of completion of the entire project, the contractor shall carry out the operation and maintenance of such Buildings & all the Infrastructure and services from the completion of respective phases till the completion of the defect liability period of entire project.

9. Completion of Work

9.1. Physical and Virtual Completion of Work

When the phase of the work as per milestone/whole of the Work is physically and virtually complete and has satisfactorily passed required tests that may be prescribed under the Contract:-

a The contractor shall give a written notice to this effect within 10 days of completion along with an undertaking to rectify any defects that may be found

during inspection. The Engineer - in- Charge shall jointly inspect the work with the contractor within 15 days of receipt of such notice.

b The Engineer-in-charge shall inspect the works completed to see if they are in such a condition so as to be put to its proper or other intended final use and / or occupied without any short comings and no major or minor items of works are remaining which in the opinion of the Engineer-in-charge will cause undue difficulties in satisfactory use/ occupation of the works.

9.2. Provisional Acceptance and Certificate of completion

The whole of the work shall be deemed to have been physically completed and provisionally accepted after fulfilment of all the following by the Contractor.

a Physical completion of all works and obtaining all required approvals from the statutory authorities as required for occupation and use of the works and handing over such certificates to the Engineer-in-charge

b Submitting As-Built Drawings, Catalogues, Brochures, and Data Sheets, manuals in the form as directed by Engineer in Charge

c Issue of Certificate of Physical Completion by the Engineer-in-Incharge.

9.3. Certificate of Final Completion

a The contract shall not be considered as completed until a Certificate of Final

b Completion has been issued by the Engineer-in-charge stating that the whole of the Works have been completed to his satisfaction and remedying / rectifying of defects have been satisfactorily completed.

c The work shall be treated as complete when all the phases and components of the work are complete. The Certificate for Final Completion of the Composite work shall be recorded by the Engineer-in-charge after obtaining / recording of completion certificate of all the components.

d Provided always that the issue of the Certificate of Final Completion shall be a condition precedent to payment or return to the Contractor the security deposit and / or

e Performance security in accordance with the conditions set out in the contract.

9.4. Certificate of Overall Completion

The Engineer-in-charge shall give the Certificate for Overall Completion as per the following, whichever is later:

• Twenty-eight days after the expiration of the Defects Liability Period

OR

• If different Defect Liability Periods shall become applicable to different sections or parts of the Works, the expiration of the last such period

OR

• As soon as thereafter any works ordered during such period and have been completed to the satisfaction of the ADA.

9.5. The contractor shall give performance test of the entire work as per standards specifications before the work is finally accepted and nothing extra whatsoever shall be payable to the contractor for the tests.

10. Handing over & Taking Over Process

Handing over & taking over process shall be done in phases as per the scope of phased construction given in Schedule “F” of the tender document. For handing over & taking over process, in addition to clauses specified elsewhere, following services / works have to be complied with by the contractor:

a. Submission of Guarantees in stamp paper, of appropriate value, (in prescribed format)

   for all water proofing treatment and Anti termite treatment etcetera executed in the works for a period of ten years. If any defects noticed within 10 years from completion of defect liability period the contractor shall be sole responsible for the defects and same shall be rectified by the contractor as per information from Engineer-in-Charge/PMC within a period of 10 days from the notice.

b. Rectification of all defects shall be carried out by the contractor before Handing over/ Taking over process.

c. As built drawings: - 6 (six) sets for all networks, standalone infrastructure, landscaping and arboriculture, buildings including gates and boundary wall, Specialized services and other required drawings as approved by Engineer-in-charge along with their soft copies in the required software version shall be submitted by the contractor before handing over & taking over process.

d. All services/equipment are to be run and checked before handing over & taking over process as per requirements of Engineer-in-charge.

e. Contractor has to arrange water, electricity, fuel, consumables and manpower at their own cost for the purpose of testing of services and equipments. No amount shall be payable on this account.

f. The Contractor shall submit catalogues, brochures, operation manual, manufacturer test certificate, Guarantee/ Warranty papers, license etcetera for all equipment /materials before handing over & taking over process.

11. Guarantees

Notwithstanding provisions in the General Condition of the Contract and elsewhere in these Specific Conditions of Contract, the contractor shall furnish the **guarantees** in the prescribed form appended herewith. These guarantees shall be provided at the stage of virtual completion of work and shall be effective from the completion of work, to be reckoned from the date after the expiry of the main tenance period prescribed in the contract. In case a specialized agency has been approved for execution of a work/system, the Contractor shall ensure that the Guarantees shall be though such agencies (Obligators/Guarantor). The guarantees shall be provided in respect of following works (as per formats appended to this document) and any additional works, as provided for in the contract.

i. For removal of defects after completion in respect of Water Supply and Sanitary Installations.
ii. For Water Proofing Treatment for Basements
iii. For Water Proofing Treatment for Roof
iv. For Water Proofing Treatment (Under floors)
v. For Anti-Termite Works
vi. For Aluminium Works
vii. For Structural Glazing / Curtain Wall System/works
viii. For Mechanical/ Seismic Expansion Joint/Works
ix. For any other work, as prescribed in the tender document.

12. Defect after completion

a) General

Any defect, shrinkage, settlement or other faults that may appear within the "Defects Liability Period" which in the opinion of the Engineer-in- charge are due to materials or workmanship not in accordance with the contract, shall be rectified as per the directions in writing of the Engineer-in- charge to the Authorized representative of the contractor within such reasonable time as shall be specified therein by the contractor, at his own cost.
In case of default, the Engineer-in-charge may employ any person's to amend and make good such defects, shrinkage, settlements or other faults and all expenses consequent thereon or incidental thereto shall be borne by the contractor.

All preventive/routine & breakdown maintenance related to all works executed under this Contract shall be in the scope of Contractor & cost incurred to this effect shall be deemed to be included in the Bid. Nothing extra will be paid on this account whatsoever.

The scope of work shall, also include operation and maintenance of various Civil & E&M works shall be carried out by EPC Contractor either himself or through respective OEM & Vendors who are involved in supply & installation of works at site. O&M activities shall be provided up to completion of the defect liability period i.e. up to 36 months from the date of start of the project, as already detailed above and shall be separately paid as per respective terms and conditions of this Contract.

b) Execution of work of repair etcetera

Any defects, shrinkage, settlement or other faults which may appear or be noticed within the defect liability period, and arising in the opinion of the Engineer-in- charge from materials or workmanship not having in accordance with the contract, shall upon the direction in writing of the Engineer-in-charge's representative and within such reasonable time as shall be specified therein and without any delay, be amended and made good or replaced by the contractor at his own cost.

c) Cost of Execution of Work of Repair, Etcetera

All such works shall be carried out by the Contractor at his own expense if the necessity thereof shall, in the opinion of the Engineer-in- charge, be due to the use of materials or workmanship not in accordance with the Contract, or due to neglect or failure on the part of the Contractor to comply with any obligation, expressed or implied, on the Contractor's part under the Contract.

d) Contractor's personnel to be at site

During the defects liability period the contractor shall depute at least one of his authorized representatives at site along with required tradesmen to attend the defects to the satisfaction of Engineer-in-charge.

13. Dues not paid by the Contractor

The contractor shall pay all dues or fees to Statutory authorities and Electric and Water supply authorities & Lift licensing authority etcetera within due period and indemnify the ADA and the Engineer-in-charge from any claims or compensations or penalties or damages arising out of non-payment of any such dues or fees. However, in case some dues or fees are not paid by contractor and or claims for compensations or penalties etcetera are raised by the Statutory authorities, the ADA may deposit the required amount or any or all of the above and recover or deduct the same from any money payable to the contractor by the ADA or any other means available to the ADA such as bank guarantee.

14. Urgent Repairs

If, by reason of any accident, or failure, or other event occurring to or in connection with the works, or any part thereof, either during the execution of the works, or during period of Defects Liability any remedial or other work or repair, shall, in the opinion of the Engineer- in-charge be urgently necessary for the safety of the Works and the Contractor is unable or unwilling to do such work or repair despite notice, the Engineer-in-charge may employ and pay other persons to carry out such work or repair as the case may be and may consider necessary. If the work or repair so done by the other agency is the work which, in the opinion of the Engineer-in-charge the Contractor was liable to do at his own expense under the Contract, all expenses incurred by Other agency in so doing shall be recoverable from the Contractor by the Engineer-in-charge, or shall be deducted by the Engineer-in- charge from any monies due or which may become due to Contractor.

15. Plant Temporary Works & Materials

a) Plant, etcetera Exclusive use for the Works

All Constructional Plant, Temporary Works and materials provided by the Contractor shall, when brought on to the Site, be deemed to be exclusively intended for the execution of the Works and the Contractor shall not remove the same or any part thereof except for the purpose of moving it from one part of the Site to another, without the consent, in writing of the Engineer-in-charge, which shall not be unreasonably withheld.

b) Removal of Plant etcetera

Upon completion of the Works, the Contractor shall remove from the Site all the said Constructional Plant and Temporary Works remaining thereon and any unused materials provided by the Contractor, within 10 days of obtaining the completion certificate/ Virtual completion of the work.

16. Reports by Contractor

a) The Contractor shall submit MSP (Microsoft) tracker activity wise bar charts, indicating the duration of various subheads of the work, for the complete work within 15 days of award of work or as per Clause 5 of the GCC, whichever is earlier, for approval by the
Engineer - in- Charge. On the basis of approved bar charts contractor shall submit Progress Charts by the 4th day of every month. Soft copy of PERT chart shall be supplied whenever demanded by the Engineer-in-charge.

b) The Contractor shall submit Monthly Progress Report in triplicate in format approved by Engineer-in-charge. Failure to submit reports may result in holding up or delay in Payment of bills.

c) Monthly Progress Photographs: - The Contractor shall arrange at his own cost to maintain a progress record of the works by taking postcard size colour photographs (preferably digitized photographs) 6 Nos. or more per month per block as directed by the Engineer- in-charge during the construction stages and after completion shall supply three sets at no extra cost. The Contractor will be required to submit monthly reports on the progress of his work as per the format approved by the Engineer-in-charge.

d) The Contractor shall prepare Weekly Reports of planned and actual progress of work and subsequent week's scheduled work. These will also include material procurement status. These reports shall be submitted to the Engineer-in-charge & shall be reviewed in Weekly
Co-ordination Meetings.

e) The Contractor shall file daily category-wise labour report to the Engineer-in-charge. The report shall indicate scheduled requirement against actual strength.

f) The contractor shall maintain daily weather record. Daily maximum and minimum temperature and corresponding, humidity shall be recorded and charted. Rainy days shall be recorded when the rain lasting more than one hour hampers the work. Any other inclemency in weather shall be recorded. The records shall be regularly shown to the Engineer-in-charge and his signature obtained.

17. Operations and Maintenance Manual

The Contractor shall provide and submit to the Engineer-in-charge with six copies of the Operation and Maintenance Instruction Manuals. The arrangement of these manuals shall be as follows:

SECTION A:	Index
SECTION B:	Salient features of the Project.
SECTION C:	Description and details of materials, items and fittings and fixtures used for the project along with Catalogues /Brochures Operation & Maintenance Manuals etcetera
SECTION D:	Operation & Maintenance instructions
SECTION E:	List of recommended Spare parts/consumables.

Until above mentioned documents are received and approved by the Engineer-in-charge, Contract shall not be considered as complete and payment will be withheld

until such documents etcetera have been submitted to and approved by the Engineer-in-charge. The cost of providing such records including proper submission thereof is deemed to be included in the Bid.

18. Co-ordination Meetings

The Contractor shall be required to attend co-ordination meetings with the ADA and the other Contractors during the period of Contract as intimated by the Engineer- in-charge. All costs incidental to such interaction shall be to the Contractor's account and no claim will be entertained by the ADA on this account.

19. Compliance of Statutory Obligations and obtaining Approvals/ Completion

20. Certificates:

The Contractor shall comply all the statutory obligations and obtain all required clearances to implement the project without any financial repercussions to Engineer-in-charge and ensure all follow up actions with the local authorities in this respect for smooth completion of the project. The Contractor shall obtain all necessary approvals from Municipal bodies and other local bodies including, Water/Sewer supply agencies, Electric Supply and inspectorate agencies, Police and Security Agencies, Chief Controller of Explosives, Fire Department, Civil Aviation Department, Lift inspector, Pollution Control Board, , tree replantation, permission for bore well and for temporary structures etcetera in accordance to prevailing rules, Building Bye-Laws etcetera, as the case may be with related to Construction/ Completion. The contractor shall be assisted by the Engineer-in-charge to obtain all NOC, completion & Occupancy certificates from respective local bodies and other statutory authorities, such as:

i. Construction Permit, if required
ii. Pollution control Board,
iii. Environment Clearances,
iv. Provisional & Final NOC from fire department,
v. Lift license i/c NOC,
vi. Chief Electrical Inspector CEA,
vii. Local Municipal authority.
viii. Airport Authority,
ix. Forest Department for tree replantation etcetera,
x. Explosive Department,
xi. Local Municipal authority for water and sewer connection,
xii. Building Occupancy Certificate
xiii. Any other statutory requirement for execution of work and to occupy the Buildings & all the Infrastructure and run the services in all respects.

Contractor shall organize all inspections of concerned authorities & obtain the NOC's within the time for completion. The Engineer-in-charge may, at the written request of the Contractor, assist him in obtaining the approvals from relevant authorities. However, any such request by the Contractor shall not bind the Engineer-in-charge in any manner.

All expenditure on these accounts will be borne by the contractor. However, the fees paid by the contractor to these statutory authorities only for obtaining the required

statutory approvals shall be reimbursed by ADA on submission of valid payment receipts from these statutory authorities.

The contractor is required to submit the relevant drawings/filled application forms as per prescribed format & any other details like completion Drawings and any other statutory documentary requirements of local bodies in copies as per requirement to obtain the above etcetera at their own cost.

21. Training and Operating Instructions

a If required by the Engineer-in-charge, the Contractor shall at his cost, train members of the maintenance staff of Administrative Department either at his or the subcontractor's workshop or at such other place or places as may be considered suitable by the Engineer- in-charge.

b Upon completion of all work and all tests, the Contractor shall furnish the necessary.

c skilled/unskilled/semi-skilled personnel for operating the entire installation for a period of thirty (30) working days. During this period, the Contractor shall instruct and train the Administrative Department representative(s) in operation, adjustments and maintenance of the equipment installed.

d The Contractor shall submit to the Engineer-in-charge draft comprehensive operating instructions and maintenance schedule for all systems and equipment included in this Contract. This shall be supplemented, not substituted, by manufacturer's operating and maintenance manuals. Upon approval of the draft, the Contractor shall submit to the Engineer-in-charge six (6) complete bound sets of operating and maintenance schedules along with manufacturers printed literature/catalogues.

22. Test Certificates

The contractor shall submit test certificates for all the materials / systems issued by the Engineer-in-Charge approved inspection / office / manufacturer certifying the Equipment / Materials / installation and its function are in agreement with the requirements of relevant specifications and accepted standards.

23. Quiet Operation and Vibration

All equipments shall operate under all conditions of designed load without any sound or vibration, which is considered objectionable by the Engineer-in-charge. Such conditions shall be corrected by the Contractor at his own expense. Decision of the Engineer-in-charge shall be final in this regard.

24. Accessibility

The Contractor shall locate all equipments, which require servicing, operation or regular maintenance in fully accessible positions. The exact location and size of access panels, required for each valve or other devices requiring attendance, shall be finalized and communicated to Engineer - in- Charge well in time, to facilitate working by other agencies, failing this, the Contractor shall make all the necessary repairs and changes at his own expense.

25. Licenses and Permits

The Contractor or the approved specialized agency engaged by them shall hold a valid license for services like plumbing, electrical, Lifts etcetera & wherever required in addition, issued by the Competent Authority under whose jurisdiction the work falls.

26. Plant, Materials and Workmanship

26.1 Manner of Execution	The Contractor shall carry out the manufacture of Plant, the production and manufacture of Materials, and all other execution of the Works: (a) in the manner (if any) specified in the Contract, (b) in a proper workmanlike and careful manner, in accordance with recognised good practice, and (c) with properly equipped facilities and non-hazardous Materials, except as otherwise specified in the Contract.
26.2 Samples	The Contractor shall submit samples to the Employer, for review in accordance with the procedures for Contractor's Documents as specified in the Contract and at the Contractor's cost. Each sample shall be labelled as to origin and intended use in the Works.
26.3 Inspection	The Employer's Personnel shall at all reasonable times: (a) have full access to all parts of the Site and to all places from which natural Materials are being obtained, and (b) during production, manufacture and construction (at the Site and elsewhere), be entitled to examine, inspect, measure and test the materials and workmanship, and to check the progress of manufacture of Plant and production and manufacture of Materials. The Contractor shall give the Employer's Personnel full opportunity to carry out these activities, including providing access, facilities, permissions and safety equipment. No such activity shall relieve the Contractor from any obligation or responsibility.
	The Contractor shall give notice to the Engineer whenever any work is ready and before it is covered up, put out of sight, or packaged for storage or transport. The Engineer shall then either carry out the examination, inspection, measurement or testing without unreasonable delay, or promptly give notice to the Contractor that the Engineer does not require to do so. If the Contractor fails to give the notice, he shall, if and when required by the Engineer, uncover the work and thereafter reinstate and make good, all at the Contractor's cost.
26.4 Testing	This Sub-Clause shall apply to all tests specified in the Contract, other than the Tests after Completion (if any). Except as otherwise specified in the Contract, the Contractor shall open a site Laboratory, provide all apparatus, assistance, documents and other information, electricity, equipment, fuel, consumables, instruments, labour, materials, and suitably qualified and experienced staff, as are necessary to carry out the specified tests efficiently. The Contractor shall agree, with

	the Engineer, the time and place for the specified testing of any Plant, Materials and other parts of the Works. The Engineer may, vary the location or details of specified tests, or instruct the Contractor to carry out additional tests. If these varied or additional tests show that the tested Plant, Materials or workmanship is not in accordance with the Contract, the cost of carrying out this Variation shall be borne by the Contractor, notwithstanding other provisions of the Contract. The Engineer shall give the Contractor not less than 24 hours' notice of the Engineer's intention to attend the tests. If the Engineer does not attend at the time and place agreed, the Contractor may proceed with the tests, unless otherwise instructed by the Engineer, and the tests shall then be deemed to have been made in the Engineer's presence. If the Contractor suffers delay and/or incurs Cost from complying with these instructions or as a result of a delay for which the Employer is responsible, the Contractor shall give notice to the employer and shall be entitled to: (a) After receiving this notice, the Engineer shall proceed to agree or determine these matters. The Contractor shall promptly forward to the Engineer duly certified reports of the tests. When the specified tests have been passed, the Engineer shall endorse the Contractor's test certificate, or issue a Certificate to him, to that effect. If the Engineer has not attended the tests, he shall be deemed to have accepted the readings as accurate.
26.5 Rejection	If, as a result of an examination, inspection, measurement or testing, any Plant, Materials or workmanship is found to be defective or otherwise not in accordance with the Contract, the Engineer may reject the Plant, Materials or workmanship by giving notice to the Contractor, with reasons. The Contractor shall then promptly make good the defect and ensure that the rejected item complies with the Contract. If the Engineer requires this Plant, Materials or workmanship to be retested, the tests shall be repeated under the same terms and conditions. If the rejection and retesting cause the Employer to incur additional costs, the Contractor shall pay these costs to the Employer.
26.6 Remedial Work	Notwithstanding any previous test or certification, the Engineer may instruct the Contractor to: (a) remove from the Site and replace any Plant or Materials which is not in accordance with the Contract, (b) remove and re-execute any other work which is not in accordance with the Contract, and (c) execute any work which is urgently required for the safety of the Works, whether because of an accident, unforeseeable event or otherwise. The Contractor shall comply with the instruction within a reasonable time, which shall be the time (if any) specified in

	the instruction, or immediately if urgency is specified under sub-paragraph (c). If the Contractor fails to comply with the instruction, the Employer shall be entitled to employ and pay other persons to carry out the work. Except to the extent that the Contractor would have been entitled to payment for the work, the Contractor shall pay to the Employer all costs arising from this failure.
26.7 Ownership of Plant and Materials	Except otherwise specified in the Contract, each item of Plant and Materials shall, to the extent consistent with the Laws of the Country, become the property of the Employer at whichever is the earlier of the following times, free from liens and other encumbrances: (a) when it is incorporated in the Works; (b) when the Contractor is paid the corresponding value of the Plant and Materials.
26.8 Royalties	Unless otherwise stated in the Specification, the Contractor shall pay all royalties, rents and other payments for: (a) natural Materials obtained from outside the Site, and (b) the disposal of material from demolitions and excavations and of other surplus material (whether natural or man-made), except to the extent that disposal areas within the Site are specified in the Contract.

Request for Inspection/ Approval

Project: Selection of Contractor for Integrated Infrastructure Development Works, in Atal Puram Township at Agra in the State of Uttar Pradesh on EPC basis

REQUEST FOR INSPECTION / APPROVAL

Cleint	Agra Development Authority
PMC	----------
Contractor	----------

RFI NO.: _____ Date of Submission: _____

Description of Works	: _____		
Location Chainage	: _____		
BOQ Item No.	: _____		
Approx Quantity	: _____		
RFI Sumission Date	: _____	Time : _____	
Submitted By	: _____	Position : _____	
Date of Inspection	: _____	Time : _____	

ADA for Construction supervision & Quality control

Date:	Time:	Comments
Site Engineer		

Satisfactory / Non – Compliance _____

_____

_____

Date:	Time:	Comments
Survey Engineer		

Satisfactory / Non – Compliance _____

_____

_____

Approved Quantity _____

APPROVED / REJECTED for the following reasons

_____

_____

ADA	Expert (PMC)	Team Leader (PMC)	Officer
Signature	Signature	Signature	Signature

1. Comments Resolution Sheet

OWNER'S ENGINEERING/REVIEW ENGINEERING FOR PROJECT :

Project: Selection of Contractor for Integrated Infrastructure Development Works, in Atal Puram Township at Agra in the State of Uttar Pradesh on EPC basis

Project Owner: **Agra Development Authority**	**Implementing Agency:** ---------- ---------- ----------		

Comments Resolution Sheet

DOCUMENT NO./ DRAWING NO.	----------	TRANSMITTAL NO.	----------
DRAWING/ DOCUMENT DATE	----------	DATE	----------
DOCUMENT NAME/ DRAWING NAME	----------	REVISION NO.	B

S. No.	ITEM DESCRIPTION/SUBJECT HEAD/CLAUSE NO.	ADA OBSERVATIONS & COMMENT	APPROVAL CATEGORY	CONTRACTORS REPLY	ADA REPLY	APPROVAL CATEGORY
1						

Approval Category: (CAT-A/1/2/3/4)
A- "GOOD FOR CONSTRUCTION"
1 - "APPROVED" Drawing/documents approved for final distribution.
2 - "APPROVED WITH COMMENT" Drawing/Document cleared for Fabrication/Manufacturing subject to incorporating the comments.
Resubmit the Drawing/Document for Cat-1 approval and further for GFC drawing
3 - "COMMENTED-TO BE RESUBMIT"
4 - "NOT APPROVED-REJECTED"
5 - "RECIEVED FOR INFORMATION ONLY"

Specific Conditions of Contract-ELECTRICAL SERVICES

2. General

i. The Specific Conditions of the Contract - Electrical Services shall read in conjunction with the Specific Conditions of the Contract-Scope of Work, and, Specific Condition of the Contract-General. In case of variations / deviations, if any, the Specific Conditions of the Contract- Electrical Services shall prevail.

ii. The electrical installations shall be in total conformity with the Shop Drawings, Single Line Diagrams (SLD), Design Basis Report, Schematic Drawings, Power & Control wiring drawings etcetera prepared by the Contractor and approved by the Engineer-in- charge & shall be tested & commissioned in the presence of the Contractor and the Engineer - in-Charge.

iii. The responsibility for the sufficiency, adequacy and conformity to the Contract requirements of the electrical installation work lies solely with the Contractor.

iv. The planning, design, construction and workmanship shall be in accordance with the best engineering practices to ensure satisfactory performance and service life and shall be complete in all respects. Any materials or accessories which may not have been specifically mentioned, but which are necessary for the satisfactory and trouble-free operation and maintenance of the equipment shall be provided without any extra cost. This shall also include spares, consumables, tools & tackles required for commissioning of the equipment.

v. The Contractor shall obtain all statutory approvals (electrical loads, approval of drawing/ approval of meter room etcetera) from the concerned statutory authorities and permits required for the HT/LT electrical installation work. All statutory fee payable in this regard will be reimbursed against production of receipts/documentary evidence. On completion of work, the contractor shall obtain NOC from SEB/ Power Distribution Company & Director of Safety of the concerned state; a copy of the same shall be delivered to ADA. Contractor shall be responsible for dealing with SEB/ Power Distribution Company and other statutory authorities till project commissioning/ handing over and getting electricity in the complex.

vi. The Engineer-in-Charge shall have full power for getting the materials or work tested by independent agency at the electrical contractor's expenses in order to prove their soundness and adequacy. The contractor will rectify the defects/ suggestions pointed out by Engineer-in-Charge/independent agency at his own expenses.

3. Regulations and Standards

i. The installation shall comply in all respects with the requirements of Indian Electricity Act 1910, Indian Electricity Rules (IER) 1956 and other related Laws and Regulations as amended up to date, there under and special requirements, if any, of the State Electricity Boards/ Power Distribution Company etcetera The Bidder is liable to furnish the list of authorized licensed persons/ employed/deputed to carry out the works/perform the assigned duties to fulfill the requirements of IER 1956 as amended up to date.

ii. Wherever these Specific Conditions call for a higher standard of material and /or workmanship than those required by any of the above regulations, then these Specific Conditions shall take precedence over the said Regulation and Standards. All Internal & External Electrical works, LV works, ~~HVAC,~~ Fire Fighting,

Fire detection & alarm system etcetera to be done as per specifications &relevant BIS codes and other applicable codes as relevant.

4. Conformity with Statutory Acts, Rules and Standards

i. All installations shall be in conformity with the Bye-laws, Regulations and Standards of the local authorities as applicable. But if the specifications and drawings call for a higher standard of material and/or workmanship than those required by any of the above Regulations and Standards, then the specifications and drawings provided in the contract shall take precedence over the said regulations and standards as per the directions of the Engineer-in-charge.

ii. However, if the drawings or specifications required something which violates the Bye- laws and Regulations, then the Bye-laws and Regulations shall govern the requirement of this installation as per the directions of the Engineer- in- charge.

iii. Indian Electricity Act and Rules: All electrical works in connection with installations of the system shall be carried out in accordance with the provision of the Indian

Electricity Act, 1910 and the Indian Electricity Rules 1956, both amended up to date.

i. CPWD Specifications: as at Schedule “F” of GCC.

ii. Indian Standards: The system / components shall conform to relevant BIS wherever they exist and to the National Building Code-2016 and ECBC with latest amendments /addendums.

iii. Nothing in these specifications shall be construed to relieve the Contractor of his responsibility for the design, manufacture and installation of the equipment with all its accessories in accordance with applicable Statutory Regulations and safety codes in force.

5. Completeness of Bid

All sundry fittings, assemblies, accessories, hardware items, foundation bolts, termination lugs for electrical connections as required, and all other sundry items which are useful and necessary for proper assembly and efficient working of the various components of the work shall be deemed to have been included in the quoted prices, whether such items are specifically mentioned in the Bid documents or not.

6. Works to be done by the Contractor: -

Unless and otherwise mentioned in the Bid documents, the following works shall be done by the Contractor, and their cost shall be deemed to be included in the contract price:

i. Foundations for equipment and components where required, including foundation bolts
ii. Cutting and making good all damages caused during installation and restoring the same to their original finish
iii. Sealing of all floor openings including shafts and niches etcetera provided for pipes, ducts, cables, bus bars etcetera from fire safety point of view, after laying of the same.
iv. Painting at site of all exposed metal surfaces of the installation other than pre-painted items like fittings, fans, switchgear/ distribution gear items, cubicle switch

board etcetera damages during erection, shall however be rectified by the contractor.

v. Testing and commissioning of complete installation.

7. Cutting of structural members

No structural member shall be chased or cut without the written permission of the Engineer-in-Charge.

8. Drawings

The tender drawings have been appended to the tender document for guidance of the contractor. The contractor shall plan and design all services and prepare shop drawings. The shop drawings shall cover, but not limited to, the extent and general arrangements of the fixtures, controlling switches, wiring system, distribution boards, panels, sub-panels etcetera The Contractor shall submit requisite number of working electrical drawings based on tender drawings including reflected ceiling plan for the Engineer-in-charge's approval. Contractor has to make necessary changes if any as per comments given by Engineer-in- charge before execution. The work shall be executed as indicated in the approved drawings, however any minor changes found essential to co-ordinate the installation of this work with the other trades shall be made in consultation with the Engineer-in-charge.

Any discrepancies noticed shall be reported to the Engineer-in-charge for clarification. In case of failure to do so Contractor shall not be entitled to any cost for omissions or defects in electrical drawings due to any conflict with other services work.

Any information/data shown/not shown in these drawings shall not relieve the contractor of his responsibility to carry out the work as per the specifications. Additional information required by the Bidder/tenderer for successfully completing the work shall be obtained by him.

9. Position of HT/LT Switch Boards

The recommended position of the switch boards, transformer as shown on the layout drawings will be adhered to as far as practicable.

The contractor shall procure such equipment/ materials as per list of the approved makes with prior approval of Engineer-In-Charge. For all non-specified items, approval of the

Engineer-In-Charge shall be obtained prior to procurement of the same. Engineer-In-Charge/ADA shall in no way be liable for rejection of the any material due to poor quality, poor workmanship, poor material etcetera.

10. Shop Drawings

Prior to the laying of the conduits and trunking, the Contractor shall submit the shop drawings for the approval of the Engineer-in-charge. The observations, if any, of Engineer- In charge shall be incorporated and drawings shall be re-submitted for the approval of the Engineer-in-charge.

The Contractor shall prepare and submit to the Engineer-in-charge for his approval detail shop drawings, General Arrangement Drawings, SLD, power/ control wiring drawing for Main & Sub Panels / Distribution Boards, special pull boxes, light & fan switchboards, telephone distribution boards, FDA system and lightning protection system and other equipment to be procured/ fabricated by the Contractor.

The contractor shall prepare detailed coordinated electrical shop drawing indicating lighting/lighting fixtures, convenience outlets, HT Panels, LT Panel Boards/ Panels, PCC, DB's, Rising Mains, Cable Schedule with other relevant services and submit for approval of the Engineer-in-Charge before commencing the work. The shop drawings shall indicate all setting out details and physical dimensions of all components, GA Drawings, wiring and cable details for 33/ 11 KV Panel Board, LT Panels, PCC's, MCC's, cable schedule and routes, manhole trap etcetera The fixing details for conduits indicating run and size of wire/cables, outlet/pull/junction boxes etcetera with fixing details etcetera shall be provided. All works shall be carried out after the approval of these drawings. However, approval of these drawings do not relieve the contractor of his responsibility for providing maintenance free and fool proof system including any missing component/ accessories to meet with the intent of the specifications. Contractor will submit requisite no of prints for preliminary approval and finally requisite sets of prints for distribution.

The Contractor shall submit and get approved the relevant drawings at least 15 days before placing of the orders with manufacturers/suppliers.

The approval of shop drawings, schedule, brochures etcetera by Engineer-in-charge and shall not relieve the Contractor from responsibility for any deviation from drawings or specifications unless he has in writing informed by Engineer-in-charge of such deviations at the time of submission of the drawings nor shall it relieve the Contractor from any responsibility for errors or omissions of any kind in the shop drawings.

11. Materials & Equipment and Approval Thereof

All the materials and equipment shall be of the approved make and design. Unless otherwise called for any approval by Engineer-in-Charge, only the best quality materials and equipment shall be used.

All materials and equipment shall be ISI marked, as applicable, and shall be of the make and design approved by the Engineer-in-charge. Unless otherwise called for, only the best Grade of materials and equipment shall be used. The Contractor shall be responsible for the safe custody of all materials and equipment's till these are taken over by Administrative Department and shall insure them against theft, damage by fire, earth quake etcetera A list of items of materials and equipment, together with a sample of each shall be submitted to the Engineer-in-charge for his approval and shall be kept in the sample box.

All materials used on the Works shall be new and of the approved quality, conforming to the relevant specifications. Prior approval shall be obtained in writing from the Engineer- in-charge for all materials proposed and when approved, sample shall be duly identified and labelled, it shall be deposited with the by Engineer-in-charge/ and shall be kept in the sample room at Site

11.1. Technical Submittals

The Contractor shall submit Technical Submittals for all materials, equipment and machinery for approval in writing of the Engineer-in-charge before placing orders. The material submittals shall comprise of at least the following:

i. Manufacturer's technical catalogues and brochures giving technical data about performance and other parameters
ii. Manufacturers drawings / sketches showing construction, dimensional and installation details
iii. Rating charts and performance curves clarifying rating of equipment proposed.

11.2. Samples, Catalogues, Brochures and Data

Contractor shall submit the samples & catalogue of the material, which are proposed to be used at Site as per the approved makes for obtaining approval of the Engineer-in-charge.

The Contractor shall submit the number of copies, as required, of all brochures / manufacturer's description data, operation manuals with internal complete circuit diagrams and other similar literature while obtaining the approval of product from Engineer-in-charge.

12. Inspection, Testing and Inspection Certificate

a. The Engineer-in-charge/ADA or duly authorized representative shall have at all reasonable times free access to the Contractor/ Manufacturer's premises or works and shall have the power at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection, if part of the works is being manufactured or assembled at other premises or works, the Contractor shall obtain permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works. Inspection may be made at any stage of manufacture, dispatch or at site at the option of the Engineer-in-charge/ADA and the equipment if found unsatisfactory due to bad workmanship or quality, material is liable to be rejected.
b. All equipment being supplied shall conform to Routine and Type Tests in accordance with relevant IS Codes requirements stipulated under respective sections. Routine and Type Tests shall be carried out at manufacturers' works/ factories. Expenditure incurred on conducting such tests shall be to the Contractor's account. Bidder shall submit the routine & type tests reports to Engineer-In-charge.
c. The Engineer-in-Charge shall inform contractor within fifteen (15) days from the date of inspection or as defined, inform in writing to the Contractor of any objection to any drawings and all or any equipment and workmanship which in his opinion is not in accordance with the Contract. The Contractor shall give due consideration to such objections and make the necessary modifications accordingly.
d. Before dispatch to site, the contractor shall offer the equipment for inspection at premises of the manufacturer, 15 days in advance and inform Engineer-in- charge about the date of inspection. Subsequently, Engineer-in-charge shall depute its Inspection Engineer(s) for carrying out the inspection at premises of the manufacturer on mutually agreed date(s). Contractor shall invariably depute his representative(s) for witnessing the complete inspection procedure jointly with Inspection Engineer(s) of Engineer-in-charge.
e. The contractor shall arrange all necessary instruments, tools, tackles and testing facilities free of cost for such inspections. Contractor shall arrange for inspection visit(s) and bear all inspection costs including Inland/ abroad travel (Air/Rail/Road), lodging and boarding expenses etcetera free of cost for the Inspection Engineer(s) deputed by Engineer-in-charge.
f. For tests whether at the premises or at the works of the Contractor or of any Sub-Contractor, the Contractor except where otherwise specified shall provide Free of

charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be required by Engineer-in-charge or this authorized representative to carry out effectively such tests of the equipment in accordance with the Specification.

g. The inspection by Engineer-in-charge/PMC and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed quality assurance programme forming a part of the Contract.
h. The ADA will have the right of having at his own expenses any other tests(s) of reasonable nature carried out at Contractor's premises or at site or in any other place in addition of aforesaid type and routine tests to satisfy that the material comply with the specifications.
i. The ADA reserves the right for getting any field tests not specified in respective sections of the technical specification conducted on the completely assembled equipment at site. The testing equipment for these tests shall be provided by the Contractor.
j. ADA reserves the right to waive off inspection of any equipment, items etcetera at its sole discretion.
k. Notwithstanding approval of tests or equipment by the by Engineer-in-charge, the Contractor shall be required to perform site tests and prove the correctness of ratings and performance of equipment / machinery and materials supplied and installed by the Contractor as per the Contract specifications and conditions. The Engineer-in- charge shall also have the power to order the material or work to be tested by an independent agency at the Contractor's expense in order to prove soundness &adequacy.

13. Testing and Commissioning

The Contractor shall pay for and arrange without any cost to the Engineer-in- charge, all necessary balancing and testing equipment, instruments, materials, accessories, power, water, fuel and the requisite labour for testing. Any defects in materials and/ or in workmanship detected in the course of testing shall be rectified by the Contractor entirely at his own cost, to the satisfaction of the Engineer-in- charge. The installation shall be retested after rectification of defects and shall be commissioned only after approval by the Engineer-in-charge. All tests shall be carried out in the presence of the Engineer-in-charge or his representative.

14. PACKAGING

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. While packing all the materials, the limitation from the point of view of availability of Railway wagon/truck/trailer sizes in India should be taken account of the Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, wharf age and other such charges claimed by the transporters, railways etcetera shall be to the account of the Contractor. ADA takes no responsibility of the availability of any special packaging/transporting arrangement.

15. TESTS

I. Charging

On completion of erection of the equipment and before charging, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the Engineer- in-charge, ADA and the Contractor for correctness and completeness of installation and acceptability for charging, leading to initial pre-commissioning tests at Site. The pre-

commissioning tests to be performed as per relevant I.S. given and shall be included in the Contractor's quality assurance programme.

II. Commissioning Tests

The available instrumentation and control equipment will be used during such tests and the Contractor will calibrate all such measuring equipment and devices as far as practicable. However, unmeasurable parameters shall be taken into account in a reasonable manner by the Contractor for the requirement of these tests. The tests will be conducted at the specified load points and as near the specified cycle condition as practicable. The Contractor will apply proper corrections in calculation, to take into account conditions, which do not correspond to the specified conditions.

All instruments, tools and tackles required for the successful completion of the Commissioning Tests shall be provided by the Contractor, free of cost.

Pre-commissioning test shall be carried out as per relevant IS and/or as specified.

The Contractor shall be responsible for obtaining statutory clearances from the concerned authorities for commissioning of the equipment. Performance Bank Guarantee Certificates for Equipment

All equipment shall be guaranteed against unsatisfactory performance and/or break down for a minimum period of 12 (Twelve) months or as per Technical Specifications or as per OEM, whichever is higher, from the date of handing over of complete work to the Administrative Department. The equipment or component or any other

Part of installations found defective within the guarantee period shall be replaced/ repaired by the Contractor free of cost to the satisfaction of the Engineer-in-Charge. The above guarantee and/ or warrantee provided by the manufacturer will be submitted along with all the test certificates from manufacturer to Engineer-in- Charge.

16. Completion Drawings (As Built Drawings)

On completion of the work and before issue of certificate of virtual completion, the Contractor shall at his own cost submit to the Engineer-in-charge requisite Sets of layout drawings drawn at the approved scale indicating the actual installations. These drawings shall clearly indicate the complete plant layouts, and piping layouts, location wiring, exact location of all the concealed piping, valves, controls, wiring and other services. The Contractor shall also submit requisite sets of consolidated control diagrams, technical literature on all automatic controls and complete technical literature on all equipment and materials. The Contractor shall mount a set of all consolidated control diagrams and all piping diagrams/Single Line diagrams in a frame with glass, and display in the plant room.

Also, the contractor shall submit soft copy of 'As Built' drawings (in AutoCAD & PDF format) of the work including write up (trouble shooting, installation, operation and maintenance manual with instructions) incorporating all such changes and modifications during engineering and execution along with

warrantee & guarantee certificates from manufacturers. As-Built Drawings for all Buildings & all the infrastructure/ blocks/facilities constructed shall be provided as following:

a. Single Line diagrams showing all LT Panels, DB, Rising mains etcetera

b. Routing and locations of Conduits, inspection and junction boxes etcetera

c. Locations and rating of Light, Power and UPS sockets and switches
d. Location and details of main & sub distribution boards, distribution boards indicating the circuit number controlled by them
e. Type of fitting viz. fluorescent, pendants, brackets, bulkhead etcetera, including their rating & type of lamp, fans and exhaust fans
f. A complete wiring diagram as installed and schematic drawing showing all connections for the complete electrical system
g. Location of telephone outlets, junction boxes and sizes of various conduits and number & sizes of wire drawn
h. Layout of Telephone/ LAN/OF C cables
i. Location of all earthing stations, route and size of all earthing conductors, manholes etcetera
j. Layout and particulars of cables & sub mains.
k. Schematic drawing for Telephone & IPABX System
l. ~~Layout of conduits & locations of for LAN/ Wifi Points~~
i. Layout and details of Earthing Network & Lightning protection system including Insulation tests and earth test results
m. PA System drawings & Fire Alarm Control System Drawings
n. ~~Cable TV/ Dish Antenna drawings~~
o. General Arrangement drawings for all Electrical & LV Equipment
p. Cable route layout of HT, LT, Control cables & other cables
q. External lighting drawing with road layout
r. GA & Layout Drawings for Audio Video & Stage Lighting System
s. Any other drawings/details as per requirements and directions of Engineer-in- charge

17. Checks during Defect Liability Period

During the Defect Liability Period/ Maintenance Period, the Contractor shall monthly check all controls in various areas to ensure that these are functioning satisfactorily. This shall apply to all pressure switches and pressure gauges, contacts, relays, controller switches, high- and low-pressure cut-outs etcetera.

18. Check List

The Contractor shall provide to the ADA / Engineer-in-charge, 4 (four) copies of a comprehensive maintenance checklist and shall place a copy of it in the Substations & Plant Room. The checklist shall be a list of each piece of equipment in this Contract, and shall provide a space for each of the next fifty-two weeks to record the maintenance results and status of various equipments during the maintenance period. This list shall be updated every month at the time of inspection. The Contractor shall certify on this check list that he has examined each piece of equipment and that; it is operating as intended in the contract/ by the manufacturer, and that all necessary tests have been performed.

19. Repairs

All equipment that requires repairing shall be immediately serviced and repaired during the maintenance period. All spares/parts and labours shall be furnished by the contractor free of cost.

20. Training of Personnel

The Contractor shall arrange for training of the Administrative Department personnel prior to provisional takeover of the project including for the following:

i. Telephone Exchange
ii. All other Equipment like pumps, panels etcetera
iii. Adjustment of setting for controls and protective devices
iv. Preventive maintenance
v. Operation of all electrical panels including their interconnectivity and inter locking scheme
vi. All LV Works
vii. Pumping System
viii. Any other specialized system as executed under this contract

21. Safe Custody and Storage

Safe custody of all machinery and equipment dismantled, shifted & supplied by the Contractor shall be his own responsibility till the final taking over by the Administrative Department. The Contractor should, therefore, employ sufficient staff for watch and ward at his own expenses. ADA may, however, allow the Contractor to use the building space for temporary storage of such equipment, if such space is available.

22. Handling, Storing and Installation

- In accordance with the specific installation instructions as shown on manufacturer's drawings or as directed by the Engineer-in-Charge or his representative, the Contractor shall unload, store, erect, install, wire, test and place into commercial use all the equipment included in the contract. Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, square and properly aligned and oriented.
- Contractor shall follow the unloading and transporting procedure at site, as well as storing, testing and commissioning of the various equipment being procured by him separately. Contractor shall unload, transport, store, erect, test and commission the equipment as per instructions of the manufacturer's Engineer(s) and shall extend full co-operation to them.
- In case of any doubt/ misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the Engineer-in-Charge. Contractor shall be held responsible for any damage to the equipment consequent for not following manufacturer's drawings/instructions correctly.
- Where assemblies are supplied in more than one section, Contractor shall make all necessary connections between sections. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the Contractor at his own expense.
- The Contractor shall submit to the Engineer-in-Charge every week, a report detailing all the receipts during the week. However, the Contractor shall be solely responsible for any shortages or damages in transit, handling and/or in storage and erection of the equipment at Site. Any demurrage, wharf age and other such charges claimed by the transporters, railways etcetera shall be to the account of the Contractor.
- The Contractor shall be fully responsible for the equipment/material until the same is handed over to the Administrative Department in an operating condition after commissioning. Contractor shall be responsible for the maintenance of the

equipment/material while in storage as well as after erection until taken over by Administrative Department, as well as protection of the same against theft, element of nature, corrosion, damages etcetera

- The Contractor shall be responsible for making suitable indoor storage facilities, to store all equipment, which require indoor storage.
- The words 'erection' and 'installation' used in the specification are synonymous.
- Exposed live parts shall be placed high enough above ground to meet the requirements of electrical and other statutory safety codes.
- The minimum phase to earth, phase to phase and section clearance along with other technical parameters for the various voltage levels shall be maintained as per relevant IS codes.

23. Operation and running of entire system

The contractor shall pay for and arrange for operation & running of entire electrical system and other equipment for a minimum period of one month after satisfactory completion of work as desired by Engineer-in-charge. Cost of operation & running of entire system including required material e.g. Water, electricity, consumables, tools & tackles, requisite manpower etcetera shall be deemed to be included in the contract price and nothing extra shall be paid.

24. Layout of all services, SLD/ P&I diagrams, operating and maintenance instructions, DO's and Don'ts's etcetera for all the Substations, Plant rooms, pump room, control panels etcetera must be provided along with coloured prints at each floor.

Indicative quantities for estimates.

NOT TO BE INCLUDED IN THE TECHNICAL BID.

This detail to be submitted during the time of negotiation by the selected bidders.

- **Online financial quote will be considered and shall prevail.**
- **All line items in the online financial bid should correspond to these formats.**

Indicative quantities for estimates.

Not to be included in Technical Bid

1. Site Grading
2. Road pavement, culverts and minor bridges
3. Footpath & Track
4. Storm water drainage
5. Potable water supply
6. Sewerage system
7. Treated water supply
8. Rain water Harvesting
9. Solid Waste Management
10. Power Infrastructure & Street Lighting
11. Utility Duct
12. Landscaping, gate, boundary wall, arboriculture
13. Safety & security (ICT)

COST ESTIMATE FOR SITE LEVELLING & GRADING

Item	Description	Unit	Quantity	Applicable Rate	Amount
1.00	Cleaning Jungles including uprooting of trunk vegetation grass, bushes, wood trees and sapling of girth upto 30cm measured at a height of 1 meter above ground level and removal of rubbish upto a distance of 50 meters out side the periphery of area cleared.	Sqm	1385600		
2.00	Dismantling of flexible pavements and disposal of dismantled materials up to a lead of 1000 metres, stacking serviceable and unserviceable materials separately. (dismantling materials to be transported mechanically). Bituminous courses - By Mechnical Means	Cum	81		
3.00	Dismantling of existing structures like culverts, bridges, retaining walls and other structure comprising of masonry, cement concrete, wood work, steel work, including T&P and scaffolding wherever necessary, sorting the dismantled material, disposal of unserviceable material and stacking the serviceable material with all lifts and lead of 1000 metres Cement Concrete Grade M-15 & M-20 - By Mechanical Means	Cum	162		
4.00	Dismantling of existing structures like culverts, bridges, retaining walls and other structure comprising of masonry, cement concrete, wood work, steel work, including T&P and scaffolding wherever necessary, sorting the dismantled material, disposal of unserviceable material and stacking the serviceable material with all lifts and lead of 1000 metres Dismantling Brick / Tile work - In lime mortar	Cum	81		
5.00	Demolishing cement concrete manually/ by mechanical means including disposal of material within 50 metres lead as per direction of Engineer - in - charge. Nominal concrete 1:3:6 or richer mix (i/c equivalent design mix)	Cum	81		
6.00	Demolishing cement concrete manually/ by mechanical means including disposal of material within 50 metres lead as per direction of Engineer - in - charge. Nominal concrete 1:4:8 or leaner mix (i/c equivalentdesign mix)	Cum	81		
7.00	Excavation in Soil using Hydraulic Excavator and Tippers with disposal upto 1000 metres. (Excavation in soil with hydraulic excavator including cutting and loading in tippers, trimming bottom and side slopes, in accordance with requirements of lines, grades and cross sections, and transporting to the embankment location within all lifts and lead upto 1000m)	Cum	397403		
8.00	Earthwork in excavation in filling for site leveling and grading from existing ground level to finished ground level in all kinds of soil (excluding rock) including dewatering of surface or sub-surface water, transportation, spreading, levelling to required slope and compacting, rolling each layer with ½ tonne roller, or wooden or steel rammers, and rolling every 3rd and top-most layer with power vibratory roller of minimum 8 tonnes and dressing up to meet requirement of Tables 300.1 and 300.2 as per Technical Specification Clause 301.5 MORD/ 305 MORTH and filling the approved excavated earth in layers not exceeding 200 mm including breaking clods and make ready for watering with all bye works complete as per specification all safety, tools, plant and labour complete in all respect as directeed by Engineer-in charge. Profile measurement shall be taken before and after filling.	Cum	371711		
Total for Site Levelling & Grading Works					

COST ESTIMATE FOR ROADS

Item	Bill Description	Unit	Quantity	Rate	Amount
1	Dismantling of Structures (Dismantling of existing structures like culverts, bridges, retaining walls and other structure comprising of masonry, cement concrete, wood work, steel work, including T&P and scaffolding wherever necessary, sorting the dismantled material, disposal of unserviceable material and stacking the serviceable material with all lifts and lead of 1000 metres)				
	By Mechanical Means for items No. 2.04(b) & (c)				
	Cement Concrete Grade M-15 & M-20	CUM	200		0.00
	Dismantling Stone Masonry				0.00
	Rubble stone masonry in cement mortar.	CUM	150		0.00
2	Excavation for roadwork in soil with hydraulic excavator of 0.9 cum bucket capacity including cutting and loading in tippers, trimming bottom and side slopes, in accordance with requirements of lines, grades and cross sections, and transporting to the embankment location within all lifts and lead upto	CUM	1,58,845		0.00
3	Construction of embankment with approved material obtained from borrow pits with all lifts and leads, transporting to site, spreading, grading to required slope and compacting to meet requirement of table 300-2. as per Clause 305 of Technical Specification	CUM	16,800		0.00
4	Construction of sub-grade and earthen shoulders with approved material obtained from borrow pits with all lifts & leads, transporting to site, spreading, grading to required slope and compacted to meet requirement of table No. 300-2	CUM	1,01,795		0.00
5	Construction of Median and Island with Soil Taken from Borrow Areas Construction of median and Island above road level with approved material brought from borrow pits, spread, sloped and compacted as per clause 408	CUM	7,308		0.00
6	Compacting original ground supporting subgrade (Loosening of the ground upto a level of 500 mm below the subgrade level, watered, graded and compacted in layers to meet requirement of table 300-2 for subgrade construction.)	CUM	1,01,151		0.00
7	Construction of Granular Sub-Base of required grading as per design spreading in uniform layers with motor grader on prepared surface mixing by mix in place method with front end loader at OMC and compacting with vibratory roller to achieve the desired density, complete as per clause 401 For Grading -V Material	CUM	40,083		0.00
8	Providing, laying, spreading and compacting graded stone aggregate to wet mix macadam specification including premixing the Material with water at OMC in mechanical mix plant carriage of mixed Material by tipper to site, laying in uniform layers with paver/grader in sub-base / base course on well prepared surface and compacting with vibratory roller to achieve the desired density.	CUM	47,652		0.00
9	Providing and applying primer coat with Bitumen Emulsion on prepared surface of granular base including cleaning of road surface and spraying primer at the rate of 0.90 kg per Sqm using mechanical means.	SQM	190609		0.00
10	***Tack coat on Bituminous surface*** Providing and applying tack coat with RS1 Bituminous Emulsion using emulsion pressure distributor at the rate of 0.20 kg/m2 on the prepared bituminous surface cleaned with mechanical broom	SQM	381217		0.00

Item	Bill Description	Unit	Quantity	Rate	Amount
11	Providing and laying Dense Graded Bituminous Macadam with 120 TPH capacity hot mix plant batch type using crushed aggregates of specified grading, premixed with bituminous binder VG-40, @ 4.0 per cent by weight of total mix and filler, transporting the hot mix to work site, laying with mechanical paver finisher to the required grade, level and alignment, rolling with smooth wheeled, vibratory and tandem rollers to achieve the desired compaction as per MoRTH specification clause No. 505 complete in all respects	CUM	11518		0.00
12	Providing and laying Bituminous Concrete with 120 TPH capacity hot mix plant batch type using crushed aggregates of specified grading, premixed with bituminous binder VG-40, @ 5.4 per cent of mix and filler, transporting the hot mix to work site, laying with mechanical paver finisher to the required grade, level and alignment, rolling with smooth wheeled, vibratory and tandem rollers to achieve the desired compaction as per MORTH specification clause No. 507 complete in all respects	CUM	7649		0.00
13	Providing Landscaping complete at Median as per technical specifications	SQM	1887		0.00
14	Shrubs & floweing plants at Median (ht. maintained at 1.5 m) in median	km	0.77		0.00
15	Providing and laying of hot applied thermoplastic compound 2.5 mm thick including reflectorising glass beads @ 250 gms per sqm area, thickness of 2.5 mm is exclusive of surface applied glass beads as per IRC: 35. The finished surface to be level, uniform and free from streaks and holes all complete as per Technical specifications and as directed by the Engineer-in-charge.	Sqm	10840		0.00
16	Directional Arrows and Letters Road Marking with Hot Applied Thermoplastic Compound with Reflectorising Glass Beads on Bituminous Surface (Providing and laying of hot applied thermoplastic compound 2.5 mm thick including reflectorising glass beads @ 250 gms per sqm area, thickness of 2.5 mm is exclusive of surface applied glass beads as per IRC:35 .The finished surface to be level, uniform and free from	Sqm	40		0.00
17	Providing and fixing of retro-reflectorised cautionary, mandatory and informatory sign as per IRC: 67 made of high intensity grade sheeting vide clause 801.3, fixed over aluminium sheeting, 1.5 mm thick supported on a mild steel angle iron post 75 mm x 75 mm x 6 mm firmly fixed to the ground by means of properly designed foundation with M15 grade cement concrete 45 cm x 45 cm x 60 cm, 60 cm below ground level as per approved drawing all complete as per Technical specifications and as directed by the Engineer-in-charge				0.00
a	Place Identification sign (1200x800)	Nos	2		0.00
b	Triangle Sign 900mm	Nos	122		0.00
c	Octagonal Sign 900mm	Nos	122		0.00
d	Circular Sign600mm	Nos	120		0.00
e	Single chevron 600mm x 450mm	Nos	200		0.00
f	Oneway Object Hazard Marker (300 x 900)	Nos	10		0.00
g	Facility Sign Rectangular	Nos	10		0.00
h	Interchange Advance Guide (600x450)	Nos	2		0.00
j	Service Area Ahead Sign (600x450)	Nos	10		0.00
k	Overhead Cantilevel Gantry	tonne	3		0.00
m	NH Route Marker	Nos	0		0.00
i	Destination sign	Nos	4		0.00

Item	Bill Description	Unit	Quantity	Rate	Amount
18	Providing and erecting overhead signs with a corrosion resistant 2mm thick aluminium alloy sheet reflectorised with high intensity retro-reflective sheeting as per IRC:67:2012 with vertical and lateral clearance given in clause 802.2 and 802.3 and installed as per clause 802.7 over a designed support system of aluminium alloy or galvanised steel trestles and trusses of sections and type as per structural design requirements and approved plans. **A. Truss and Vertical Support**	tonne	4		0.00
19	Providing and erecting overhead signs with a corrosion resistant 2mm thick aluminium alloy sheet reflectorised with high intensity retro-reflective sheeting as per IRC:67:2012 with vertical and lateral clearance given in clause 802.2 and 802.3 and installed as per clause 802.7 over a designed support system of aluminium alloy or galvanised steel trestles and trusses of sections and type as per structural design requirements and approved plans. **B. Aluminium Alloy Plate for Over Head Sign**	Sqm	36		0.00
20	Kilometre Stone (Reinforced cement concrete M15grade kilometre stone of standard design as per IRC:8-1980, fixing in position including painting and printing etc)				
	i) Kilometer Stones	Nos	21		0.00
	ii)Hectometre Stone Stones	Nos	84		0.00
21	Providing and erecting a "Thrie" metal beam crash barrier comprising of 3 mm thick corrugated sheet metal beam rail, 85 cm above road/ground level, fixed on ISMC series channel vertical post, 150 x 75 x 5 mm spaced 2 m centre to centre, 2 m high with 1.15 m below ground level, all steel parts and fitments to be galvanised by hot dip process, all fittings to conform to IS:1367 and IS:1364, metal beam rail to be fixed on the vertical post with a space of channel section 150 x 75 x 5 mm, 546 mm long complete as per clause 810	Rm	800		0.00
22	Supplying and installation of delineators (road way indicators, hazard markers, object markers), 80-100 cm high above ground level, painted black and white in 15 cm wide strips, fitted with 80 x 100 mm rectangular or 75 mm dia circular reflectorised panels at the top, buried or pressed into the ground and conforming toIRC-79 and the drawings.	Nos	500		0.00
23	Providing and fixing of road stud 100x 100 mm, die-cast in aluminium, resistant to corrosive effect of salt and grit, fitted with lense reflectors, installed in concrete or asphaltic surface by drilling hole 30 mm upto a depth of 60 mm and bedded in a suitable bituminous grout or epoxy mortar, all as per BS 873 part 4:1973	Nos	2347		0.00
24	Construction of cement concrete kerb with top and bottom width 115 and 165 mm respectively, 250 mm high in M 20 grade PCC on M-10 grade foundation 150 mm thick, foundation having 50 mm	Rm	44747		0.00
	Total for Road Work				**0.00**

COST ESTIMATE FOR BOX CULVERT

Item No.	Description	Unit	Total Qty	Applicable Rate (in Rs.)	Amount (in Rs.)
BOX CULVERTS					
1	Earthwork in **excavation of foundation** for structures, including all lifts and leads complete as per drawing and Technical Specification Clause 304 and 2903				
	a)Ordinary and soft Soils (material to be used in embankments)	Cum	742		
2	Providing Plain Cement Concrete M15 for **levelling course** etc. including centering all complete as per drawing and Technical Specifications Section Section				
	PCC M15 grade	Cum	149		
3	Providing **Back filling** behind abutments, wing walls and return walls, with selected imported granular material of approved quality including all leads and lifts complete as per Technical Specification Clause 305.	Cum	683		
4	Providing and laying of **Filter media** of Stone aggregate conforming to Technical Specifications Clause 2504.2.2 behind abutment, wing wall, retaining wall and return walls, complete as per drawing and Technical Specifications Clause 305 & 2504.	Cum	888		
5	Providing and laying Plain/Reinforced cement concrete for **Foundation** complete as per drawing and Technical Specification Section 1500, 1700, 2100 & 2200				
	RCC M 30	Cum	502		
6	Providing, cutting, bending and fixing in position of TMT bar reinforcement in reinforced concrete Foundation complete as per drawing and Technical Specification	MT	35		
7	Providing and laying Plain/Reinforced cement concrete for **substructure** complete as per drawing and Technical Specification Section 1500, 1700, 2100 & 2200				
	RCC M 30	Cum	549		
8	Providing, cutting, bending and fixing in position of **TMT bar** reinforcement in reinforced concrete substructure complete as per drawing and Technical Specification	MT	38		
9	Providing and laying Reinforced cement concrete in **superstructure** excluding cost steel complete as per drawing and Technical Specification Section 1500, 1700, 2100 & 2300				
	RCC M 30	Cum	629		
10	Providing, cutting, bending and fixing in position of **TMT bar** reinforcement in reinforced concrete superstructure complete as per drawing and Technical Specification Section 1600 for 5.07a	MT	44		
11	Providing **Weep holes** in abutments, wing walls and return walls complete as per drawing and Technical Specification clause 2706.	Nos	1020		
12	**Painting of CD No.** and Span arrangement as per Technical specifications	Nos	102		
	Total				

COST ESTIMATE FOR BRIDGES

Sl. No.	Description	Unit	Quantity	Rate	Amount
MINOR BRIDGES					
1	Earthwork in excavation for structures including all lifts and leads complete as per drawings and Technical Specifications Clause No.304.				
	In all types of Soil/Clay/marsh, Road Crust	cu.m	7,805.00		-
2	Providing and laying in position Cement Concrete of Grade M 15 in leveling course below open foundations, pile caps, well cap projections, friction slab, annular filling around foundation in rock, etc., complete as per drawings and Technical Specification section 1500,1700, 2100	Cum	348.00		-
3	Providing and laying in position Cement Concrete in abutment piers, pier cap, pedestals, cantilever/counterfort abutments, abutment cap, dirt walls, wing walls, retaining walls, median wall etc. complete as per drawings and Technical Specifications 1500,1700 & 2200				-
	Box Structure				-
	(ii) Grade M 35	Cum	2,789.00		-
4	Providing & fixing in position HYSD (TMT) Fe 500 grade reinforcement bars in abutment wall, abutment cap, dirt wall, pier, pier caps and retaining wall, Box Strucutre, etc. complete as per drawings and Technical Specifications Section 1600.	MT	235.00		-
5	providing and Back filling behind/inside abutments, wing walls and return walls or any other area with selected imported granular materials of approved quality complete as per drawing & Technical Specification as per appendix 6 of IRC 78:2000.	cum	2,375.00		-
6	providing and filling Filter media behind abutment, retaining wall, return wall, etc., complete as per drawing and Technical Specifications	cum	990.00		-
7	Providing and fixing 100mm diameter PVC pipe for weep holes in retaining wall, abutment, wing/return wall extending to full depth of the member complete as per Technical Specification clause 2706	Nos.	1,647.00		-
8	Providing and fixing in position Expansion Joints complete as per drawings and Technical Specifications Section 2600.				-
	(I) Providing 20mm thick premoulded filler type joints complete as per drawing and technical specfications section 2600	Lm	230.00		-
9	Providing and fixing in position GI drainage spouts complete as per drawings and Technical Specifications Clause 2705.				-
	a. Drinage Spout	Nos.	12.00		-
10	Providing and laying in position Cement Concrete grade M 15 in approach slabs complete as per drawings and Technical Specifications Sections 1500, 1700 and 2700.	Cum	122.00		-
11	Reinforced cement concrete approach slab including reinforcement and formwork complete as per drawing and Technical specification	Cum	242.00		-
12	Providing and laying in position Cement Concrete grade M40 in crash barriers/ Hand Railing including 100mm dia PVC pipe, providing bituminous fiber board and Polysulphide joint filler at expansion joints/gap locations complete as per drawings and Technical Technical Specifications Clause No. 809 and Sections 1500, 1600, 1700 and 2700				-
	(a) Crash barrier	Rm	165.00		-
13	Providing and laying in position hand packed boulder pitching on slopes of embankment, in front of abutments and in launching apron complete as per drawings and Technical Specifications Section 2500.	Cum	477.00		-
14	Carry out confirmatory bores upto required depths at each foundation location as per technical specifications complete				-
	Bed Protection Using boulder apron	Cum	315.00		-
	Wearing Course 65thk BC	Cum	60.00		-
	Curtain wall PCC M20	Cum	171.00		-
	150thk PCC on Bed	Cum	159.00		-
	TOTAL =				**0**

COST ESTIMATE FOR LVUP

Sl. No.	Description	Unit	Quantity	Rate	Amount
	LIGHT VEHICULAR/ VEHICULAR UNDERPASSES				
1	Earthwork in excavation for structures including all lifts and leads complete as per drawings and Technical Specifications Clause No.304.				
	In all types of Soil/Clay/marsh, Road Crust	cu.m	595.77		-
2	Providing and laying in position Cement Concrete of Grade M 15 in leveling course below open foundations, pile caps, well cap projections, friction slab, annular filling around foundation in rock, etc., complete as per drawings and Technical Specification section 1500,1700, 2100	Cum	49.65		-
3	Providing and laying in position Cement Concrete in abutment piers, pier cap, pedestals, cantilever/counterfort abutments, abutment cap, dirt walls, wing walls, retaining walls, median wall etc. complete as per drawings and Technical Specifications 1500,1700 & 2200				-
	Box Structure including bottom, sides and top slab				-
	(ii) Grade M 35	Cum	811.17		-
4	Providing & fixing in position HYSD (TMT) Fe 500 grade reinforcement bars in abutment wall, abutment cap, dirt wall, pier, pier caps and retaining wall, Box Strucutre, etc. complete as per drawings and Technical Specifications Section 1600	MT	73.01		-
5	providing and Back filling behind/inside abutments, wing walls and return walls or any other area with selected imported granular materials of approved quality complete as per drawing & Technical Specification as per appendix 6 of IRC 78:2000.	cum	1,012.72		-
6	Providing and fixing 100mm diameter PVC pipe for weep holes in retaining wall, abutment, wing/return wall extending to full depth of the member complete as per Technical Specification clause 2706	Nos.	283.70		-
7	(I) Providing 20mm thick premoulded filler type joints complete as per drawing and technical specfications section 2600	Lm	63.06		-
8	Providing and fixing in position GI drainage spouts complete as per drawings and Technical Specifications Clause 2705.				-
	a. Drinage Spout	Nos.	16.00		-
	b. Down take pipe 100 DIA PVC	Lm	92.00		-
9	Providing and laying in position Cement Concrete grade M 15 in approach slabs complete as per drawings and Technical Specifications Sections 1500, 1700 and 2700.	Cum	33.11		-
10	Reinforced cement concrete approach slab including reinforcement and formwork complete as per drawing and Technical specification	Cum	66.21		-
11	Providing and laying in position Cement Concrete grade M40 in crash barriers/ Hand Railing including 100mm dia PVC pipe, providing bituminous fiber board and Polysulphide joint filler at expansion joints/gap locations complete as per drawings and Technical Technical Specifications Clause No. 809 and Sections 1500, 1600, 1700 and 2700				-
	(a) Crash barrier	Rm	80.40		-
12	Providing & Painting structure no., span arrangement and flow directions complete as per drawings and Technical Specifications Section 800.	Strucutre	4.00		-
13	Geo composite behind Abutments / Wing walls / Return walls etc	sqm	365.83		-
14	Painting two coats on crash barrier with synthetic enamel paint in all shades Ref. to Technical specification 803 .	sqm	161.00		-
15	Wearing Course BC	Cum	33.50		-
	TOTAL =				**0**

COST ESTIMATE FOR POTABLE WATER SUPPLY

S. No	Description of Work	Total Qty		Applicable Rate (in. Rs.)	Amount (in Rs.)
A	**BOREWELL(s)**				
1	Boring / drilling bore well of required dia for casing / strainer pipe, by suitable method prescribed in IS : 2008 (part I), including collecting samples from strata, preparing and submitting strata chart/bore log, including hire & running charges of all equipments, tools plants & machineries required for the job ,all complete as per direction of Engineer-in-charge, upto 90 metre depth below ground level in				
	All types of soil				
	300 mm dia	198	metre		
2	Boring / drilling bore well of required dia for casing / strainer pipe, by suitable method prescribed in IS : 2008 (part I), including collecting samples from strata, preparing and submitting strata chart/bore log, including hire & running charges of all equipments, tools plants & machineries required for the job ,all complete as per direction of Engineer-in-charge, beyond 90 metre & upto 150 metre depth below ground level				
	Rocky strata including Boulders				
	300 mm dia	154	metre		
3	Supplying, assembling, lowering and fixing in vertical position in bore well, ERW (Electric Resistance Welded) FE 410 plain slotted (having slot of size 1.6/3.2 mm) mild steel threaded and socketed/ plain bevel ended pipe (type A) of required dia, conforming to IS: 8110, of reputed and approved make, having wall thickness not less than 5.40 mm, including painted with outside surface with two coats of anticorrosive bitumestic paint of approved brand and manufacture, including hire & labour charges, fittings & accessories, all complete for all depths as per direction of Engineer -in-charge				
	150 mm nominal size dia having minimum wall thickness 5.00 mm	176	metre		
4	Providing and fixing 3 layer PP-R (Poly propylene Random copolymer) pipes SDR 7.4 U V stabilized & anti - microbial fusion welded, having thermal stability for hot & cold water supply including all PP - R plain & brass threaded polypropylene random fittings i/c trenching, refilling & testing of joints complete as per direction of Engineer in-charge				
	PN - 10 Pipe, 110 mm OD (SDR - 11)	110	Rmt		
	PN - 10 Pipe, 160 mm OD (SDR - 11).	198	Rmt		
5	Providing and fixing Bail plug / Bottom plug of required dia to the bottom of pipe assembly of tubewell as per IS : 2800 (part I).				
	150 mm dia.	22	Each		
6	Providing and fixing suitable size threaded mild steel cap or spot welded plate to the top of bore well housing / casing pipe, removable as per requirement all complete for borewell of :				
	150 mm dia.	2	Each		
7	Providing and fixing M.S. clamp of required dia to the top casing / housing pipe of tubewell as per IS : 2800 (part I) , including necessary bolts & nuts of required size complete.				
	150 mm dia.	9	Each		
8	Gravel packing in tubewell construction in accordance wirh IS: 4097, including providing gravel fine/medium/coarse, in required grading & sizes as per actual requirment, all complete as per direction of Engineer-in-charge.	51	Cum		
	Supplying, Installation and Commissioning of Submerssible Pump including column pipe and all electrical works i.e cables, earthing, MCC etc. in tubewell for discharge of 300 to 850 LPM and manumetric head of 31m water column.				
9	SITC of Radial / mixed flow ISI marked water and anti-corrosive liquid filled submersible motor pump sets suitable for 100/150mm dia borewell. The size of adopter fixed on top of the motor should exceed the top of coupler , for safegaurd the coupler. The construction material of motor and pump should match IS: 8034 : 2018 and IS: 9283 guideline. The radial flow pumpset should operate at 5 star energy efficiency level of BEE and mixed flow pump set should operate at 3 star energy level of BEE, accompained by valid BEE certificate. Motor should be IE2 class as per IEC 60034-2-1: 2007, IEC 60034-30: 2008, & IS12615:2011 with required accessories including making connection suitable for Bore well. The job includes labour part of lowering of riser pipe G.I./ H.D.P.E. with rope, cables & pump, installation of complete fitting and accessories, jointing of electrical cables up to Starter. All labour for testing of submersible pumps set and supply of water to water mains, complete in all respect. OEM shall have submit NABL / CPRI / ERDA accrediated lab type test certificate before execution. All as per pre approved by Engineer in-charge. For additional technical parameters of products/ work ,				
	12.5 HP, 3-Ø, (78 - 126)Mtr, (395-245) LPM	2	Each		
10	S & F of Star delta Starter with MCB,Main and Aux Contactor,O/L Relay, L/R Selector Switch,3 Indicating lamps,Start-Stop Push Button ,Control MCB with panel with all accessories with 11 KW rating	2	Each		

11	SITC of 22 Kw Soft Starters with panel supplied by manufacturer conforming to applicable standards with logic inputs & outputs, relay outputs and analogue outputs, plug in I/O connections, display of electrical parameters, state of load & operating time. RS 485 serial link for connections to Modbus.	2	Each		
12	Excavating trenches of required width for pipes, cables, etc including excavation for sockets, and dressing of sides, ramming of bottoms, depth upto 1.5 m, including getting out the excavated soil, and then returning the soil as required, in layers not exceeding 20 cm in depth, including consolidating each deposited layer by ramming, watering, etc. and disposing of surplus excavated soil as directed, within a lead of 50 m : All kinds of soil				
	Pipes, cables etc. exceeding 80 mm dia. but not exceeding 300 mm dia	7	metre		
12	Providing, D.I.K-9 pipes (push on joints pressure pipes of following diameters confirming to the I. S. specification inclusive cost of jointing materials (Rubber gasket of EPDM Quality) F.O.R. Destination Rates per meter (exclusive of G.S.T.) in Rs., anywhere in U.P. up to stores of consignees, inclusive of third party inspection charges, packing and forwarding charges, transit insurance charges, road transportation charges etc.completed as directed by Engineer in charges (IS 1536/2001 for pipes				
	150mm	7	Rmt		
13	Laying in position DI K-9 SS pipes of following diameter, grade and alignment as directed by Engineer-in-charge including conveyance of material from stores to site of work etc. complete.				
	150mm	1	quintal		
14	Providing push-on-joints to Centrifugally (Spun) Cast Iron Pipes or Ductile Iron Pipes including testing of joints and the cost of rubber gasket :				
	150mm	4	Rmt		
15	Providing and laying D.I. specials of class K-12 suitable for push-on jointing as per IS : 9523 :				
	Upto 600 mm dia.	0	quintal		
16	Disinfecting water mains by flushing with water containing bleaching powder @ 0.5 gms per litre of water and cleaning the same with fresh water, operation to be repeated three times including getting the sample of water from the disinfected main tested in the government laboratory.				
	150mm	7	metre		
17	Extra for every operation of disinfecting the water main by flushing with water containing bleaching powder @ 0.5 gms per litre of water and cleaning the same with fresh water, including getting the samples of water tested in the government laboratory.				
	150mm	7	metre		
18	Supply and delivery of (Sluice Valves) with Body and Bonnet of Ductile Iron GGG-40/SG-400/15 or GGG-50/SG-500/7 or Equivalent as per IS1865, IS:3896-2 and Wedge fully Rubber Lined with food grade quality grade W270 grade EPDM, Replaceable Spindle Nut without gland packing with 3-O ring protection system on the Shaft and Seals of NBR. The Valves should be Vacuum tight and 100% leak proof with face to face dimensions as BS:5163 Type A/IS:14846. All the valves should be with fusion bonded Electrostatic Powder coating both inside and outside (Min 250 Microns)- RAL 5005 with Pocket Less Straight through body Passage conforming to Design standards of DIN 3202F4/BS:5163 Type A Flange drilling as per IS - 1538 excluding all				
	DI. D/F Sluice valves of Electrically Operated & SCADA Compatible class PN 1.6				
	150mm	2	Each		
19	Providing, lowering, aligning, fixing in position in pipe line, DI D/F resilient seated (soft seated) Swing type SCADA Enabled Non Return Valve of approved make of following Pressure rating & dia complete, generally confirming to IS: 5312 (part -1)/ 2004 (amended up to date) and of following specifications: Body, Bonnet & disc of Ductile cast iron of grade GGG40/GGG50 as per DIN 1693 or GR SG-400/12 as per IS 1865 or equivalent grade as per IS :3896-part2-1985 and subsequent revisions, Face to face dimensions as per IS 5312 (part -1):2004 Drilled as per IS:1538. Electrostatic Epoxy Powder(EP-P) / Fusion Bonded Epoxy (Non-Toxic & suitable for drinking water) coated with minimum thickness of 250 micron applied on body, cover and disc inside and outside . Disc seal ring of EPDM/ Neoprene (food grade quality) and disc seal retaining ring of SS/CS. Shaft of SS- AISI- 410, Hinge SS AISI 316/410 ,Bonnet Gasket EPDM ,Bush- Brass with EPDM/NBR "O "ring seal Nut-Bolt confirming to IS:1363 and IS: 1367 (galvanised steel) Insertion rubber of black EPDM 6mm thick. Suitable support structure as per directions of EIC including jointing & jointing material, labour, testing and commissioning along with pipeline as per Technical Specification &				
	PN - 1.6 (Without by pass arrangement)				
	150 mm.	2	Each		
B	**RAW WATER SUMP**				

20	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift upto 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.				
	All kinds of soil.				
	Total Quantity	2301	cum		
21	Extra rates for quantities of works, executed:				
	In or under water and/or liquid mud, including pumping out water as required	21	cum		
	In or under foul position, including pumping out water as required	21	cum		
22	Extra for every additional lift of 1.5 m or part thereof in excavation / banking excavated or stacked materials.				
	All kinds of soil.				
a)	1st 1.5m lift	1575	cum		
b)	Above first 1.5m lift	1575	cum		
23	Close timbering in case of shafts, wells, cesspits, manholes and the like including strutting, shoring and packing cavities (wherever required) etc. complete. (Measurements to be taken of the face area timbered).				
	Depth not exceeding 1.5 m	204	sqm		
	Depth exceeding 1.5 m but not exceeding 3 m	204	sqm		
	Depth exceeding 4.5 m	476	sqm		
24	Providing and laying cement concrete in 1:4:8 (1 Cement:4 coarse sand :8 graded stone aggregate 40 mm nominal size) and curing complete, Including cost of form work. in Foundation and floors				
	Below Raft				
	Total Quantity	105	cum		
25	Providing and laying in position ready mixed or **site batched** design mix cement concrete for reinforced cement concrete work; using coarse aggregate and fine aggregate derived from natural sources, Portland Pozzolana / Ordinary Portland /Portland Slag cement, admixtures in recommended proportions as per IS: 9103 to accelerate / retard setting of concrete, to improve durability and workability without impairing strength; including pumping of concrete to site of laying, curing, carriage for all leads; but excluding the cost of centering, shuttering, finishing and reinforcement as per direction of the engineer-in-charge; for the following grades of concrete. Note: Extra cement up to 10% of the minimum specified cement content in design mix shall be payable separately. In case the cement content in design mix is more than 1.10 times of the specified minimum cement content, the contractor shall have discretion to either re-design the mix or bear the cost of extra cement.				
	M30 grade with minimum cement content of 350 kg /cum				
	All works upto plinth level	674	cum		
	Total Quantity				
b)	All works above plinth level upto floor V level	371	cum		
26	Centering and shuttering including strutting, propping etc. and removal of form for				
a)	Foundations, footings, bases of columns, etc. for mass concrete				
	Total Quantity	144	sqm		
b)	Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.				
	Total Quantity	1247	sqm		
c)	Suspended floors, roofs, landings, balconies and access platform				
	Total Quantity	887	sqm		
d)	Lintels, beams, plinth beams, girders, bressumers and cantilevers				
	Total Quantity	1368	sqm		
e)	Columns, Pillars, Piers, Abutments, Posts and Struts				
	Total Quantity	238	sqm		
f)	Edges of slabs and breaks in floors and walls				
	Total Quantity	125	metre		
27	Supplying, fitting and placing TMT steel (Fe 500 grade TMT bars IS 1786-1979) bar reinforcement wrought & put up for RCC and RCM works including cost and conveyance of steel and binding wire, labour for cutting, bending, lifting, placing in position and tying as per approved structural drawings including all labour charges, etc complete as per drawings and technical specifications for bars below 36 mm dia including over laps and wastage for finished item of work at all levels as directed by the engineer - in- charge				
a)	upto plinth level	71620	kg		
	Total Quantity				
b)	above plinth leve	52587	kg		

28	Providing and laying APP (Atatic Polypropylene Polymer) modifiei prefabricated five layer 3 mm thick water proofing membrane, black finished reinforced with non- woven polyesler matt consisting of a coat of bitumen primer for bitumen membrane @ O.4O litre/sqm by the same membrane manufacture of density at 25'C, 0.87-0.89 kg/ litre and viscocity 7O-160 cps. Over the primer coat the layer of membrane shall be laid using Butane Torch and sealing all joints etc' and preparing the surface complete. The vital physical and chemicai parameters of the membrane shall be as under : Joint strength in longitudinal and transverse direction at 23'C as 650/ 45ON/ scm. Tear strength in longitudinal and transverse direction as 3OO/250N. Softening point of membrane not less than 150'C. cold flexibilitv shall be upto -2"C when tesled in accordance wlth ASTN4, D - 5147. The laying of membrane shall be				
	Total Quantity	595	sqm		
29	Cement plastering including T&P, scaffolding, material and complete labour, including cost of water, curing, racking of joints etc. with 15 mm cement plaster on rough side finished with a floating coat of neat cement of mix : including Providing/mixing of synthetic fibers compulsorily complying with IS 16481:2022 of 06 mm/12 mm length to be mixed @ 0.25% by weight of Cement i.e. 125 gms per 50 kg Cement up to 900 gms per cum of Concrete/ mortar				
	1:4 (1 cement : 4 fine/ coarse sand)				
	Total Quantity	624	sqm		
30	Finishing walls with Acrylic Smooth exterior paint of required shade; New work (Two or more coat applied @ 1.67 llth) sqm over and including priming coat ofexterior primer applied @ 2 20 kg/10 sqm) supply of all labour material and T&P required for proper completion of work.				
	Total Quantity	187	sqm		
31	Supply, fabricating & fixing of Powder coated aluminium (minimum thickness of powder coating 50 micron) Aluminium ladder of 450mm wide with 2 nos rectangular section of 65 x 35 mm (3 mm thick) as vertical post and 25 mm bars steps at 300 mm c/c complete in all respect as per the specification and the direction of the Engineer.				
	Total Quantity	32	kg		
32	Providing and fixing in position circular shape 500 mm internal diameter M D - 10 pre-cast R.C.C. manhole cover and frame of required shape and approved quality				
	Total Quantity	2	each		
33	Providing and laying Double Flanged (Screwed/ Welded) Centrifugally (Spun) Ductile Iron Pipes of Class K - 9 conforming to IS : 8329				
	100 mm dia Ductile Iron Double Flanged	11	metre		
	400 mm dia Ductile Iron Double Flanged	11	metre		
34	Providing, lowering, aligning, fixing in position in pipe line, DI D/F resilient seated (soft seated) short body pattern type double eccentric Butterfly valves of approved make of following class & dia complete confirming to BS EN 593/ BS 5155/ IS 13095/1991 amended up to date and of following specifications: Body, disc and end cover of Ductile cast iron of grade GGG40/GGG50 as per DIN 1693 or GR SG-400/12 as per IS 1865 or equivalent grade as per IS :3896-part2-1985 and subsequent revisions, Face to face dimensions as per DIN 3202 F4/ IS 13095 Drilled as per IS:1538. Electrostatic Epoxy Powder(EP-P) / Fusion Bonded Epoxy (NonToxic & suitable for drinking water) coated with minimum thickness of 250 micron applied on both body and disc inside and outside. Disc seal ring of EPDM/ Neoprene (food grade quality) and disc seal retaining ring of SS/CS. Shaft of SS- AISI- 304/316 & shaft bearingsbronze/ PTET or Teflon with EPDM/NBR "O "ring seal, Nut-Bolt confirming to IS:1363 and IS: 1367 (Galvanised steel) Insertion rubber of black EPDM 6mm thick. Suitable support structure as per directions of EIC including jointing & jointing material, labour, testing and commissioning along with pipeline as per				
	Electrically Operated & SCADA Compatible (PN 1.6 class)				
	100 mm dia Butterfly Valves PN 1.6 (Mpa)	3	each		
	400 mm dia Butterfly Valves PN 1.6 (Mpa)	3	each		
35	Supply and delivery of (Sluice Valves) with Body and Bonnet of Ductile Iron GGG-40/SG-400/15 or GGG-50/SG-500/7 or Equivalent as per IS1865, IS:3896-2 and Wedge fully Rubber Lined with food grade quality grade W270 grade EPDM, Replaceable Spindle Nut without gland packing with 3-O ring protection system on the Shaft and Seals of NBR. The Valves should be Vacuum tight and 100% leak proof with face to face dimensions as BS:5163 Type A/IS:14846. All the valves should be with fusion bonded Electrostatic Powder coating both inside and outside (Min 250 Microns)- RAL 5005 with Pocket Less Straight through body Passage conforming to Design standards of DIN 3202F4/BS:5163 Type A Flange drilling as per IS - 1538 excluding all				
	DI. D/F Sluice valves of Electrically Operated & SCADA Compatible class PN 1.6				
	100 mm dia Butterfly Valves PN 1.6 (Mpa)	3	each		
	400 mm dia Butterfly Valves PN 1.6 (Mpa)	3	each		
36	Providing flanged joints to double flanged D.I. pipes and specials, including testing of joints				

	100mm dia flanged joints at pipe	2	each		
	100mm dia flanged jointsnear valves	2	each		
	400mm dia flanged joints at pipe	2	each		
	400mm dia flanged jointsnear valves	2	each		
C	**RAW WATER PUMP HOUSE (CIVIL)**				
37	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, for all lift, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.				
	All kinds of soil.				
	Total Quantity	339	cum		
38	Extra rates for quantities of works, executed:				
	In or under water and/or liquid mud, including pumping out water as required	24	cum		
	In or under foul position, including pumping out water as required	24	cum		
39	Extra for every additional lift of 1.5 m or part thereof in excavation / banking excavated or stacked materials.				
a)	All kinds of soil.				
	Total Quantity	873	cum		
40	Close timbering in case of shafts, wells, cesspits, manholes and the like including strutting, shoring and packing cavities (wherever required) etc. complete. (Measurements to be taken of the face area timbered).				
	Depth not exceeding 1.5 m	97	sqm		
	Depth exceeding 1.5 m but not exceeding 3 m	97	sqm		
	Depth exceeding 4.5 m	141	sqm		
41	Providing and laying cement concrete in 1:4:8 (1 Cement:4 coarse sand :8 graded stone aggregate 40 mm nominal size) and curing complete, Including cost of form work. in Foundation and floors				
	Below Raft				
	Total Quantity	22	cum		
42	Providing and laying in position ready mixed or **machine batched and machine mixed at site** design mix cement concrete for reinforced cement concrete work; using cement content as per approved design mix, including pumping of concrete to site of laying and including the cost of centering, shuttering, finishing but excluding reinforcement, including admixtures in recommended proporlions as per IS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer-incharge Note: Extra cement up to 10% of the minimum specified cement content in design mix shall be payable separately. In case the cement content in design mix is more than 1.10 times of the specified minimum cement content, the contractor shall have discretion to either re-design the mix or bear the cost of				
	M25 grade with minimum cement content of 350 kg /cum				
a)	All works upto plinth level	253	cum		
b)	All works above plinth level upto floor V level	81	cum		
43	Providing and laying damp-proof course 40 mm thick with cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 12.5 mm nominal				
	Total Quantity	13	sqm		
44	Diluting and injecting chemical emulsion for POSTCoNSTRUCTIONAL anti termite treatment				
	Along external wall where the apron is not provided using chemical emulsion @ 7.5 litres / sqm of the vertical surface of the substructure to a depth of 300mm including excavation channel along the wall & rodding etc. complete: With Chlorpyriphos/ Lindane E.C. 2A% with 1 % concentration				
	Total Quantity	56	Rm		
45	Supplying, fitting and placing TMT steel (Fe 500 grade TMT bars IS 1786-1979) bar reinforcement wrought & put up for RCC and RCM works including cost and conveyance of steel and binding wire, labour for cutting, bending, lifting, placing in position and tying as per approved structural drawings including all labour charges, etc complete as per drawings and technical specifications for bars below 36 mm dia including over laps and wastage for finished item of work at all levels as directed by the engineer - in- charge				
a)	upto plinth level	29873	kg		
b)	above plinth leve	9285	kg		
46	Class-150 (Non Modulao brick work in 1 :4 cement and Coarse sand mortar for super structure above plinth level upto floor five level including necessary cutting and moulding of brick work as required and also including honey combed brick work including supply of all materials, labour and T&P etc. required for proper completion of the work				
	Total Quantity	57	cum		
47	15mm Cenrent plaster with cement mortar in proportion of 1:6 cement & coarse sand of single coat for exterior plastering upto floor two level inclucling internal rounded angles chamfers, and rounded angles not exceeding 80mm. In girth and finished even and smooth.				
	Total Quantity	288	sqm		

48	20 mm cement plaster 1:3 ('l cement:3 coarse sand) linished with a floating coat of neat cement.				
	Below +0.00 lvl				
	Total Quantity	298	sqm		
49	12mm Cenrent plaster with cement mortar in proportion of 1:4 cement & coarse sand of single coat for interior plastering upto floor two level inclucling internal rounded angles chamfers, and rounded angles not exceeding 80mm. ln girth and finished even and smooth.				
	Total Quantity	250	sqm		
50	6mm Celling plaster 1:3 (1 cement : 3 fine sand) cement & fine sand in F.lvl. not less than 1.25, 1:3 including chiping of RCC surface before ceiling plaster. The cost of including all material, labour T&P and scafolding etc. all complete.				
	Total Quantity	306	sqm		
51	Providing and laying integral cement based water proofing treatment including preparation of surface as required for treatment of roofs, balconies, terraces etc consisting of following operations: a) Applying a slurry coat of neat cement using 2.75 kg/sqm of cement admixed with water proofing compound conforming to IS. 2645 and approved by Engineer-in-charge over the RCC slab including adjoining walls upto 300 mm height including cleaning the surface before treatment. b) Laying brick bats with mortar using broken bricks/brick bats 25 mm to 115 mm size with 50% of cement mortar 1:5 (1 cement : 5 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineerin-charge over 20 mm thick layer of cement mortar of mix 1:5 (1 cement :5 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineerin-charge to required slope and treating similarly the adjoining walls upto 300 mm height including rounding of junctions of walls and slabs. c) After two days of proper curing applying a second coat of cement slurry using 2.75 kg/ sqm of cement admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge. d) Finishing the surface with 20 mm thick jointless cement mortar of mix 1:4 (1 cement :4 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge including laying glass fibre cloth of approved quality in top layer of plaster and finally finishing the surface with trowel with neat cement slurry and making pattern of 300x300 mm square 3 mm deep. e) The whole terrace so finished shall be flooded with water for a minimum period of two weeks for curing and for final test."All above operations to be				
	With average thickness of 120 mm and minimum thickness at khurra as 65				
	Total Quantity	228	sqm		
52	Supplying and fixing rolling shutters of approved make, made of required size M.S laths, interlocked together through their entire length and jointed together at the end by end locks, mounted on specially designed pipe shaft with brackets, side guides and arrangements for inside and outside locking with push and pull operation complete, including the cost of providing and fixing necessary 27.5 cm long wire springs manufactured from high tensile steel wire of adequate strength conforming to IS: 4454 - part 1 and l\il.S. top cover of required thickness for rolling shutters 80x 1.25 mm M.S. laths with 1.25 mm				
	Total Quantity	8	sqm		
53	Extra for providing grilled rolling shutters manufactured out of 8 mm dia M.S. bar instead of laths as per design approved by Engineer-in- charge, (area of grill to be measured).				
	Total Quantity	4	sqm		
54	Providing and fixing factory made uPVC white colour sliding glazed window upto 1.50 m in height dimension comprising of uPVC multi-chambered frame with in-built roller track and sash extruded profiles duly reinforced with 1.60 ± 0.2 mm thick galvanized mild steel section made from roll forming process of required length (shape & size according to uPVC profile), appropriate dimension of uPVC extruded glazing beads and uPVC extruded interlocks, EPDM gasket, wool pile, zinc alloy (white powder coated) touch locks with hook, zinc alloy body with single nylon rollers (weight bearing capacity to be 40 kg), G.I fasteners 100 x 8 mm size for fixing frame to finished wall and necessary stainless steel screws etc. Profile of frame & sash shall be mitred cut and fusion welded at all corners, including drilling of holes for fixing hardware's and drainage of water etc. After fixing frame the gap between frame and adjacent finished wall shall be filled with weather proof silicon sealent over backer rod of required size and of approved quality, all complete as per approved drawing & direction of Engineer-in-Charge. (Single / double glass panes, wire mesh and silicon sealent shall be paid separately). Variation				
	Note: For uPVC frame and sash extruded profiles minus 5% tolerance in dimension i.e. in depth & width of profile shall be acceptable.				

	Two track two panels sliding window made of (big series) frame 67 x 50 mm & sash 46 x 62 mm both having wall thickness of 2.3 ± 0.2 mm and single glazing bead / double glazing bead of appropriate dimension . (Area of window above 1.75 sqm upto 2.50 sqm).				
	Total Quantity	12	Mtr.		
55	Providing and fixing aluminium work for doors, windows, ventilators and partitions with extruded built up standard tubular sections/ appropriate Z sections and other sections of approved make conforming to IS: 733 and IS: 1285, fixing with dash fasteners of required dia and size, including necessary filling up the gaps at junctions, i.e. at top, bottom and sides with required EPDM rubber/ neoprene gasket etc. Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically wherever required including cleat angle, Aluminium snap beading for glazing / paneling, C.P. brass / stainless steel screws, all complete as per architectural drawings and the directions of Engineer-in-charge. (Glazing, paneling and dash fasteners to be paid for separately) :				
a)	For fixed portion				
	Powder coated aluminium (minimum thickness of powder coating 50 micron)				
	Ventilators				
	Total Quantity	185	kg		
56	Making khurras 45x45 cm with average minimum thickness of 5 cm cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate of 20 mm nominal size) over P.V.C. sheet 1 m x1 m x 400 micron, finished with 12 mm cement plaster 1:3 (1 cement : 3 coarse sand) and a coat of neat cement, rounding the edges and making and finishing the outlet complete.				
	Total Quantity	2	each		
57	62 mm thick cement concrete flooring with concrete hardener topping, under layer 50 mm thick cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm nominal size) and top layer 12mm thick cement hardener consisting of mix 1:2 (1 cement hardener mix : 2 graded stone aggregate, 6mm nominal size) by volume, hardening compound mixed @ 2 litre per 50 kg of cement or as per manufacture's specifications. This includes cost of cement slurry, but excluding the cost of nosing of steps etc. complete				
	Floor @(-)5.35m				
	Total Quantity	215	sqm		
58	25 mm thick Kota stone slab flooring over 20 mm (average) thick base laid over and jointed with grey cement slurry mixed with pigment to match the shade of the slab, including rubbing and polishing complete with base of cement mortar 1 : 4 (1 cement : 4 coarse sand).				
	Floor @0.00m				
	Total Quantity	78	sqm		
59	Kota stone slabs 20 mm thick in risers of steps, skirting, dado and pillars laid on 12 mm (average) thick cement mortar 1:3 (1 cement: 3 coarse sand) and jointed with grey cement slurry mixed with pigment to match the shade of the slabs, including rubbing and polishing complete.				
	Floor @0.00m				
	Total Quantity	4	sqm		
60	Distempering with oil bound washable distemper of approved brand and manufacture to give an even shade : New work (two or more coats) over and including water thinnable priming coat with cement primer including cost of all materials, labour T&P etc required for proper completion ofwork.				
	Total Quantity	548	sqm		
61	Finishing walls with Acrylic Smooth exterior paint of required shade New work (Two or more coats applied @ 328 ll lo sqm) over and including priming coat of exterior primer applied @ 2.20k9/10 sqm supply of all labour material and T&P required for proper completion of work.				
	Same as external plaster				
	Total Quantity	288	sqm		
62	Providing and fixing on wall face unplasticised Rigid PVC rain water pipes conforming to IS : 13592 Type A, including jointing with seal ring conforming to IS : 5382, leaving 10 mm gap for thermal expansion, (i) Single socketed pipes.				
	110 mm diameter				
	Total Quantity	11	metre		
63	Supply, fabricating & fixing of Powder coated aluminium (minimum thickness of powder coating 50 micron) Aluminium ladder of 450mm wide with 2 nos rectangular section of 65 x 35 mm (3 mm thick) as vertical post and 25 mm bars steps at 300 mm c/c complete in all respect as per the specification and the direction of the Engineer.				
	Total Quantity	33	kg		
64	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing, staircase railing and similar works, including applying priming coat of approved steel primer.				
	Total Quantity	287	kg		
65	Providing and laying Double Flanged (Screwed/ Welded) Centrifugally (Spun) Ductile Iron Pipes of Class K - 9 conforming to IS : 8329				
	400 mm dia Ductile Iron Double Flanged				
	Total Quantity	18	metre		

	Total Quantity	13	metre		
66	Providing flanged joints to double flanged C.I./ D.I. pipes and specials, including testing of joints				
	400 mm diameter pipe	4	each		
	700 mm diameter pipe	4	each		
67	Supply and delivery of (Sluice Valves) with Body and Bonnet of Ductile Iron GGG-40/SG-400/15 or GGG-50/SG-500/7 or Equivalent as per IS1865, IS:3896-2 and Wedge fully Rubber Lined with food grade quality grade W270 grade EPDM, Replaceable Spindle Nut without gland packing with 3-O ring protection system on the Shaft and Seals of NBR. The Valves should be Vacuum tight and 100% leak proof with face to face dimensions as BS:5163 Type A/IS:14846. All the valves should be with fusion bonded Electrostatic Powder coating both inside and outside (Min 250 Microns)- RAL 5005 with Pocket Less Straight through body Passage conforming to Design standards of DIN 3202F4/BS:5163 Type A Flange drilling as per IS - 1538 excluding all				
	DI. D/F Sluice valves of Electrically Operated & SCADA Compatible class PN 1.6				
	400 mm diameter	4	each		
68	Providing, lowering, aligning, fixing in position in pipe line, DI D/F resilient seated (soft seated) Swing type SCADA Enabled Non Return Valve of approved make of following Pressure rating & dia complete, generally confirming to IS: 5312 (part -1)/ 2004 (amended up to date) and of following specifications: Body, Bonnet & disc of Ductile cast iron of grade GGG40/GGG50 as per DIN 1693 or GR SG-400/12 as per IS 1865 or equivalent grade as per IS :3896-part2-1985 and subsequent revisions, Face to face dimensions as per IS 5312 (part -1):2004 Drilled as per IS:1538. Electrostatic Epoxy Powder(EP-P) / Fusion Bonded Epoxy (Non-Toxic & suitable for drinking water) coated with minimum thickness of 250 micron applied on body, cover and disc inside and outside . Disc seal ring of EPDM/ Neoprene (food grade quality) and disc seal retaining ring of SS/CS. Shaft of SS- AISI- 410, Hinge SS AISI 316/410 ,Bonnet Gasket EPDM ,Bush- Brass with EPDM/NBR "O "ring seal Nut-Bolt confirming to IS:1363 and IS: 1367 (galvanised steel) Insertion rubber of black EPDM 6mm thick. Suitable support structure as per directions of EIC including jointing & jointing material, labour, testing and commissioning along with pipeline as per Technical Specification &				
	400 mm diameter	4	each		
69	Providing, lowering, laying, aligning, fixing in position in pipe line Air Cushion Valves 150 mm dia as per IS:14845 (including jointing and jointing material), including all material, labour, testing and commissioning as per Technical Specifications and as per direction of Engineer etc. complete in all respect.	4	each		
D	**MECHANICAL & INSTRUMENTATION WORKS AT RAW WATER PUMP HOUSE**				
70	Supply, delivery and fixing of floor mounted type FCMA Air/ Oil Cooled soft starter suitable for the 75Hp LT motor offered for operation in AC three Phase 50Hz (+/- 5%), 415V(+/-10%) including line contactors suitable for next standard higher KW rating, Over load relay, instrument panel with frequency meter, Ammeter, Voltmeter, indicating lamp 6Nos, LED ON/OFF type and Start /Stop push button	4	each		
71	Earthing with copper earth plate 600 mm X 600 mm X 3 mm thick including accessories, and providing masonry enclosure with cover plate having locking arrangement and watering pipe of 2.7 meter long etc. with charcoal/ coke and salt as required.	2	each		
72	Providing and laying earth connection from earth electrode with 6 SWG dia G.I. Wire in 15 mm dia G.I. pipe from earth electrode including connection with G.I. thimble excavation and re-filling as required.	2	each		
73	Supplying, erecting, testing & commissioning of Electrically Operated Travelling Crane (EOT) .Main girder & End Carriage fabricated from Rolled Steel Section, Gear Box for all motion, Electro Magnetic Friction Disc Type Brakes, all safety limit switches , LT wheels EN 9, Double Flanged 4No, with Sq. Cage motor of adequate rating (KW), duly painted mechanical cleaning and one coat of primer and two coat of synthetic paint and as per the direction				
a)	3 MT Capacity, Span 9 M and Lift 6 M	1	set		
74	Supply, installation and commissioning of Mono Rail Single Girder Crane suitable for lift up to 9m with chain 9m pulley block and traveling trolley excluding cost of girder complete in all respect as per the direction of the Engineer.	1	set		
75	Providing, Installation, Testing and Commissioning of Ultrasonic Level Transmitter : Principle : Time of Flight / Sensor MOC PP / Power Supply: 24 V DC / Output: 4- 20mA / Display: Integral display for programming and Display Reading / IP 66/ Accuracy +1%				
	0 - 8 Mtr.	1	set		
76	Providing, installation, testing and commissioning of TSS Analyser with Transmitter and Sensor Measuring Range: 0-10 mg/L, Accuracy: ≤ 3%, Resolution: ≤ 0.15 mg/L, Operating Temperature: 0- 40°C, Cleaning: Automatic Self-Cleaning using compressed Air as per CBCP/SPCB guidelines	1	No.		

77	Providing, installation, testing and commissioning of pH Analyser: Transmitter : Range: 0-14 pH, Power Supply 230 VAC, Input: One Digital Sensor, Output: 4-20mA HART, IP66 Protection / Tx protection cover required / Sensor Range 0-14 pH , able to transmit digital signal to transmitter, calibration data can be transferred to Transmitter , process temp: 65 deg cen/ flow through tee MOC SS as per CBCP/SPCB guidelines	1	No.			
78	Providing, installation, testing and commissioning of Chlorine Analyser : Transmitter : Range: 0.05 to 20 ppm, Power Supply 230 VAC, Input: 2 Digital Sensors - one for chlorine and second for pH, Output: 4-20mA HART, IP66/67 Protection / Tx protection cover required / Sensor Range 0-14 pH , able to transmit digital signal to transmitter, calibration data can be transferred to Transmitter , process temp: 65 deg cen/ Sensor range:0.05 to 20 mg/l.as per CBCP/SPCB guidelines	1	No.			
79	Providing, installation, testing and commissioning of NH3 Analyser with Transmitter and Sensor Range: 0 - 100 ppm, Repeatability: ±5% of measured vaue, Protection class: IP 68, Accuracy: ±5% of measured value, Output: 4 - 20 mA DC (Isolated) as per CBCP/SPCB guidelines	1	No.			
80	Providing, installation, testing and commissioning of NO3 Analyser with Transmitter and Sensor Range: 0 - 1000 mg/L, Repeatability: ±5% of measured vaue, Protection class: IP 68, Accuracy: ±5% of measured value, Output: 4 - 20 mA DC (Isolated) as per CBCP/SPCB guidelines	1	No.			
81	Providing, installation, testing and commissioning of Mixed Liquid Suspended Solid (MLSS) Analyser Range: 0.001 - 4000 NTU, Repeatability: ±5% of measured vaue, Protection class: IP 68, Accuracy: ±1% of measured value, Output: 4 - 20 mA DC (Isolated) as per CBCP/SPCB guidelines	1	No.			
82	Providing, installation, testing and commissioning of Turbidity Analyser : Range - Selective 0 to 4000 NTU, Accuracy:+/-2% of reading or +/-0.02NTU; Compliance to US EPA180.1, With inbuilt transmitter with 4-20 mA output, Relay contacts & Modbus communication as per CBCP/SPCB guidelines.	1	No.			
83	Providing, installation, testing and commissioning of Total Organic Carbon (TOC) Meter, Measuring Range: 0-25 mg/L, Accuracy: 3%, Resolution: ≤ 0.15 mg/L, Cleaning: Automatic Self-Cleaning using compressed Air as per CBCP/SPCB guidelines.	1	No.			
84	Providing, installation, testing and commissioning of ORP Meter with Transmitter and Sensor, Measuring Range: -2000mV to 2000mV, Accuracy: ≤ 0.01 units of V, Resolution: ≤ 0.01 units of V, Response Time: ≤ 60 seconds, Operating Temperature: 0- 40°C, Repealability: ±0.05	1	No.			
85	Providing, installation, testing and commissioning of ORP Meter with Transmitter and Sensor, Measuring Range: -2000mV to 2000mV, Accuracy: ≤ 0.01 units of V, Resolution: ≤ 0.01 units of V, Response Time: ≤ 60 seconds, Operating Temperature: 0- 40°C, Repealability: ±0.05	1	No.			
86	Providing, Installation, Testing and Commissioning of Differential Pressure transmitter sensor material and wetted parts MOC SS316, 4-20mA DC (Isolated) output, IP 65 of IS 13947 Part I, Overall Accuracy ± 0.5% of measered value, Range: Adjustable over full span	1	No.			
87	Providing, Installation, Testing and Commissioning of Electromagnetic Flow Meter : Liner: Polyurethane or Hard Rubber / Electrode MOC: SS316L or CS /Housing : Die Cast Aluminium or CS / Power Supply: 90-230 V AC / Output: 4-20mA with HART / Sensor Cable : 10 mt / Flow Tube or Sensor housing protection IP68 / Process Flange : SS316 / Display : 3 1/2 LCD Display / Cable Connection : 1/2"NPT /Accuracy : 0.5%					
	400 mm	1	No.			
88	Dissolved Oxygen Analyser : Measuring range: 0 to 20mg/l, Optical fluorescence technology , Membrane free operation ;Accuracy:0.01mg/l or +/-1% of measured value ; With digital transmitter having output: 4-20mA HART,	1	No.			
E	**PUMPSETS AT RAW WATER PUMP HOUSE**					
89	Supply, delivery at site with necessary packing, receiving, unloading, shifting, storing, installation, testing and commissioning of Horizontal Centrifugal Split Casting pumps with motor as per IS 12615-2011 or amended up to date, CI casing and casing ring, SS 316 impeller, SS 410 Shaft and shaft sleeve, coupling guard, common base plate, foundation bolts etc. complete with all respect as per the specification Discharge 31 to 40 LPS	4	Each			
F	**POTABLE WATER SUPPLY NETWORK**					
90	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, for all lift, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m. All kinds of soil					
	Pipes, cables etc. exceeding 80 mm dia. but not exceeding 300 mm dia	7517	metre			
91	Extra rates for quantities of works, executed:					
	In or under water and/or liquid mud, including pumping out water as required	1278	metre depth			
	In or under foul position, including pumping out water as required	1278	metre depth			

92	Disposal of excavated eath with similar unserviceable, dismantled or waste material by mechanical transport including loading, transporting, unloading to approved municipal dumping ground for lead upto 2 km for all lifts, complete as per directions of Engineer-in-charge		
	Total earth to be disposed from the work site	136	Cum
93	Providing, D.I.K-9 pipes (push on joints pressure pipes of following diameters confirming to the I. S. specification inclusive cost of jointing materials (Rubber gasket of EPDM Quality) F.O.R. Destination Rates per meter (exclusive of G.S.T.) in Rs., anywhere in U.P. up to stores of consignees, inclusive of third party inspection charges, packing and forwarding charges, transit insurance charges, road transportation charges etc.completed as directed by Engineer in charges (IS 1536/2001 for pipes		
	250mm	564	Rmt
	300mm	729	Rmt
	350mm	521	Rmt
	450mm	244	Rmt
	600mm	391	Rmt
94	Laying in position DI K-9 SS pipes of following diameter, grade and alignment as directed by Engineer-in-charge including conveyance of material from stores to site of work etc. complete.		
	Total Quantity	2231	quintal
94	Providing push-on-joints to Centrifugally (Spun) Cast Iron Pipes or Ductile Iron Pipes including testing of joints and the cost of rubber gasket IS 158/1969 and IS 12820/1989 or latest edition/ revision with amendments for Rubber Gaskets.		
	250mm	102	joint
	300mm	133	joint
	350mm	95	joint
	450mm	44	joint
	600mm	72	joint
95	Providing and laying D.I. specials of class K-12 suitable for push-on jointing as per IS : 9523 :		
	Upto 600 mm dia.	41	quintal
96	Hydraulic testing of D.I. pipe line to specified pressure including cost of all materials and labour and water for testing for specified length including cutting, placing end cap making arrangement for filling safe water using reciprocating type pumps which should be able to provide specified test pressure gauges and other necessary equipments, labour, operation charges, etc. required for testing. The rate under this item shall also include cost of retesting, if necessary and reinstating to original position		
	250mm	0.56	Km
	300mm	0.73	Km
	350mm	0.52	Km
	450mm	0.24	Km
	600mm	0.39	Km
97	Providing, HDPE pipes, PE-100, PN-10 of following diameters confirming to the IS 4984, 2016 and its latest amendment(s) F.O.R. Destination Rates per meter (exclusive of G.S.T.) in Rs., anywhere in U.P. up to stores of consignees, inclusive of third party inspection charges, packing and forwarding charges, transit insurance charges, road transportation charges etc.completed as directed by Engineer in charges		
	90 mm dia HDPE PE-100 8Kgs/cm2 pipe line	17844	Rmt
	110mm dia HDPE PE-100 8Kgs/cm2 pipe line	6054	Rmt
	125mm dia HDPE PE-100 8Kgs/cm2 pipe line	2048	Rmt
	160mm dia HDPE PE-100 8Kgs/cm2 pipe line	1824	Rmt
	200mm dia HDPE PE-100 8Kgs/cm2 pipe line	2023	Rmt
98	Laying, jointing of HDPE Pipeline (PE-100) including supply of Electrofusion Specials & Fittings. It also includes all labour, T&P, electricity, etc. required		
	90 mm dia HDPE PE-100 8Kgs/cm2 pipe line	17844	Rmt
	110mm dia HDPE PE-100 8Kgs/cm2 pipe line	6054	Rmt
	125mm dia HDPE PE-100 8Kgs/cm2 pipe line	2048	Rmt
	160mm dia HDPE PE-100 8Kgs/cm2 pipe line	1824	Rmt
	200mm dia HDPE PE-100 8Kgs/cm2 pipe line	2023	Rmt
99	Disinfecting water mains by flushing with water containing bleaching powder @ 0.5 gms per litre of water and cleaning the same with fresh water, operation to be repeated three times including getting the sample of water from the disinfected main tested in the government laboratory.		
	80mm	17844	metre
	100mm	6054	metre
	125mm	2048	metre
	150mm	1824	metre
	200mm	2023	metre
	250mm	564	metre
	300mm	729	metre
	350mm	521	metre
	450mm	244	metre
	600mm	391	metre

100	Extra for every operation of disinfecting the water main by flushing with water containing bleaching powder @ 0.5 gms per litre of water and cleaning the same with fresh water, including getting the samples of water tested in the government laboratory.				
	80mm	17844	metre		
	100mm	6054	metre		
	125mm	2048	metre		
	150mm	1824	metre		
	200mm	2023	metre		
	250mm	564	metre		
	300mm	729	metre		
	350mm	521	metre		
	450mm	244	metre		
	600mm	391	metre		
101	Supply and delivery of (Sluice Valves) with Body and Bonnet of Ductile Iron GGG-40/SG-400/15 or GGG-50/SG-500/7 or Equivalent as per IS1865, IS:3896-2 and Wedge fully Rubber Lined with food grade quality grade W270 grade EPDM, Replaceable Spindle Nut without gland packing with 3-O ring protection system on the Shaft and Seals of NBR. The Valves should be Vacuum tight and 100% leak proof with face to face dimensions as BS:5163 Type A/IS:14846. All the valves should be with fusion bonded Electrostatic Powder coating both inside and outside (Min 250 Microns)- RAL 5005 with Pocket Less Straight through body Passage conforming to Design standards of DIN 3202F4/BS:5163 Type A Flange drilling as per IS - 1538 excluding all				
	DI. D/F Sluice valves of Electrically Operated & SCADA Compatible class PN 1.6				
	80mm	6	each		
	100mm	3	each		
	150mm	1	each		
	200mm		each		
	250mm	1	each		
	300mm	1	each		
	350mm	1	each		
	450mm	1	each		
	600mm	1	each		
102	Supply and delivery of (Scour Valves) with Body and Bonnet of Ductile Iron GGG-40/SG-400/15 or GGG-50/SG-500/7 or Equivalent as per IS1865, IS:3896-2 and Wedge fully Rubber Lined with food grade quality grade W270 grade EPDM, Replaceable Spindle Nut without gland packing with 3-O ring protection system on the Shaft and Seals of NBR. The Valves should be Vacuum tight and 100% leak proof with face to face dimensions as BS:5163 Type A/IS:14846. All the valves should be with fusion bonded Electrostatic Powder coating both inside and outside (Min 250 Microns)- RAL 5005 with Pocket Less Straight through body Passage conforming to Design standards of DIN 3202F4/BS:5163 Type A Flange drilling as per IS - 1538 excluding all				
	DI. D/F Scour valves of Electrically Operated & SCADA Compatible class PN 1.6				
	80mm	4	each		
	100mm	3	each		
	150mm	1	each		
	200mm	1	each		
	250mm	1	each		
	300mm	1	each		
	350mm	1	each		
	450mm	1	each		
	600mm	1	each		
103	Providing, lowering, aligning, fixing in position in pipe line, DI D/F resilient seated (soft seated) short body pattern type double eccentric Butterfly valves of approved make of following class & dia complete confirming to BS EN 593/ BS 5155/ IS 13095/1991 amended up to date and of following specifications: Body, disc and end cover of Ductile cast iron of grade GGG40/GGG50 as per DIN 1693 or GR SG-400/12 as per IS 1865 or equivalent grade as per IS :3896-part2-1985 and subsequent revisions, Face to face dimensions as per DIN 3202 F4/ IS 13095 Drilled as per IS:1538. Electrostatic Epoxy Powder(EP-P) / Fusion Bonded Epoxy (NonToxic & suitable for drinking water) coated with minimum thickness of 250 micron applied on both body and disc inside and outside. Disc seal ring of EPDM/ Neoprene (food grade quality) and disc seal retaining ring of SS/CS. Shaft of SS- AISI- 304/316 & shaft bearingsbronze/ PTET or Teflon with EPDM/NBR "O "ring seal, Nut-Bolt confirming to IS:1363 and IS: 1367 (Galvanised steel) Insertion rubber of black EPDM 6mm thick. Suitable support structure as per directions of EIC including jointing & jointing material, labour, testing and commissioning along with pipeline as per				
	Electrically Operated & SCADA Compatible (PN 1.6 class)				
	80mm	13	each		
	100mm	6	each		
	150mm	1	each		

	200mm	2	each		
	250mm	1	each		
	300mm	1	each		
	350mm	1	each		
	450mm	1	each		
	600mm	1	each		
102	Providing and supplying Double acting Air Valves confirming to IS 14845 as per Indian standard specifications combined with screw down isolating valve, small orifice elastic ball resting on a gun metal orifice nipple, large orifice vulcanite ball seating on moulded seat ring, inlet face and drilled, including insurance, third party inspection charges, loading, unloading, transportation upto departmental stores, in all respect etc. complete				
	50 mm dia	13	each		
	80 mm dia	2	each		
104	Construction of RCC valve chamber for different types of valves including earthwork excavation, 100 mm PCC M10 (1:3:6 i.e 1 Cement : 3 coarse sand : 6 graded stone aggregate 20 mm nominal size) as levelling course, RCC M20 grade (1:1½:3 i.e. 1 Cement : 1½ coarse sand : 3 graded stone aggregate 20 mm nominal) size for base slab 175mm thick, side wall 175mm thick & cover slab 150mm thick with C.I. surface box with hinged cover 100x100x75 mm (deep), including cost of steel reinforcement not less than 80 kg per cum CC, form work, proper curing of concrete work, complete in all respect as per standard specifications and drawings and as directed by Engineer-in-charge				
	1200 x 1200 x 1300 mm (depth) for 80/100/125/150 mm dia valve	28	each		
	1300 x 1300 x 1450 mm (depth) for 200/250/300 mm dia valve	7	each		
	1400 x 1600 x 1750 mm (depth) for 350/400/450/500/600 mm dia valve	7	each		
105	Providing and fixing enclosed type water meter (bulk type) conforming to IS : 2373 and tested by Municipal Board complete with bolts, nuts, rubber insertions etc. (The tail pieces if required will be paid separately)				
	100mm dia nominal bore	2	each		
	150mm dia nominal bore	6	each		
	200mm dia nominal bore	1	each		
106	Providing and fixing C.I. dirt box strainer for bulk type water meter with nuts, bolts, rubber insertions etc. complete conforming to IS : 2373.				
	100mm dia	2	each		
	150mm dia	6	each		
	200mm dia	1	each		
107	Providing, installation, testing and commissioning of Bulk Flow Meter with removable mechanism class "B" confirming to ISO: 4064/1 including all materials (excluding CI/DI fittings) and making connection with existing pipeline required for Bulk Flow Meter including cutting the existing pipe line etc complete in all respect as per technical specification as per SCADA specification and as per direction of Engineer.				
	BFM250 for DN 250 mm	2	each		
	BFM300 for DN 300 mm	2	each		
	BFM300 for DN 300 mm at the pumping main outlet	2	each		
108	Thrust Blocks				
a)	Excavation in foundation in ordinary soil (Loam, Clay or Sand) lncluding lift upto 1.50 m and lead upto 3Om and including filling watering and ramming of excavated eafth into the trenches or into the space between the building and the sides of foundation trenches or into the plinth and removal and disposal of surplus earth as directed by the Engineer lncharge upto a distance of 30m from the foundation trenches. Mannual (Small work)	146	Cum		
b)	As in Item above but excavation in soil mixed with moorum shingle kankar requiring the use of special tools and Plants such a pick axes subbals etc. Mannual (Small work)	8	Cum		
c)	Providing and laying cement concrete in 1:2:4 (1 Cement : 2 coarse sand :4 graded stone aggregate 20 mm nominal size) and curing complete, Including cost of form work. In Foundation and floors.	12	Cum		
d)	Providing and laying in position machine batched and machine mixed design mix M-25 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying and including the cost of centering, shuttering, finishing but excluding reinforcement, including admixtures in recommended proporlions as per IS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer-incharge.(Note :- Cement content considered in this item is @ 330 kg/cum. Excess/ less cement used as per design mix is payable / recoverable				
	All work up to Plinth level	228	Cum		
e)	Steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level. Thermo-Mechanically Treated bars of grade Fe-500D or more	14300	Kg		
109	Providing House Service Connection (single service connection) from distribution main to property limit , including supply and fixing of domestic multijet mechanical AMR water meters of approved make along with fittings shall be provided with following items.				

a)	Providing, installing and giving satisfactory field testing of domestic multijet mechanical AMR water meters horizontal inferencial with magnetic drive and dry dial suitable for ambient 50oC temperature duly sealed against tampering complete with coupling at both ends and conforming to ISO 4064 with GSM / radio frequency (RF) for communication to server via transreceiver alongwith Hand held Device and PC software etc complete with EEC / OIML.MID certification for Abroad meter and FCRI for India including 36 months guarantee etc complete				
	32mm dia	1691	Each		
b)	Providing and making house service connections from water supply distribution uPVC/ DI/ CI pipe line upto water meter chamber inside the property using Chlorinated Polyvinyl Chloride (CPVC) pipes. The item consisting supply and jointing of pipes & fiitings with solvent cement, trenching, refilling & testing of joints completeincluding all material, labour, testing and commissioning as per Technical Specifications and as per direction of				
	32 mm nominal dia CPVC Pipes	5917	Rmt		
	20 mm nominal dia CPVC Pipes	3381	Rmt		
c)	Excavation in foundation in ordinary soil (Loam, Clay or Sand) lncluding lift upto 1.50 m and lead upto 3Om and including filling watering and ramming of excavated eafth into the trenches or into the space between the building and the sides of foundation trenches or into the plinth and removal and disposal of surplus earth as directed by the Engineer ln charge upto a distance of 30m from the foundation trenches. Mannual (Small work)				
	32 mm nominal dia Pipes	4438	Cum		
110	Supplying and Fixing water METER BOX- with Weather resistant PE/ GRP box, press fitted Lid fixing & locking and locked with built-in or external lock.	1691	Each		
	TOTAL POTABLE WATER SUPPLY				

COST ESTIMATE FOR WATER TREATMENT PLANT

S. No	Description of Work	Total Qty		Applicable Rate (in. Rs.)	Amount (in Rs.)
A	**WATER TREATMENT PLANT**				
1	Design, construction, (including topographical survey, geotechnical investigation and other surveys as required) for specified capacity of WTP based on 22 Hrs. operation including inlet chamber, aeration fountain / cascade, inlet channels including mechanical/manual fine/coarse screens, flash mixer, mixing channel with Parshall flume and flow measuring arrangement, clariflocculator with conventional, filter house and filter plant including back wash tank and back wash pumps with 100% standby, chemical house, coagulant feed tank with feed mechanism, poly aluminium chloride (PAC) or other coagulant tank of specified capacity and nos. with mixing and dosing arrangement complete, vacuum feed gas chlorinator with 100% standby, sludge handling unit and recycling of collected water from sludge, clear water reservoir of specified capacity, clear water pumping station including specified number and capacity of pumps, motors, panels, starters, cables, transformers, etc. Mechanical & Instrumentation works for Water Treatment Plant and Clear Water Sump & Pump House, Electrical, Mechanical & Instrumentation Works complete, external and internal electrification, laboratory building with all specified lab equipment, admin building, Quarter (One no.), sanitary block with necessary water supply and drainage arrangement, campus roads, landscaping and other campus development works, rain water harvesting etc. all required works complete as per the	7.5	MLD	10.00	
	TOTAL WATER TREATMENT PLANT				

COST ESTIMATE FOR RAIN WATER HARVESTING NETWORK						
Sl. No.	**Ref.**	**Description of work**	**Quantity**	**Unit**	**Applicable Rate (in. Rs.)**	**AMOUNT (TOTAL)**
			Total			**Total Amount**
A	**NETWORK**					
1		Excavation in foundation in ordinary soil (Loam, Clay or Sand) Including lift upto 1.50 m and lead upto 3Om and including filling watering and ramming of excavated eafth into the trenches or into the space between the building and the sides of foundation trenches or into the plinth and removal and disposal of surplus earth as directed by the Engineer lncharge upto a distance of 30m from the foundation trenches.	11348.07	CUM		0.00
2		Providing and laying cement concrete in 1:4:8 (1 Cement:4 coarse sand :8 graded stone aggregate 40 mm nominal size) and curing complete, Including cost of form work. in Foundation and floors.	750.17	Cum	0.00	0.00
3		Providing and fixing on wall face unplasticised Rigid PVC rain water pipes conforming to lS : 13592 Type A, including jointing with seal ring conforming to lS : 5382, leaving 10 mrn gap for thermal expansion, (i) Single socketed pipes			0.00	0.00
		110 mm dia	10983.26	Rmt	0.00	0.00
		140 mm dia	7202.76	Rmt	0.00	0.00
4		For house connection and inner chamber connection to pits assuming 30% extra length of pipe			0.00	0.00
		110 mm dia	2716	Rmt	0.00	0.00
		140 mm dia	1654	Rmt	0.00	0.00
					Grand Total (A)	**0.00**

COST ESTIMATE FOR RECHARGE PITS WITH BOREWELL TO DEEP AQUIFIERS

Ref.	S. No	Description of Work	No's			Length/ Area	Breadth	Depth	Quantity	Total Qty		Amount	
												Applicable Rate	Total Amount
	1	Boring / drilling bore well of required dia for casing / strainer pipe, by suitable method prescribed in IS : 2008 (part I), including collecting samples from strata, preparing and submitting strata chart/bore log, including hire & running charges of all equipments, tools plants & machineries required for the job ,all complete as per direction of Engineer-in-charge, upto 90 metre depth below ground level in.										0.00	0.00
		All types of soil										0.00	0.00
		Lower & Fixing of PVC pipe 6 kg./cm2 including socket etc all complete as follows. (a) Ribbed pipe 200 mm dia.	2	x	2			50	200.00	200.00	metre		0.00
		200 mm dia	2	x	1			25	50.00	50.00	metre	0.00	0.00
		(b) Blind pipe 200 mm dia.	2	x	1			25	50.00	50.00	metre	0.00	0.00
	2	Gravel packing in tubewell construction in accordance with IS: 4097, including providing gravel fine/ medium/ coarse, in required grading & sizes as per actual requirement, all complete as per direction of Engineer-in-charge.	1	x	1	50	0.07		3.38	3.38	Cum	0.00	0.00
		Rate per Rainwater Harvesting pit - (2.3m x 4.5m x 3.2m size pit with 2 no's 200mm dia Borewell depth upto 50m)										0.00	0.00
	3	Excavation in foundation in ordinary soil (Loam, Clay or Sand) Including lift upto 1.50 m and lead upto 30m and including filling watering and ramming of excavated earth into the trenches or into the space between the building and the sides of foundation trenches or into the plinth and removal and disposal of surplus earth as directed by the Engineer Incharge upto a distance of 30m from the foundation trenches. (i) 2.3 x 2.8 x 2.25 (ii) 2.3 x 4.5 x 3.2	1	x	1	2.3	2.8	2.25	14.49	14.49	cum	0.00	0.00
			1	x	1	2.3	4.5	3.2	33.12	33.12	cum	0.00	0.00
		Add to Item (251-252) to every additional 30m lead of part of 30m (100ft) or for very additional '1.5m (sft) lifl or part of 1.5m (sft)	1	x	1	2.3	4.5	3.2	33.12	33.12	cum	0.00	0.00
	4	1:4:8 (1 Cement : 4 coarse sand (zone-III) derived from natural sources : 8 graded stone aggregate 40 mm nominal size derived from natural sources) (((2.3+0.1)x2)+ ((2.6+0.1)x2)) x 0.10 = 1.4 cum	1	x	2	2.5	2.8	0.1	1.4	1.4	cum	0.00	0.00
			1	x	2	12	0.5	0.1	1.2	1.2	cum	0.00	0.00

COST ESTIMATE FOR RECHARGE PITS WITH BOREWELL TO DEEP AQUIFIERS

Ref.	S. No	Description of Work	No's			Length/ Area	Breadth	Depth	Quantity	Total Qty		Amount: Applicable Rate	Amount: Total Amount
	5	Providing and laying in position machine batched and machine mixed design mix M-25 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying and including the cost of centering, shuttering, finishing but excluding reinforcement, including admixtures in recommended proporlions as per IS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer-incharge. (Note :- Cement content considered in this item is @ 330 kg/cum. Excess/ less cement used as per design mix is payable / recoverable separately).										0.00	0.00
		All works upto plinth level up to floor V level.										0.00	0.00
	Desilt Chamber	Top Slab	1	x	1	2.3	1.74	0.15	0.60	0.60	Cum	0.00	0.00
		Base Slab	1	x	1	2.3	2.6	0.15	0.90	0.90	Cum	0.00	0.00
		Side Walls	1	x	2	2.3	0.15	1.85	0.64	0.64	Cum	0.00	0.00
	Harvesting Pit	Top Slab	1	x	1	2	3.44	0.15	1.03	1.03	Cum	0.00	0.00
		Base Slab	1	x	2	2	0.3	0.15	0.09	0.09	Cum	0.00	0.00
		Side Walls	1	x	2	2	0.15	3.2	0.96	0.96	Cum	0.00	0.00
	6	TMT Steel Fe 500 D (85kg per Cum of Concrete) Steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level							4.22	358.4918	kg	0.00	0.00
	7	Providing and placing in position 100 mm thick factory made machine batched & machine mixed Precast RCC Rectangular Covers on drains of footpath of various sizes, of M-25 grade cement concrete for RCC work, including cost of centering, shuttering, reinforcement of 8 mm dia TMT bars of Fe 500 grade @ maximum 100mm c/c on both ways , neat cement punning on finished surface, properly encased on all edges with 1.6 mm thick , 100 mm wide MS sheet duly painted over priming coat , reinforcement to be welded at edges with MS sheet and providing 2 Nos. 12 mm dia bar for hooks etc i/c cost of cartage, all leads & lift, handling at site etc. all complete as per direction of Engineer-in-Charge.Precast RCC perforated drain covers - (Each slab size 1000 x560 x)	1	x	2	1	0.56		0.56	1.12	sqm	0.00	0.00
	8	Providing and fixing in position pre-cast R.C.C. manhole cover and frame of required shape and approved quality										0.00	0.00

COST ESTIMATE FOR RECHARGE PITS WITH BOREWELL TO DEEP AQUIFIERS

Ref.	S. No	Description of Work	No's			Length/ Area	Breadth	Depth	Quantity	Total Qty		Amount	
												Applicable Rate	Total Amount
	19.19.4.1	EHD - 35 Circular shape 560 mm internal dia	1	X	2				2.00	2.00		0.00	0.00
	9	Extra for compaction of earth work in embankment under optimum moisture conditions to give at least 95% of the maximum dry density (proctor density).				4	2	0.5	4.00	4.00	cum	0.00	0.00
	10	Supplying and stacking at site.43 mm to 63 mm size of stone aggregate .)packing in around the Borewell - 4 x 2x 0.50 depth filling				4	2	0.5	4.00	4.00	cum	0.00	0.00
	11	Supplying and stacking at site Gravel (13.2 to 20mm)packing in around the Borewell - 4 x 2x 0.50 depth filling				4	2	0.5	4.00	4.00	cum	0.00	0.00
	12	Supplying and stacking at site coarse sand packing in around the Borewell - 4 x 2x 0.50 depth filling				4	2	0.5	4.00	4.00	cum	0.00	0.00
	TOTAL												**0.00**

Cost Estimate of Construction of Storm Water Drainage System						
Ref.	S. No	Description of Work	Total Qty		Applicable Rate (in. Rs.)	AMOUNT Total
	1	Excavation in foundation in ordinary soil (Loam, Clay or Sand) Including lift upto 1.50 m and lead upto 3Om and including filling watering and ramming of excavated eafth into the trenches or into the space between the building and the sides of foundation trenches or into the plinth and removal and disposal of surplus earth as directed by the Engineer ln charge upto a distance of 30m from the foundation trenches.				
		Lift 0 to 1.5 M	11872.71	Cum		
	2	Extra for every additional 30m lead of part of 30m or for every additional '1.5m lifl or part of 1.5m	5990.33	Cum		
	3	Disposal of excavated eath with similar unserviceable, dismantled or waste material by mechanical transport including loading, transporting, unloading to approved municipal dumping ground for lead upto 2 km for all lifts, complete as per directions of Engineer-in-charge	13308.41	Cum		
	4	Providing and laying cement concrete in 1:4:8 (1 Cement:4 coarse sand :8 graded stone aggregate 40 mm nominal size) and curing complete, lncluding cost of form work. in Foundation and floors.				
		PCC under Raft	1273.22	Cum		
	6	Close timbering in case of shafts, wells, cesspits, manholes and the like including strutting, shoring and packing cavities (wherever required) etc. complete. (Measurements to be taken of the face area timbered).				
		Depth not exceeding 1.5 m	21584.79	sqm		
		Depth exceeding 1.5 m but not exceeding 3 m	7479.86	sqm		
		Depth exceeding 3 m	1185.39	sqm		
	7	Providing and filling in position bitumen mix filler of proportion 80 kg. of hot bitumen, 1 kg. of cement and 0.25 cubic metre of coarse sand for expansion joints.	11.45	Cum		
	8	Providing and laying in position machine batched and machine mixed design mix M-25 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying and including the cost of centering, shuttering, finishing but excluding reinforcement, including admixtures in recommended proporlions as per IS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer-incharge. Note :- Cement content considered in this item is @ 330 kg/cum. Excess/ less cement used as per design mix is payable / recoverable separately				
		Allwork up to Plinth level				
		Raft	990.18	Cum		
	9	Extra for laying concrete in or under foul positions	99.02	Cum		
	10	Providing and laying in position machine batched and machine mixed design mix M-25 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying and including the cost of centering, shuttering, finishing but excluding reinforcement, including admixtures in recommended proporlions as per IS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer-incharge. Note :- Cement content considered in this item is @ 330 kg/cum. Excess/ less cement used as per design mix is payable / recoverable separately				
		All work up to Plinth level				
		Drain Wall	3959.27	Cum		

Ref.	S. No	Description of Work	Total Qty		Applicable Rate (in. Rs.)	AMOUNT Total
	11	Providing and laying in position machine batched and machine mixed design mix M-25 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying and including the cost of centering, shuttering, finishing but excluding reinforcement, including admixtures in recommended proporlions as per IS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer-incharge. Note :- Cement content considered in this item is @ 330 kg/cum. Excess/ less cement used as per design mix is payable / recoverable separately.				
		Allwork up to Plinth level				
		Drain Cover Slab	1530.17	Cum		
	12	Providing, hoisting and fixing upto plinth level precast reinforced cement concrete work in string courses, bands, copings, bed plates, anchor blocks, plain window sills and the like, including the cost of required centering, shuttering but excluding cost of reinforcement with 1:1.5:3 (1 cement : 1.5 coarse sand(zone-III) derived from natural sources : 3 graded stone aggregate 20 mm nominal size derived from natural sources).				
		Pre-Cast Drain Cover Slab at 30metre interval	514.00	Cum		
	13	Providing and fixing in position steel bar reinforcement of various diameters for RCC piles, caps, footings, foundations, slabs, beams, columns, canopies, staircases. newels, chajjas, lintels, pardies, copings, fins, arches, etc. as per detailed designs, drawings and schedules; including cutting, bending, hooking the bars, binding with wires or tack welding and supporting as required, etc. complete. (including cost of binding wire).				
		(i) TMT Corrosion resistant steel (CRS) reiforcement bar	489065.00	Kg		
	14	Providing Barricading for Trenches using 80 - 100 mm dia Wooden Ballies as vertical post, atleast 1.5m above ground level and atleast 30-45 cm below ground level at a spacing of 3 m. Two rows of PVC Tape (preferably red in colour) strip barricading horizontal strip securely tied by the vertical members. Vertical members shall be painted in red and white colour. Rate is inclusive removal and cleaning of site complete in all respect.	30050.24	Rmt		
	15	Providing and fixing in position SFRC Cover and frame (heavy duty EHD - 35 grade designation) 560 mm internal diameter conform ing to I.S. 12592, total weight of cover and frame to be not less than 182 kg. fixed in cement concrete slab.				
		Circular shape 560 mm internal diameter	2290.20	No		

Ref.	S. No	Description of Work	Total Qty		Applicable Rate (in. Rs.)	AMOUNT
						Total
	16	Extra for providing and mixing water proofing material in cement concrete and/or cement plaster work in proportion recommended by the manufacturers.	42765.50	per bag of 50kg cement used in the mix		
	17	Construction of Silt Catch Pit of required inner size and depth having required wall thickness including necessary earth work excavation, providing and laying of PCC 1:4:8 of 100 mm thick and providing and laying and placing of Design Mix M25 Graded of Concrete confirming to IS 456/2000 for Reinforcement Cement Concrete Structural elements under controlled water cement ratio using 20mm and down graded machine broken granite stone jelly with required reinforcement as per the approved drawing including transportation, pumping and Vibration charges, cost of centering and shuttering and reinforcement, curing, finishing etc complete as per standard specification and as directed by departmental Engineer in Charge				
	A)	Excavation in foundation in ordinary soil (Loam, Clay or Sand) Including lift upto 1.50 m and lead upto 3Om and including filling watering and ramming of excavated eafth into the trenches or into the space between the building and the sides of foundation trenches or into the plinth and removal and disposal of surplus earth as directed by the Engineer Incharge upto a distance of 30m from the foundation trenches. Mannual (Small work)				
		Lift 0 to 1.5 M	966.18	Cum		
	B)	Providing and laying cement concrete in 1:4:8 (1 Cement:4 coarse sand :8 graded stone aggregate 40 mm nominal size) and curing complete, Including cost of form work. in Foundation and floors.	96.62	Cum		
	C)	Providing and laying in position machine batched and machine mixed design mix M-25 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying and including the cost of centering, shuttering, finishing but excluding reinforcement, including admixtures in recommended proporlions as per lS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer-incharge. Note :- Cement content considered in this item is @ 330 kg/cum. Excess/ less cement used as per design mix is payable / recoverable separately				
		All work up to Plinth level.				
		Raft	69.56	Cum		
	D)	Providing and laying in position machine batched and machine mixed design mix M-25 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying and including the cost of centering, shuttering, finishing but excluding reinforcement, including admixtures in recommended proporlions as per lS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer-incharge. Note :- Cement content considered in this item is @ 330 kg/cum. Excess/ less cement used as per design mix is payable / recoverable separately				

Ref.	S. No	Description of Work	Total Qty		Applicable Rate (in. Rs.)	AMOUNT
						Total
		All work up to Plinth level.				
		Drain Wall				
			231.88	Cum		
	F)	Providing and fixing in position steel bar reinforcement of various diameters for RCC piles, caps, footings, foundations, slabs, beams, columns, canopies, staircases. newels, chajjas, lintels, pardies, copings, fins, arches, etc. as per detailed designs, drawings and schedules; including cutting, bending, hooking the bars, binding with wires or tack welding and supporting as required, etc. complete. (including cost of binding wire).				
		(i) TMT Corrosion resistant steel (CRS) reiforcement bar	22571.47	Kg		
TOTAL						

Cost Estimate of Cnstruction of Outfall Structures

Ref.	S. No	Description of Work	Total Qty									Applicable Rate (in. Rs.)	AMOUNT
			No.			Length/ Area	Breadth	Depth	Quantity	Total Quantity			Total
	1	Excavation in foundation in ordinary soil (Loam, Clay or Sand) Including lift upto 1.50 m and lead upto 30m and including filling watering and ramming of excavated eafth into the trenches or into the space between the building and the sides of foundation trenches or into the plinth and removal and disposal of surplus earth as directed by the Engineer In charge upto a distance of 30m from the foundation trenches.											
		Lift 0 to 1.5 M	1	x	11	1.1	1.21	1.50	21.96				
	O-35	Outfall - 1	1	x	1	1.1	1.98	1.50	3.27				
	O-43	Outfall - 2	1	x	1	1.1	1.54	1.50	2.54				
	O-39	Outfall - 3	1	x	1	1.1	1.32	1.50	2.18				
	O-38	Outfall - 4	1	x	1	1.1	1.1	1.50	1.82				
	O-33	Outfall - 5	1	x	1	1.1	2.2	1.50	3.63				
	O-40	Outfall - 6	1	x	1	1.1	0.77	1.50	1.27				
	O-36	Outfall - 7	1	x	1	1.1	0.66						
	O-44	Outfall - 8	1	x	1	1.1	0.88	1.50	1.45				
	O-41	Outfall - 9	1	x	1	1.1	0.495						
	O-34	Outfall - 10	1	x	1	1.1	0.88	1.50	1.45				
	O-42	Outfall - 11	1	x	1	1.1	0.33						
		Total Quantity								18.00	Cum		
	2	Extra for every additional 30m lead of part of 30m (100ft) or for every additional '1.5m (sft) lifl or part of 1.5m											
	O-35	Outfall - 1	1	x	1	1.1	1.98	4.74	10.32				
	O-43	Outfall - 2	1	x	1	1.1	1.54	2.37	4.02				
	O-39	Outfall - 3	1	x	1	1.1	1.32	2.05	2.98				
	O-38	Outfall - 4	1	x	1	1.1	1.1	0.99	1.19				
	O-33	Outfall - 5	1	x	1	1.1	2.2	2.76	6.67				
	O-40	Outfall - 6	1	x	1	1.1	0.77	0.25	0.21				
	O-36	Outfall - 7	1	x	1	1.1	0.66						
	O-44	Outfall - 8	1	x	1	1.1	0.88	0.32	0.31				
	O-41	Outfall - 9	1	x	1	1.1	0.495						
	O-34	Outfall - 10	1	x	1	1.1	0.88	0.52	0.50				
	O-42	Outfall - 11	1	x	1	1.1	0.33						
		Total Quantity								26.00	Cum		
	3	Disposal of excavated eath with similar unserviceable, dismantled or waste material by mechanical transport including loading, transporting, unloading to approved municipal dumping ground for lead upto 2 km for all lifts, complete as per directions of Engineer-in-charge								26.00	Cum		
	4	Providing and laying cement concrete in 1:4:8 (1 Cement:4 coarse sand :8 graded stone aggregate 40 mm nominal size) and curing complete, Including cost of form work. in Foundation and floors.											
		PCC below Raft											
	O-35	Outfall - 1	1	x	1	1.1	1.98	0.15	0.33				
	O-43	Outfall - 2	1	x	1	1.1	1.54	0.15	0.25				
	O-39	Outfall - 3	1	x	1	1.1	1.32	0.15	0.22				
	O-38	Outfall - 4	1	x	1	1.1	1.1	0.15	0.18				
	O-33	Outfall - 5	1	x	1	1.1	2.2	0.15	0.36				
	O-40	Outfall - 6	1	x	1	1.1	0.77	0.15	0.13				
	O-36	Outfall - 7	1	x	1	1.1	0.66						
	O-44	Outfall - 8	1	x	1	1.1	0.88	0.15	0.15				
	O-41	Outfall - 9	1	x	1	1.1	0.495						
	O-34	Outfall - 10	1	x	1	1.1	0.88	0.15	0.15				
	O-42	Outfall - 11	1	x	1	1.1	0.33						
		Total Quantity								1.80	Cum		
	5	Providing and laying in position machine batched and machine mixed design mix M-25 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying and including the cost of centering, shuttering, finishing but excluding reinforcement, including admixtures in recommended proportions as per IS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer-incharge. Note :- Cement content considered in this item is @ 330 kg/cum. Excess/ less cement used as per design mix is payable / recoverable separately											
		All work up to Plinth level.											
		Raft											
	O-35	Outfall - 1	1	x	1	1.1	1.98	0.25	0.54				
	O-43	Outfall - 2	1	x	1	1.1	1.54	0.25	0.42				
	O-39	Outfall - 3	1	x	1	1.1	1.32	0.25	0.36				
	O-38	Outfall - 4	1	x	1	1.1	1.1	0.25	0.30				

Ref.	S. No	Description of Work	Total Qty									Applicable Rate (in. Rs.)	AMOUNT
			No.			Length/ Area	Breadth	Depth	Quantity	Total Quantity			Total
	O-33	Outfall - 5	1	x	1	1.1	2.2	0.25	0.61				
	O-40	Outfall - 6	1	x	1	1.1	0.77	0.25	0.21				
	O-36	Outfall - 7	1	x	1	1.1	0.66						
	O-44	Outfall - 8	1	x	1	1.1	0.88	0.25	0.24				
	O-41	Outfall - 9	1	x	1	1.1	0.495						
	O-34	Outfall - 10	1	x	1	1.1	0.88	0.25	0.24				
	O-42	Outfall - 11	1	x	1	1.1	0.33						
		Total Quantity								2.90	Cum		
		Wall											
	O-35	Outfall - 1	1	x	2	1.1	0.22	6.24	3.02				
	O-43	Outfall - 2	1	x	2	1.1	0.22	3.87	1.87				
	O-39	Outfall - 3	1	x	2	1.1	0.22	3.55	1.72				
	O-38	Outfall - 4	1	x	2	1.1	0.22	2.49	1.20				
	O-33	Outfall - 5	1	x	2	1.1	0.22	4.26	2.06				
	O-40	Outfall - 6	1	x	2	1.1	0.22	1.75	0.85				
	O-36	Outfall - 7	1	x	2	1.1	0.22						
	O-44	Outfall - 8	1	x	2	1.1	0.22	1.82	0.88				
	O-41	Outfall - 9	1	x	2	1.1	0.22						
	O-34	Outfall - 10	1	x	2	1.1	0.22	2.02	0.98				
	O-42	Outfall - 11	1	x	2	1.1	0.22						
		Total Quantity								12.60	Cum		
	6	Extra for laying concrete in or under foul positions								1.26	Cum		
	7	Providing and fixing in position steel bar reinforcement of various diameters for RCC piles, caps, footings, foundations, slabs, beams, columns, canopies, staircases. newels, chajjas, lintels, pardies, copings, fins, arches, etc. as per detailed designs, drawings and schedules; including cutting, bending, hooking the bars, binding with wires or tack welding and supporting as required, etc. complete. (including cost of binding wire).											
		(i) TMT Corrosion resistant steel (CRS) reiforcement bar								1171.22	Kg		
	8	Extra for providing and mixing water proofing material in cement concrete and/or cement plaster work in proportion recommended by the manufacturers.				per bag of 50kg cement used in the mix				102.30	Kg		
	9	Supplying and stacking of hard stone (for stone pitching) 22.5 cm thick at site											
	O-35	Outfall - 1	1	x	1	1.5	1.98	0.30	0.89				
	O-43	Outfall - 2	1	x	1	1.5	1.54	0.30	0.69				
	O-39	Outfall - 3	1	x	1	1.5	1.32	0.30	0.59				
	O-38	Outfall - 4	1	x	1	1.5	1.1	0.30	0.50				
	O-33	Outfall - 5	1	x	1	1.5	2.2	0.30	0.99				
	O-40	Outfall - 6	1	x	1	1.5	0.77	0.30	0.35				
	O-36	Outfall - 7	1	x	1	1.5	0.66						
	O-44	Outfall - 8	1	x	1	1.5	0.88	0.30	0.40				
	O-41	Outfall - 9	1	x	1	1.5	0.495						
	O-34	Outfall - 10	1	x	1	1.5	0.88	0.30	0.40				
	O-42	Outfall - 11	1	x	1	1.5	0.33						
		Total Quantity								4.80	Cum		
	10	Dry stone pitching 22.5 cm thick laid in courses and required profile with hammer dressed stones having no side less than 15 cm, with minimum depth of 20 cm including preparing the bedding surface etc. all complete. (Payment for Stone to be made separately).											
	O-35	Outfall - 1	1	x	1	1.5	1.98		2.97				
	O-43	Outfall - 2	1	x	1	1.5	1.54		2.31				
	O-39	Outfall - 3	1	x	1	1.5	1.32		1.98				
	O-38	Outfall - 4	1	x	1	1.5	1.1		1.65				
	O-33	Outfall - 5	1	x	1	1.5	2.2		3.30				
	O-40	Outfall - 6	1	x	1	1.5	0.77		1.16				
	O-36	Outfall - 7	1	x	1	1.5	0.66		0.99				
	O-44	Outfall - 8	1	x	1	1.5	0.88		1.32				
	O-41	Outfall - 9	1	x	1	1.5	0.495		0.74				
	O-34	Outfall - 10	1	x	1	1.5	0.88		1.32				
	O-42	Outfall - 11	1	x	1	1.5	0.33		0.50				
		Total Quantity								18.23	sqm		

Ref.	S. No	Description of Work	Total Qty									Applicable Rate (in. Rs.)	AMOUNT
			No.			Length/ Area	Breadth	Depth	Quantity	Total Quantity			Total
	11	Supply, Installation, Testing and commissioning of CI Open Channel Sluice Gates, Manually operated, Rising Spindle type suitable for mounting in between two parallel walls of an Open Channel. Water sealing shall be provided at two vertical sides and bottom side of gate aperture by means of rubber seal, mounted on gate slide and having forced contact with gate aperture. The gate shall be designed in such a manner, so that it can be operated at 2 meter head. Gate frame & Shutter of CI Grade IS 210 FG 260, Head Stock IS 210 Grade FG 260, Hinge Pin SS ASTMA276, Yoke IS MS 2062, Flush Bottom Seal Support Bar of SS ASTM A276 , Stem Operating Nut ASTM A276., Duly tested for tensile strength, Chemical testing and tested Shop tested for overall dimensions as per approved GA drawing complete in all respect as per specification and direction of Engineer for following PEAK FLOW up to 3m channel depth										
		Up to 5 MLD	1	x	11				11.00	11.00	each		
TOTAL													

CONSTRUCTION OF REINFORCED CEMENT CONCRETE UTILITY DUCT					
S. No	**Description of Work**	**Quantity**	**Unit**	**Applicable Rate (in. Rs.)**	**Amount (in Rs.)**
1	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, for all lift, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.				
	Lift 0 to 1.5 M	56070.04	Cum		
2	Extra for every additional lift of 1.5 m or part thereof in excavation / banking excavated or stacked materials.	40392.17	Cum		
3	Disposal of excavated eath with similar unserviceable, dismantled or waste material by mechanical transport including loading, transporting, unloading to approved municipal dumping ground for lead upto 2 km for all lifts, complete as per directions of Engineer-in-charge	96462.20	Cum		
4	Providing and laying cement concrete in 1:3:6 (1 Cement: 3 coarse sand:6 graded stone aggregate 20 mm nominal size) and curing complete, Including cost ofform work. in Foundation and floors.				
	PCC under Raft	3738.00	Cum		
5	Close timbering in case of shafts, wells, cesspits, manholes and the like including strutting, shoring and packing cavities (wherever required) etc. complete. (Measurements to be taken of the face area				
	Depth not exceeding 1.5 m	53400.04	sqm		
	Depth exceeding 1.5 m but not exceeding 3 m	38468.73	sqm		
6	Providing and filling in position bitumen mix filler of proportion 80 kg. of hot bitumen, 1 kg. of cement and 0.25 cubic metre of coarse sand for expansion joints.	5.94	Cum		
7	Providing and laying in position machine batched and machine mixed design mix M-25 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying and including the cost of centering, shuttering, finishing but excluding reinforcement, including admixtures in recommended proporlions as per IS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer-incharge. Note :- Cement content considered in this item is @ 330 kg/cum. Excess/ less cement used as per design mix is payable / recoverable separately				
	All work up to Plinth level				
	Raft	7476.01	Cum		
	Extra for laying concrete in or under foul positions	720.02	Cum		
8	Providing and laying in position machine batched and machine mixed design mix M-25 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying and including the cost of centering, shuttering, finishing but excluding reinforcement, including admixtures in recommended proporlions as per IS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer-incharge. Note :- Cement content considered in this item is @ 330 kg/cum. Excess/ less cement used as per design mix is payable / recoverable separately				
	All work up to Plinth level				
	Drain Wall	13680.07	Cum		
9	Providing, hoisting and fixing upto plinth level precast reinforced cement concrete work in string courses, bands, copings, bed plates, anchor blocks, plain window sills and the like, including the cost of required centering, shuttering but excluding cost of reinforcement with 1:1.5:3 (1 cement : 1.5 coarse sand(zone-III) derived from natural sources : 3 graded stone aggregate 20 mm nominal size derived from natural sources)				
	Pre-Cast Drain Cover Slab at 30metre interval	5073.00	Cum		
10	Providing and fixing in position steel bar reinforcement of various diameters for RCC piles, caps, footings, foundations, slabs, beams, columns, canopies, staircases. newels, chajjas, lintels, pardies, copings, fins, arches, etc. as per detailed designs, drawings and schedules; including cutting, bending, hooking the bars, binding with wires or tack welding and supporting as required, etc. complete. (including cost of binding wire)				
	(i) TMT Corrosion resistant steel (CRS) reiforcement bar		Kg		
	Total quantity	1692486.12	Kg		

11	Providing Barricading for Trenches using 80 - 100 mm dia Wooden Ballies as vertical post, atleast 1.5m above ground level and atleast 30-45 cm below ground level at a spacing of 3 m. Two rows of PVC Tape (preferably red in colour) strip barricading horizontal strip securely tied by the vertical members. Vertical members shall be painted in red and white colour. Rate is inclusive removal and cleaning of site complete in all respect	26371.62	Rmt		
12	Supplying and installing following size of perforated painted with powder coating M.S. cable trays with perforation not more than 17.5%, in convenient sections, joined with connectors, suspended from the ceiling with M.S. suspenders including bolts & nuts, painting suspenders etc. as required.				
	Cable Tray 600 x 50 mm	71200.05	meter		
13	Steel work welded in built up sections/ framed work, including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer using structural steel etc. as required.				
	150x106x5mm MS Flat	228966.74	kg		
14	Providing and fixing T-iron frames of with rectangular/ L-Type sections, made of 1.60 mm thick M.S. Sheet, joints mitred, welded and grinded finish, with profiles of required ize, including fixing of necessary butt hinges and screws and applying a priming coat of approved steel primer				
	Fixing with 150 x 40 mm lugs 10 cm long embedded in cement concrete block 15x10x10 cm of C.C. 1:3:6 (1 Cement : 3 coarse sand : 6 graded stone aggregate 20 mm nominal size).	88028.03	kg		
Total					

COST ESTIMATE FOR TREATED WATER SUPPLY SYSTEM

S. No	Description of Work	Total Qty		Applicable Rate (in. Rs.)	Amount (in Rs.)
a)	**TREATED WASTE WATER SUMP**				
1	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, lift upto 1.5 m, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.				
	All kinds of soil.				
	Total Quantity	2416	cum		
2	Extra rates for quantities of works, executed:				
	In or under water and/or liquid mud, including pumping out water as required	22	cum		
	In or under foul position, including pumping out water as required	22	cum		
3	Extra for every additional lift of 1.5 m or part thereof in excavation / banking excavated or stacked materials.				
	All kinds of soil.				
a)	1st 1.5m lift	1654	cum		
b)	Above first 1.5m lift	1654	cum		
4	Close timbering in case of shafts, wells, cesspits, manholes and the like including strutting, shoring and packing cavities (wherever required) etc. complete. (Measurements to be taken of the face area timbered).				
	Depth not exceeding 1.5 m	214	sqm		
	Depth exceeding 1.5 m but not exceeding 3 m	214	sqm		
	Depth exceeding 4.5 m	500	sqm		
5	Providing and laying cement concrete in 1:4:8 (1 Cement:4 coarse sand :8 graded stone aggregate 40 mm nominal size) and curing complete, Including cost of form work. in Foundation and floors				
	Below Raft				
	Total Quantity	110	cum		
6	Providing and laying in position ready mixed or **site batched** design mix cement concrete for reinforced cement concrete work; using coarse aggregate and fine aggregate derived from natural sources, Portland Pozzolana / Ordinary Portland /Portland Slag cement, admixtures in recommended proportions as per IS: 9103 to accelerate / retard setting of concrete, to improve durability and workability without impairing strength; including pumping of concrete to site of laying, curing, carriage for all leads; but excluding the cost of centering, shuttering, finishing and reinforcement as per direction of the engineer-in-charge; for the following grades of concrete. Note: Extra cement up to 10% of the minimum specified cement content in design mix shall be payable separately. In case the cement content in design mix is more than 1.10 times of the specified minimum cement content, the contractor shall have discretion to either re-design the mix or bear the cost of .				
	M30 grade with minimum cement content of 350 kg /cum				
	All works upto plinth level	707	cum		
	Total Quantity	389			
b)	All works above plinth level upto floor V level		cum		
7	Centering and shuttering including strutting, propping etc. and removal of form for				
a)	Foundations, footings, bases of columns, etc. for mass concrete	151			
	Total Quantity		sqm		
b)	Walls (any thickness) including attached pilasters, butteresses, plinth and string courses etc.	1310			
	Total Quantity		sqm		
c)	Suspended floors, roofs, landings, balconies and access platform	932			
	Total Quantity		sqm		
d)	Lintels, beams, plinth beams, girders, bressumers and cantilevers	1436			
	Total Quantity		sqm		
e)	Columns, Pillars, Piers, Abutments, Posts and Struts	249			
	Total Quantity		sqm		
f)	Edges of slabs and breaks in floors and walls	131			
	Total Quantity		metre		
8	Supplying, fitting and placing TMT steel (Fe 500 grade TMT bars IS 1786-1979) bar reinforcement wrought & put up for RCC and RCM works including cost and conveyance of steel and binding wire, labour for cutting, bending, lifting, placing in position and tying as per approved structural drawings including all labour charges, etc complete as per drawings and technical specifications for bars below 36 mm dia including over laps and wastage for finished item of work at all levels as directed by the engineer - in- charge	75202			
a)	upto plinth level	55216	kg		
	Total Quantity				
b)	above plinth leve	625	kg		

9	Providing and laying APP (Atatic Polypropylene Polymer) modifiei prefabricated five layer 3 mm thick water proofing membrane, black finished reinforced with non- woven polyesler matt consisting of a coat of bitumen primer for bitumen membrane @ O.4O litre/sqm by the same membrane manufacture of density at 25'C, 0.87-0.89 kg/ litre and viscocity 7O-160 cps. Over the primer coat the layer of membrane shall be laid using Butane Torch and sealing all joints etc' and preparing the surface complete. The vital physical and chemicai parameters of the membrane shall be as under : Joint strength in longitudinal and transverse direction at 23'C as 650/ 45ON/ scm. Tear strength in longitudinal and transverse direction as 3OO/250N. Softening point of membrane not less than 150'C. cold flexibilitv shall be upto -2"C when tesled in accordance wlth ASTN4, D - 5147. The laying of membrane shall be got done through the authorised applicator of the manufacturer of membrane :					
	Total Quantity		sqm			
10	Cement plastering including T&P, scaffolding, material and complete labour, including cost of water, curing, racking of joints etc. with 15 mm cement plaster on rough side finished with a floating coat of neat cement of mix : including Providing/mixing of synthetic fibers compulsorily complying with IS 16481:2022 of 06 mm/12 mm length to be mixed @ 0.25% by weight of Cement i.e. 125 gms per 50 kg Cement up to 900 gms per cum of Concrete/ mortar	655				
	1:4 (1 cement : 4 fine/ coarse sand)					
	Total Quantity	196	sqm			
11	Finishing walls with Acrylic Smooth exterior paint of required shade; New work (Two or more coat applied @ 1.67 llth) sqm over and including priming coat ofexterior primer applied @ 2 20 kg/10 sqm) supply of all labour material and T&P required for proper completion of work.					
	Total Quantity	34	sqm			
12	Supply, fabricating & fixing of Powder coated aluminium (minimum thickness of powder coating 50 micron) Aluminium ladder of 450mm wide with 2 nos rectangular section of 65 x 35 mm (3 mm thick) as vertical post and 25 mm bars steps at 300 mm c/c complete in all respect as per the specification and the direction of the Engineer.					
	Total Quantity	2	kg			
13	Providing and fixing in position circular shape 500 mm internal diameter M D - 10 pre-cast R.C.C. manhole cover and frame of required shape and approved qualitv					
	Total Quantity	11	each			
14	Providing and laying Double Flanged (Screwed/ Welded) Centrifugally (Spun) Ductile Iron Pipes of Class K - 9 conforming to IS : 8329	11				
	100 mm dia Ductile Iron Double Flanged		metre			
	400 mm dia Ductile Iron Double Flanged		metre			
15	Providing, lowering, aligning, fixing in position in pipe line, DI D/F resilient seated (soft seated) short body pattern type double eccentric Butterfly valves of approved make of following class & dia complete confirming to BS EN 593/ BS 5155/ IS 13095/1991 amended up to date and of following specifications: Body, disc and end cover of Ductile cast iron of grade GGG40/GGG50 as per DIN 1693 or GR SG-400/12 as per IS 1865 or equivalent grade as per IS :3896-part2-1985 and subsequent revisions, Face to face dimensions as per DIN 3202 F4/ IS 13095 Drilled as per IS:1538. Electrostatic Epoxy Powder(EP-P) / Fusion Bonded Epoxy (NonToxic & suitable for drinking water) coated with minimum thickness of 250 micron applied on both body and disc inside and outside. Disc seal ring of EPDM/ Neoprene (food grade quality) and disc seal retaining ring of SS/CS. Shaft of SS- AISI- 304/316 & shaft bearingsbronze/ PTET or Teflon with EPDM/NBR "O "ring seal, Nut-Bolt confirming to IS:1363 and IS: 1367 (Galvanised steel) Insertion rubber of black EPDM 6mm thick. Suitable support structure as per directions of EIC including jointing & jointing material, labour, testing and commissioning along with pipeline as per	3				
	Electrically Operated & SCADA Compatible (PN 1.6 class)	3				
	100 mm dia Butterfly Valves PN 1.6 (Mpa)		each			
	400 mm dia Butterfly Valves PN 1.6 (Mpa)		each			
16	Supply and delivery of (Sluice Valves) with Body and Bonnet of Ductile Iron GGG-40/SG-400/15 or GGG-50/SG-500/7 or Equivalent as per IS1865, IS:3896-2 and Wedge fully Rubber Lined with food grade quality grade W270 grade EPDM, Replaceable Spindle Nut without gland packing with 3-O ring protection system on the Shaft and Seals of NBR. The Valves should be Vacuum tight and 100% leak proof with face to face dimensions as BS:5163 Type A/IS:14846. All the valves should be with fusion bonded Electrostatic Powder coating both inside and outside (Min 250 Microns)- RAL 5005 with Pocket Less Straight through body Passage conforming to Design standards of DIN-3202F4/BS:5163 Type A Flange drilling as per IS - 1538 excluding all	3				
	DI. D/F Sluice valves of Electrically Operated & SCADA Compatible class PN 1.6	3				
	100 mm dia Butterfly Valves PN 1.6 (Mpa)		each			
	400 mm dia Butterfly Valves PN 1.6 (Mpa)	2	each			

17	Providing flanged joints to double flanged D.I. pipes and specials, including testing of joints	2				
	100mm dia flanged joints at pipe	2	each			
	100mm dia flanged jointsnear valves	2	each			
	400mm dia flanged joints at pipe		each			
	400mm dia flanged jointsnear valves		each			
B	**TREATED WASTE WATER PUMP HOUSE (CIVIL)**					
18	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, for all lift, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.	356				
	All kinds of soil.					
	Total Quantity	25	cum			
19	Extra rates for quantities of works, executed:	25				
	In or under water and/or liquid mud, including pumping out water as required		cum			
	In or under foul position, including pumping out water as required		cum			
20	Extra for every additional lift of 1.5 m or part thereof in excavation / banking excavated or stacked materials.	917				
a)	All kinds of soil.					
	Total Quantity	102	cum			
21	Close timbering in case of shafts, wells, cesspits, manholes and the like including strutting, shoring and packing cavities (wherever required) etc. complete. (Measurements to be taken of the face area timbered).	102				
	Depth not exceeding 1.5 m	148	sqm			
	Depth exceeding 1.5 m but not exceeding 3 m		sqm			
	Depth exceeding 4.5 m		sqm			
22	Providing and laying cement concrete in 1:4:8 (1 Cement:4 coarse sand :8 graded stone aggregate 40 mm nominal size) and curing complete, Including cost of form work. in Foundation and floors	23				
	Below Raft					
	Total Quantity		cum			
23	Providing and laying in position ready mixed or **machine batched and machine mixed at site** design mix cement concrete for reinforced cement concrete work; using cement content as per approved design mix, including pumping of concrete to site of laying and including the cost of centering, shuttering, finishing but excluding reinforcement, including admixtures in recommended proporlions as per lS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer-incharge Note: Extra cement up to 10% of the minimum specified cement content in design mix shall be payable separately. In case the cement content in design mix is more than 1.10 times of the specified minimum cement content, the contractor shall have discretion to either re-design the mix or bear the cost of extra cement	266				
	M25 grade with minimum cement content of 350 kg /cum	85				
a)	All works upto plinth level		cum			
b)	All works above plinth level upto floor V level	13	cum			
24	Providing and laying damp-proof course 40 mm thick with cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 12.5 mm nominal size).					
	Total Quantity		sqm			
25	Diluting and injecting chemical emulsion for POSTCoNSTRUCTIONAL anti termite treatment	59				
	Along external wall where the apron is not provided using chemical emulsion @ 7.5 litres / sqm of the vertical surface of the substructure to a depth of 300mm including excavation channel along the wall & rodding etc. complete: With Chlorpyriphos/ Lindane E.C. 2A% with 1 % concentration					
	Total Quantity	31366	Rm			
26	Supplying, fitting and placing TMT steel (Fe 500 grade TMT bars IS 1786-1979) bar reinforcement wrought & put up for RCC and RCM works including cost and conveyance of steel and binding wire, labour for cutting, bending, lifting, placing in position and tying as per approved structural drawings including all labour charges, etc complete as per drawings and technical specifications for bars below 36 mm dia including over laps and wastage for finished item of work at all levels as directed by the engineer - in- charge	9749				
a)	upto plinth level		kg			
b)	above plinth leve	60	kg			
27	Class-150 (Non Modulao brick work in 1 :4 cement and Coarse sand mortar for super structure above plinth level upto floor five level including necessary cutting and moulding of brick work as required and also including honey combed brick work including supply of all materials, labour and T&P etc. required for proper completion of the work					
	Total Quantity	302	cum			

28	15mm Cenrent plaster with cement mortar in proportion of 1:6 cement & coarse sand of single coat for exterior plastering upto floor two level inclucling internal rounded angles chamfers, and rounded angles not exceeding 80mm. In girth and finished even and smooth.					
	Total Quantity		sqm			
29	20 mm cement plaster 1:3 ('l cement:3 coarse sand) linished with a floating coat of neat cement.	313				
	Below +0.00 lvl					
	Total Quantity	262	sqm			
30	12mm Cenrent plaster with cement mortar in proportion of 1:4 cement & coarse sand of single coat for interior plastering upto floor two level inclucling internal rounded angles chamfers, and rounded angles not exceeding 80mm. In girth and finished even and smooth.					
	Total Quantity	321	sqm			
31	6mm Celling plaster 1:3 (1 cement : 3 fine sand) cement & fine sand in F.lvl. not less than 1.25, 1:3 including chiping of RCC surface before ceiling plaster. The cost of including all material, labour T&P and scafolding etc. all complete.					
	Total Quantity		sqm			
32	Providing and laying integral cement based water proofing treatment including preparation of surface as required for treatment of roofs, balconies, terraces etc consisting of following operations:					
	a) Applying a slurry coat of neat cement using 2.75 kg/sqm of cement admixed with water proofing compound conforming to IS. 2645 and approved by Engineer-in-charge over the RCC slab including adjoining walls upto 300 mm height including cleaning the surface before treatment.					
	b) Laying brick bats with mortar using broken bricks/brick bats 25 mm to 115 mm size with 50% of cement mortar 1:5 (1 cement : 5 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineerin-charge over 20 mm thick layer of cement mortar of mix 1:5 (1 cement :5 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineerin-charge to required slope and treating similarly the adjoining walls upto 300 mm height including rounding of junctions of walls and slabs.					
	c) After two days of proper curing applying a second coat of cement slurry using 2.75 kg/ sqm of cement admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge.					
	d) Finishing the surface with 20 mm thick jointless cement mortar of mix 1:4 (1 cement :4 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge including laying glass fibre cloth of approved quality in top layer of plaster and finally finishing the surface with trowel with neat cement slurry and making pattern of 300x300 mm square 3 mm deep.					
	e) The whole terrace so finished shall be flooded with water for a minimum period of two weeks for curing and for final test."All above operations to be	239				
	With average thickness of 120 mm and minimum thickness at khurra as 65 mm.					
	Total Quantity	8	sqm			
33	Supplying and fixing rolling shutters of approved make, made of required size M.S laths, interlocked together through their entire length and jointed together at the end by end locks, mounted on specially designed pipe shaft with brackets, side guides and arrangements for inside and outside locking with push and pull operation complete, including the cost of providing and fixing necessary 27.5 cm long wire springs manufactured from high tensile steel wire of adequate strength conforming to IS: 4454 - part 1 and l\il.S. top cover of required thickness for rolling shutters.. 80x,1.25 mm M.S. laths with 1.25 mm thick top cover					
	Total Quantity	4	sqm			
34	Extra for providing grilled rolling shutters manufactured out of 8 mm dia M.S. bar instead of laths as per design approved by Engineer-in- charge, (area of grill to be measured).					
	Total Quantity		sqm			

35	Providing and fixing factory made uPVC white colour sliding glazed window upto 1.50 m in height dimension comprising of uPVC multi-chambered frame with in-built roller track and sash extruded profiles duly reinforced with 1.60 ± 0.2 mm thick galvanized mild steel section made from roll forming process of required length (shape & size according to uPVC profile), appropriate dimension of uPVC extruded glazing beads and uPVC extruded interlocks, EPDM gasket, wool pile, zinc alloy (white powder coated) touch locks with hook, zinc alloy body with single nylon rollers (weight bearing capacity to be 40 kg), G.I fasteners 100 x 8 mm size for fixing frame to finished wall and necessary stainless steel screws etc. Profile of frame & sash shall be mitred cut and fusion welded at all corners, including drilling of holes for fixing hardware's and drainage of water etc. After fixing frame the gap between frame and adjacent finished wall shall be filled with weather proof silicon sealent over backer rod of required size and of approved quality, all complete as per approved drawing & direction of Engineer-in-Charge. (Single / double glass panes, wire mesh and silicon sealent shall be paid separately). Variation in profile dimension in higher side shall be accepted but no extra payment on					
	Note: For uPVC frame and sash extruded profiles minus 5% tolerance in dimension i.e. in depth & width of profile shall be acceptable.	12				
	Two track two panels sliding window made of (big series) frame 67 x 50 mm & sash 46 x 62 mm both having wall thickness of 2.3 ± 0.2 mm and single glazing bead / double glazing bead of appropriate dimension . (Area of window above 1.75 sqm upto 2.50 sqm).					
	Total Quantity		Mtr.			
36	Providing and fixing aluminium work for doors, windows, ventilators and partitions with extruded built up standard tubular sections/ appropriate Z sections and other sections of approved make conforming to IS: 733 and IS: 1285, fixing with dash fasteners of required dia and size, including necessary filling up the gaps at junctions, i.e. at top, bottom and sides with required EPDM rubber/ neoprene gasket etc. Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically wherever required including cleat angle, Aluminium snap beading for glazing / paneling, C.P. brass / stainless steel screws, all complete as per architectural drawings and the directions of Engineer-in-charge. (Glazing, paneling and dash fasteners to be paid for separately) :					
a)	For fixed portion					
	Powder coated aluminium (minimum thickness of powder coating 50 micron)	185				
	Ventilators					
	Total Quantity	2	kg			
37	Making khurras 45x45 cm with average minimum thickness of 5 cm cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate of 20 mm nominal size) over P.V.C. sheet 1 m x1 m x 400 micron, finished with 12 mm cement plaster 1:3 (1 cement : 3 coarse sand) and a coat of neat cement, rounding the edges and making and finishing the outlet complete.					
	Total Quantity		each			
38	62 mm thick cement concrete flooring with concrete hardener topping, under layer 50 mm thick cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20mm nominal size) and top layer 12mm thick cement hardener consisting of mix 1:2 (1 cement hardener mix : 2 graded stone aggregate, 6mm nominal size) by volume, hardening compound mixed @ 2 litre per 50 kg of cement or as per manufacture's specifications. This includes cost of cement slurry, but excluding the cost of nosing of steps etc. complete	237				
	Floor @(-)5.35m					
	Total Quantity		sqm			
39	25 mm thick Kota stone slab flooring over 20 mm (average) thick base laid over and jointed with grey cement slurry mixed with pigment to match the shade of the slab, including rubbing and polishing complete with base of cement mortar 1 : 4 (1 cement : 4 coarse sand).	82				
	Floor @0.00m					
	Total Quantity		sqm			
40	Kota stone slabs 20 mm thick in risers of steps, skirting, dado and pillars laid on 12 mm (average) thick cement mortar 1:3 (1 cement: 3 coarse sand) and jointed with grey cement slurry mixed with pigment to match the shade of the slabs, including rubbing and polishing complete.	4				
	Floor @0.00m					
	Total Quantity	575	sqm			
41	Distempering with oil bound washable distemper of approved brand and manufacture to give an even shade : New work (two or more coats) over and including water thinnable priming coat with cement primer including cost of all materials, labour T&P etc required for proper completion ofwork.					
	Total Quantity		sqm			
42	Finishing walls with Acrylic Smooth exterior paint of required shade New work (Two or more coats applied @ 328 ll lo sqm) over and including priming coat of exterior primer applied @ 2.20k9/10 sqm supply of all labour material and T&P required for proper completion of work.	302				
	Same as external plaster					

	Total Quantity			sqm		
43	Providing and fixing on wall face unplasticised Rigid PVC rain water pipes conforming to IS : 13592 Type A, including jointing with seal ring conforming to IS : 5382, leaving 10 mm gap for thermal expansion, (i) Single socketed pipes.	11				
	110 mm diameter					
	Total Quantity	33		metre		
44	Supply, fabricating & fixing of Powder coated aluminium (minimum thickness of powder coating 50 micron) Aluminium ladder of 450mm wide with 2 nos rectangular section of 65 x 35 mm (3 mm thick) as vertical post and 25 mm bars steps at 300 mm c/c complete in all respect as per the specification and the direction of the Engineer.					
	Total Quantity	287		kg		
45	Providing and fixing hand rail of approved size by welding etc. to steel ladder railing, balcony railing, staircase railing and similar works, including applying priming coat of approved steel primer.					
	Total Quantity	25		kg		
46	Providing and laying Double Flanged (Screwed/ Welded) Centrifugally (Spun) Ductile Iron Pipes of Class K - 9 conforming to IS : 8329	20				
	400 mm dia Ductile Iron Double Flanged					
	Total Quantity	6		metre		
	Total Quantity	5		metre		
47	Providing flanged joints to double flanged C.I./ D.I. pipes and specials, including testing of joints					
	400 mm diameter pipe			each		
	700 mm diameter pipe	6		each		
48	Supply and delivery of (Sluice Valves) with Body and Bonnet of Ductile Iron GGG-40/SG-400/15 or GGG-50/SG-500/7 or Equivalent as per IS1865, IS:3896-2 and Wedge fully Rubber Lined with food grade quality grade W270 grade EPDM, Replaceable Spindle Nut without gland packing with 3-O ring protection system on the Shaft and Seals of NBR. The Valves should be Vacuum tight and 100% leak proof with face to face dimensions as BS:5163 Type A/IS:14846. All the valves should be with fusion bonded Electrostatic Powder coating both inside and outside (Min 250 Microns)- RAL 5005 with Pocket Less Straight through body Passage conforming to Design standards of DIN-3202F4/BS:5163 Type A Flange drilling as per IS - 1538 excluding all taxes, duties and transportation					
	DI. D/F Sluice valves of Electrically Operated & SCADA Compatible class PN 1.6	6				
	400 mm diameter	6		each		
49	Providing, lowering, aligning, fixing in position in pipe line, DI D/F resilient seated (soft seated) Swing type SCADA Enabled Non Return Valve of approved make of following Pressure rating & dia complete, generally confirming to IS: 5312 (part -1)/ 2004 (amended up to date) and of following specifications: Body, Bonnet & disc of Ductile cast iron of grade GGG40/GGG50 as per DIN 1693 or GR SG-400/12 as per IS 1865 or equivalent grade as per IS :3896-part2-1985 and subsequent revisions, Face to face dimensions as per IS 5312 (part -1):2004 Drilled as per IS:1538. Electrostatic Epoxy Powder(EP-P) / Fusion Bonded Epoxy (Non-Toxic & suitable for drinking water) coated with minimum thickness of 250 micron applied on body, cover and disc inside and outside . Disc seal ring of EPDM/ Neoprene (food grade quality) and disc seal retaining ring of SS/CS. Shaft of SS- AISI- 410, Hinge SS AISI 316/410 ,Bonnet Gasket EPDM ,Bush- Brass with EPDM/NBR "O "ring seal Nut-Bolt confirming to IS:1363 and IS: 1367 (galvanised steel) Insertion rubber of black EPDM 6mm thick. Suitable support structure as per directions of EIC including jointing & jointing material, labour, testing and commissioning along with pipeline as per Technical Specification & as per direction of Engineer-in-charge.					
	400 mm diameter			each		
50	Providing, lowering, laying, aligning, fixing in position in pipe line Air Cushion Valves 150 mm dia as per IS:14845 (including jointing and jointing material), including all material, labour, testing and commissioning as per Technical Specifications and as per direction of Engineer etc. complete in all respect.	6		each		
		4				
C	**MECHANICAL & INSTRUMENTATION WORKS AT TREATED WASTE WATER PUMP HOUSE**	4				
51	Supply, delivery and fixing of floor mounted type FCMA Air/ Oil Cooled soft starter suitable for the 75Hp LT motor offered for operation in AC three Phase 50Hz (+/- 5%), 415V(+/-10%) including line contactors suitable for next standard higher KW rating, Over load relay, instrument panel with frequency meter, Ammeter, Voltmeter, indicating lamp 6Nos, LED ON/OFF type and Start /Stop push button.			each		
52	Earthing with copper earth plate 600 mm X 600 mm X 3 mm thick including accessories, and providing masonry enclosure with cover plate having locking arrangement and watering pipe of 2.7 meter long etc. with charcoal/ coke and salt as required.	1		each		

53	Providing and laying earth connection from earth electrode with 6 SWG dia G.I. Wire in 15 mm dia G.I. pipe from earth electrode including connection with G.I. thimble excavation and re-filling as required.	1	each			
54	Supplying, erecting, testing & commissioning of Electrically Operated Travelling Crane (EOT) .Main girder & End Carriage fabricated from Rolled Steel Section, Gear Box for all motion, Electro Magnetic Friction Disc Type Brakes, all safety limit switches , LT wheels EN 9, Double Flanged 4No, with Sq. Cage motor of adequate rating (KW), duly painted mechanical cleaning and one coat of primer and two coat of synthetic paint and as per the direction of the Engineer					
a)	3 MT Capacity, Span 9 M and Lift 6 M	1	set			
55	Supply, installation and commissioning of Mono Rail Single Girder Crane suitable for lift up to 9m with chain 9m pulley block and traveling trolley excluding cost of girder complete in all respect as per the direction of the Engineer.					
	3 MT Capacity	1	set			
56	Providing, Installation, Testing and Commissioning of Ultrasonic Level Transmitter : Principle : Time of Flight / Sensor MOC PP / Power Supply: 24 V DC / Output: 4- 20mA / Display: Integral display for programming and Display Reading / IP 66/ Accuracy ±1%	1				
	0 - 8 Mtr.	1	set			
57	Providing, installation, testing and commissioning of TSS Analyser with Transmitter and Sensor Measuring Range: 0-10 mg/L, Accuracy: ≤ 3%, Resolution: ≤ 0.15 mg/L, Operating Temperature: 0- 40°C, Cleaning: Automatic Self-Cleaning using compressed Air as per CBCP/SPCB guidelines	1	No.			
58	Providing, installation, testing and commissioning of pH Analyser: Transmitter : Range: 0-14 pH, Power Supply 230 VAC, Input: One Digital Sensor, Output: 4-20mA HART, IP66 Protection / Tx protection cover required / Sensor Range 0-14 pH , able to transmit digital signal to transmitter, calibration data can be transferred to Transmitter , process temp: 65 deg cen/ flow through tee MOC SS as per CBCP/SPCB guidelines	1	No.			
59	Providing, installation, testing and commissioning of Chlorine Analyser : Transmitter : Range: 0.05 to 20 ppm, Power Supply 230 VAC, Input: 2 Digital Sensors - one for chlorine and second for pH, Output: 4-20mA HART, IP66/67 Protection / Tx protection cover required / Sensor Range 0-14 pH , able to transmit digital signal to transmitter, calibration data can be transferred to Transmitter , process temp: 65 deg cen/ Sensor range:0.05 to 20 mg/l.as per CBCP/SPCB guidelines	1	No.			
60	Providing, installation, testing and commissioning of NH3 Analyser with Transmitter and Sensor Range: 0 - 100 ppm, Repeatability: ±5% of measured vaue, Protection class: IP 68, Accuracy: ±5% of measured value, Output: 4 - 20 mA DC (Isolated) as per CBCP/SPCB guidelines	1	No.			
61	Providing, installation, testing and commissioning of NO3 Analyser with Transmitter and Sensor Range: 0 - 1000 mg/L, Repeatability: ±5% of measured vaue, Protection class: IP 68, Accuracy: ±5% of measured value, Output: 4 - 20 mA DC (Isolated) as per CBCP/SPCB guidelines	1	No.			
62	Providing, installation, testing and commissioning of Mixed Liquid Suspended Solid (MLSS) Analyser Range: 0.001 - 4000 NTU, Repeatability: ±5% of measured vaue, Protection class: IP 68, Accuracy: ±1% of measured value, Output: 4 - 20 mA DC (Isolated) as per CBCP/SPCB guidelines	2	No.			
63	Providing, installation, testing and commissioning of Turbidity Analyser : Range - Selective 0 to 4000 NTU, Accuracy:+/-2% of reading or +/-0.02NTU; Compliance to US EPA180.1, With inbuilt transmitter with 4-20 mA output, Relay contacts & Modbus communication as per CBCP/SPCB guidelines.	2	No.			
64	Providing, installation, testing and commissioning of Total Organic Carbon (TOC) Meter, Measuring Range: 0-25 mg/L, Accuracy: 3%, Resolution: ≤ 0.15 mg/L, Cleaning: Automatic Self-Cleaning using compressed Air as per CBCP/SPCB guidelines.	2	No.			
65	Providing, installation, testing and commissioning of ORP Meter with Transmitter and Sensor, Measuring Range: -2000mV to 2000mV, Accuracy: ≤ 0.01 units of V, Resolution: ≤ 0.01 units of V, Response Time: ≤ 60 seconds, Operating Temperature: 0- 40°C, Repeatability: ±0.05		No.			
66	Providing, installation, testing and commissioning of ORP Meter with Transmitter and Sensor, Measuring Range: -2000mV to 2000mV, Accuracy: ≤ 0.01 units of V, Resolution: ≤ 0.01 units of V, Response Time: ≤ 60 seconds, Operating Temperature: 0- 40°C, Repeatability: ±0.05	2	No.			
67	Providing, Installation, Testing and Commissioning of Differential Pressure transmitter sensor material and wetted parts MOC SS316, 4-20mA DC (Isolated) output, IP 65 of IS 13947 Part I, Overall Accuracy ± 0.5% of measered value, Range: Adjustable over full span	1	No.			
68	Providing, Installation, Testing and Commissioning of Electromagnetic Flow Meter : Liner: Polyurethane or Hard Rubber / Electrode MOC: SS316L or CS /Housing : Die Cast Aluminium or CS / Power Supply: 90-230 V AC / Output: 4-20mA with HART / Sensor Cable : 10 mt / Flow Tube or Sensor housing protection IP68 / Process Flange : SS316 / Display : 3 1/2 LCD Display / Cable Connection : 1/2"NPT /Accuracy : 0.5%					
	400 mm		No.			

69	Dissolved Oxygen Analyser : Measuring range: 0 to 20mg/l, Optical fluorescence technology , Membrane free operation ;Accuracy:0.01mg/l or +/- 1% of measured value ; With digital transmitter having output: 4-20mA HART, IP66/67 Protection	6	No.
D	**PUMPSETS AT TREATED WASTE WATER PUMP HOUSE**		
70	Supply, delivery at site with necessary packing, receiving, unloading, shifting, storing, installation, testing and commissioning of Horizontal Centrifugal Split Casting pumps with motor as per IS 12615-2011 or amended up to date, CI casing and casing ring, SS 316 impeller, SS 410 Shaft and shaft sleeve, coupling guard, common base plate, foundation bolts etc. complete with all respect as per the specification		
	Discharge 31 to 40 LPS	7517	Each
E	**TREATED WASTE WATER SUPPLY NETWORK**		
71	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, for all lift, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.		
	All kinds of soil	1278	
	Pipes, cables etc. exceeding 80 mm dia. but not exceeding 300 mm dia	1278	metre
72	Extra rates for quantities of works, executed:		
	In or under water and/or liquid mud, including pumping out water as required	136	metre depth
	In or under foul position, including pumping out water as required		metre depth
73	Disposal of excavated eath with similar unserviceable, dismantled or waste material by mechanical transport including loading, transporting, unloading to approved municipal dumping ground for lead upto 2 km for all lifts, complete as per directions of Engineer-in-charge	275	
	Total earth to be disposed from the work site	360	Cum
74	Providing, D.I.K-9 pipes (push on joints pressure pipes of following diameters confirming to the I. S. specification inclusive cost of jointing materials (Rubber gasket of EPDM Quality) F.O.R. Destination Rates per meter (exclusive of G.S.T.) in Rs., anywhere in U.P. up to stores of consignees, inclusive of third party inspection charges, packing and forwarding charges, transit insurance charges, road transportation charges etc.completed as directed by Engineer in charges (IS 1536/2001 for pipes	580	
	250mm		Rmt
	300mm	2083	Rmt
	350mm		Rmt
75	Laying in position DI K-9 SS pipes of following diameter, grade and alignment as directed by Engineer-in-charge including conveyance of material from stores to site of work etc. complete.	50	
	Total Quantity	65	quintal
75	Providing push-on-joints to Centrifugally (Spun) Cast Iron Pipes or Ductile Iron Pipes including testing of joints and the cost of rubber gasket IS 158/1969 and IS 12820/1989 or latest edition/ revision with amendments for Rubber Gaskets.	106	
	250mm		joint
	300mm	40	joint
	350mm		joint
76	Providing and laying D.I. specials of class K-12 suitable for push-on jointing as per IS : 9523 :	21573	
	Upto 600 mm dia.	7019	quintal
77	Hydraulic testing of D.I. pipe line to specified pressure including cost of all materials and labour and water for testing for specified length including cutting, placing end cap making arrangement for filling safe water using reciprocating type pumps which should be able to provide specified test pressure gauges and other necessary equipments, labour, operation charges, etc. required for testing. The rate under this item shall also include cost of retesting, if necessary and reinstating to original position	2087	
	250mm	2552	Km
	300mm		Km
	350mm	21573	Km
78	Providing, HDPE pipes, PE-100, PN-10 of following diameters confirming to the IS 4984, 2016 and its latest amendment(s) F.O.R. Destination Rates per meter (exclusive of G.S.T.) in Rs., anywhere in U.P. up to stores of consignees, inclusive of third party inspection charges, packing and forwarding charges, transit insurance charges, road transportation charges etc.completed as directed by Engineer in charges	7019	
	90 mm dia HDPE PE-100 8Kgs/cm2 pipe line	2087	Rmt
	110mm dia HDPE PE-100 8Kgs/cm2 pipe line	2552	Rmt
	160mm dia HDPE PE-100 8Kgs/cm2 pipe line		Rmt
	200mm dia HDPE PE-100 8Kgs/cm2 pipe line	21573	Rmt
79	Laying, jointing of HDPE Pipeline (PE-100) including supply of Electrofusion Specials & Fittings. It also includes all labour, T&P, electricity, etc. required	7019	
	90 mm dia HDPE PE-100 8Kgs/cm2 pipe line	2087	Rmt
	110mm dia HDPE PE-100 8Kgs/cm2 pipe line	2552	Rmt

	160mm dia HDPE PE-100 8Kgs/cm2 pipe line	275	Rmt			
	200mm dia HDPE PE-100 8Kgs/cm2 pipe line	360	Rmt			
80	Disinfecting water mains by flushing with water containing bleaching powder @ 0.5 gms per litre of water and cleaning the same with fresh water, operation to be repeated three times including getting the sample of water from the disinfected main tested in the government laboratory.	580				
	80mm		metre			
	100mm	21573	metre			
	150mm	7019	metre			
	200mm	2087	metre			
	250mm	2552	metre			
	300mm	275	metre			
	350mm	360	metre			
81	Extra for every operation of disinfecting the water main by flushing with water containing bleaching powder @ 0.5 gms per litre of water and cleaning the same with fresh water, including getting the samples of water tested in the government laboratory.	580				
	80mm		metre			
	100mm		metre			
	150mm	9	metre			
	200mm	3	metre			
	250mm	2	metre			
	300mm	2	metre			
	350mm	2	metre			
82	Supply and delivery of (Sluice Valves) with Body and Bonnet of Ductile Iron GGG-40/SG-400/15 or GGG-50/SG-500/7 or Equivalent as per IS1865, IS:3896-2 and Wedge fully Rubber Lined with food grade quality grade W270 grade EPDM, Replaceable Spindle Nut without gland packing with 3-O ring protection system on the Shaft and Seals of NBR. The Valves should be Vacuum tight and 100% leak proof with face to face dimensions as BS:5163 Type A/IS:14846. All the valves should be with fusion bonded Electrostatic Powder coating both inside and outside (Min 250 Microns)- RAL 5005 with Pocket Less Straight through body Passage conforming to Design standards of DIN-3202F4/BS:5163 Type A Flange drilling as per IS - 1538 excluding all taxes, duties and transportation	2				
	DI. D/F Sluice valves of Electrically Operated & SCADA Compatible class PN 1.6	2				
	80mm		each			
	100mm		each			
	150mm	5	each			
	200mm	2	each			
	250mm	1	each			
	300mm	1	each			
	350mm	1	each			
83	Supply and delivery of (Scour Valves) with Body and Bonnet of Ductile Iron GGG-40/SG-400/15 or GGG-50/SG-500/7 or Equivalent as per IS1865, IS:3896-2 and Wedge fully Rubber Lined with food grade quality grade W270 grade EPDM, Replaceable Spindle Nut without gland packing with 3-O ring protection system on the Shaft and Seals of NBR. The Valves should be Vacuum tight and 100% leak proof with face to face dimensions as BS:5163 Type A/IS:14846. All the valves should be with fusion bonded Electrostatic Powder coating both inside and outside (Min 250 Microns)- RAL 5005 with Pocket Less Straight through body Passage conforming to Design standards of DIN-3202F4/BS:5163 Type A Flange drilling as per IS - 1538 excluding all taxes, duties and transportation	1				
	DI. D/F Scour valves of Electrically Operated & SCADA Compatible class PN 1.6	2				
	80mm		each			
	100mm		each			
	150mm	15	each			
	200mm	7	each			
	250mm	2	each			
	300mm	2	each			
	350mm	2	each			

84	Providing, lowering, aligning, fixing in position in pipe line, DI D/F resilient seated (soft seated) short body pattern type double eccentric Butterfly valves of approved make of following class & dia complete confirming to BS EN 593/ BS 5155/ IS 13095/1991 amended up to date and of following specifications: Body, disc and end cover of Ductile cast iron of grade GGG40/GGG50 as per DIN 1693 or GR SG-400/12 as per IS 1865 or equivalent grade as per IS :3896-part2-1985 and subsequent revisions, Face to face dimensions as per DIN 3202 F4/ IS 13095 Drilled as per IS:1538. Electrostatic Epoxy Powder(EP-P) / Fusion Bonded Epoxy (NonToxic & suitable for drinking water) coated with minimum thickness of 250 micron applied on both body and disc inside and outside. Disc seal ring of EPDM/ Neoprene (food grade quality) and disc seal retaining ring of SS/CS. Shaft of SS- AISI- 304/316 & shaft bearingsbronze/ PTET or Teflon with EPDM/NBR "O "ring seal, Nut-Bolt confirming to IS:1363 and IS: 1367 (Galvanised steel) Insertion rubber of black EPDM 6mm thick. Suitable support structure as per directions of EIC including jointing & jointing material, labour, testing and commissioning along with pipeline as per	2				
	Electrically Operated & SCADA Compatible (PN 1.6 class)	2				
	80mm		each			
	100mm	13	each			
	150mm	2	each			
	200mm		each			
	250mm	46	each			
	300mm	10	each			
	350mm	6	each			
83	Providing and supplying Double acting Air Valves confirming to IS 14845 as per Indian standard specifications combined with screw down isolating valve, small orifice elastic ball resting on a gun metal orifice nipple, large orifice vulcanite ball seating on moulded seat ring, inlet face and drilled, including insurance, third party inspection charges, loading, unloading, transportation upto departmental stores, in all respect etc. complete.					
	50 mm dia	2	each			
	80 mm dia	6	each			
85	Construction of RCC valve chamber for different types of valves including earthwork excavation, 100 mm PCC M10 (1:3:6 i.e 1 Cement : 3 coarse sand : 6 graded stone aggregate 20 mm nominal size) as levelling course, RCC M20 grade (1:1½:3 i.e. 1 Cement : 1½ coarse sand : 3 graded stone aggregate 20 mm nominal) size for base slab 175mm thick, side wall 175mm thick & cover slab 150mm thick with C.I. surface box with hinged cover 100x100x75 mm (deep), including cost of steel reinforcement not less than 80 kg per cum CC, form work, proper curing of concrete work, complete in all respect as per standard specifications and drawings and as directed by Engineer-in-charge	1				
	1200 x 1200 x 1300 mm (depth) for 80/100/125/150 mm dia valve		each			
	1300 x 1300 x 1450 mm (depth) for 200/250/300 mm dia valve	2	each			
	1400 x 1600 x 1750 mm (depth) for 350/400/450/500/600 mm dia valve	6	each			
86	Providing and fixing enclosed type water meter (bulk type) conforming to IS : 2373 and tested by Municipal Board complete with bolts, nuts, rubber insertions etc. (The tail pieces if required will be paid separately)	1				
	100mm dia nominal bore		each			
	150mm dia nominal bore	2	each			
	200mm dia nominal bore	2	each			
87	Providing and fixing C.I. dirt box strainer for bulk type water meter with nuts, bolts, rubber insertions etc. complete conforming to IS : 2373.	2				
	100mm dia		each			
	150mm dia	146	each			
	200mm dia	8	each			
88	Providing, installation, testing and commissioning of Bulk Flow Meter with removable mechanism class "B" confirming to ISO: 4064/1 including all materials (excluding CI/DI fittings) and making connection with existing pipeline required for Bulk Flow Meter including cutting the existing pipe line etc complete in all respect as per technical specification as per SCADA specification and as per direction of Engineer	12				
	BFM250 for DN 250 mm		each			
	BFM300 for DN 300 mm	231	each			
	BFM300 for DN 300 mm at the pumping main outlet	14300	each			
89	Thrust Blocks					
a)	Excavation in foundation in ordinary soil (Loam, Clay or Sand) Including lift upto 1.50 m and lead upto 3Om and including filling watering and ramming of excavated eafth into the trenches or into the space between the building and the sides of foundation trenches or into the plinth and removal and disposal of surplus earth as directed by the Engineer Incharge upto a distance of 30m from the foundation trenches. Mannual (Small work)		Cum			
b)	As in Item above but excavation in soil mixed with moorum shingle kankar requiring the use of special tools and Plants such a pick axes subbals etc. Mannual (Small work)	1691	Cum			

c)	Providing and laying cement concrete in 1:2:4 (1 Cement : 2 coarse sand :4 graded stone aggregate 20 mm nominal size) and curing complete, Including cost of form work. In Foundation and floors.		Cum		
d)	Providing and laying in position machine batched and machine mixed design mix M-25 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying and including the cost of centering, shuttering, finishing but excluding reinforcement, including admixtures in recommended proporlions as per IS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer-incharge.(Note :- Cement content considered in this item is @ 330 kg/cum. Excess/ less cement used as per design mix is payable / recoverable separately)	5917			
	All work up to Plinth level	3381	Cum		
e)	Steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete upto plinth level.				
	Thermo-Mechanicallv Treated bars of grade Fe-500D or more		Kg		
90	Providing House Service Connection (single service connection) from distribution main to property limit , including supply and fixing of domestic multijet mechanical AMR water meters of approved make along with fittings shall be provided with following items.	4438			
a)	Providing, installing and giving satisfactory field testing of domestic multijet mechanical AMR water meters horizontal inferencial with magnetic drive and dry dial suitable for ambient 50oC temperature duly sealed against tampering complete with coupling at both ends and conforming to ISO 4064 with GSM / radio frequency (RF) for communication to server via transreceiver alongwith Hand held Device and PC software etc complete with EEC / OIML.MID certification for Abroad meter and FCRI for India including 36 months guarantee etc complete	1691			
	32mm dia	1691	Each		
b)	Providing and making house service connections from water supply distribution uPVC/ DI/ CI pipe line upto water meter chamber inside the property using Chlorinated Polyvinyl Chloride (CPVC) pipes. The item consisting supply and jointing of pipes & fiitings with solvent cement, trenching, refilling & testing of joints completeincluding all material, labour, testing and commissioning as per Technical Specifications and as per direction of				
	32 mm nominal dia CPVC Pipes	5917	Rmt		
	20 mm nominal dia CPVC Pipes	3381	Rmt		
c)	Excavation in foundation in ordinary soil (Loam, Clay or Sand) Including lift upto 1.50 m and lead upto 3Om and including filling watering and ramming of excavated eafth into the trenches or into the space between the building and the sides of foundation trenches or into the plinth and removal and disposal of surplus earth as directed by the Engineer In charge upto a distance of 30m from the foundation trenches. Mannual (Small work)				
	32 mm nominal dia Pipes	4438	Cum		
91	Supplying and Fixing water METER BOX- with Weather resistant PE/ GRP box, press fitted Lid fixing & locking and locked with built-in or external lock.	1691	Each		
	TOTAL TREATED WASTE WATER SUPPLY				

DETAILED COST ESTIMATE & SCHEDULE OF ELECTRICAL WORKS FOR POWER DISTRIBUTION SYSTEM OF ATAL PURAM TOWNSHIP					
S.No.	Description	Qty	Units	Applicablr Rate (Rs)	Amount (Rs)
1	2	3	4	5	7
(A)3nos. of 33kV/11kV Substations, 33kV & 11kV RMUs, 33kV & 11kV cabling					
1	**HT Switchgear**				
	Design, manufacture, testing at manufacturers works, supply, packing, forwarding and delivery including transit insurance from place of storage/ manufacturer's works to erection site, installation, commissioning and performance demonstration of the following metal enclosed vaccum circuit breaker switchgear with all necessary ratings, metering & protections as per SLDs.:			-	-
1.1	**33kV Switchgear (GIS) for Substation-1 & 3 EHV 33KV GIS Substation having short circuit rating of 31.5kA for 1 sec. as per specification and with following configuration:**	**2**	no.		-
a	1 nos. incomer with PT.(another one excluded in this package but space provision to be considered)			-	-
b	1 nos. of buscouplers			-	-
c	6 nos of outgoings (1 TIE + 1 nos. 33/11kV TR. +4 spares) (1 tie is excluded in this package but space provision to be considered)			-	-
d	2 nos. of Bus PT.			-	-
1.2	**11kV Switchgear GIS for Substation-1 & 3 having short circuit rating of 25kA for 1 sec. as per specification and with following configuration:**	**2**	no.	-	-
a	1 nos. incomer with PT.(another one excluded in this package but space provision to be considered)			-	-
b	1 nos. of buscouplers			-	-
c	15 nos of outgoings (5 zones + 1tie+1 nos. 11/0.415 kv TR. + 3 spares) (1 tie is excluded in this package but space provision to be considered)			-	-
d	2 nos. of Bus PT.			-	-
1.3	**33kV Switchgear (GIS) for Substation-2 & EHV 33KV GIS Substation having short circuit rating of 25kA for 1 sec. as per specification and with following configuration:**	1	no.	-	-
a	2 nos. incomer with PT.			-	-
b	1 nos. of buscouplers			-	-
c	7 nos of outgoings (2 TIE + 2 nos. 33/11kV TR. +2 spares)			-	-
d	2 nos. of Bus PT.			-	-
1.4	**11kV Switchgear GIS for Substation-2 having short circuit rating of 25kA for 1 sec. as per specification and with following configuration:**	1	no.	-	-
a	2 nos. incomer with PT.			-	-
b	1 nos. of buscouplers			-	-
c	13 nos of outgoings (4 zones +2tie+ 1 nos. 11/0.415 kv TR. + 2 spares)			-	-
d	2 nos. of Bus PT.			-	-
2	**Power Transformer**			-	-
	Design, manufacture, testing at manufacturers works, supply, packing, forwarding and delivery including transit insurance from place of storage/ manufacturer's works to erection site, installation, commissioning and performance demonstration of the following outdoor type Power Transformers, OLTC and with all necessary accessories.:			-	-
a	33/ 11kV, 10/12.5MVA, Oil type, two winding, 3 Phase, Dyn11, 50Hz, ONAN/ ONAF Transformer with 8.35% impedance on 10 MVA with OLTC. At ESS-2 -2nos Power transformer and at ESS-1 & ESS-3 considered 1no in EPC packege.The EPC package includes provisions for future infrastructure (e.g., space for additional transformers at ESS-1 and ESS-3).	**4**	nos	-	-
3	**Design & SITC of Distribution Transformer for 33/11 kV S/s**			-	-
	Design, manufacture, testing at manufacturers works, supply, packing, forwarding and delivery including transit insurance from place of storage/ manufacturer's works to erection site, installation, commissioning and performance demonstration of the following indoor type station Transformers with all necessary accessories.:			-	-
a	11/ 0.433kV, 250kVA, Dry type, two winding, 3 phase, Dyn11, 50Hz, AN, off circuit tap changer with +/-5% in steps of 2.5% on HV side for station transformer & 4% impedance with losses as per CBIP.	3	nos.	-	-
a	33/ 0.433kV, 250kVA, Dry type, two winding, 3 phase, Dyn11, 50Hz, AN, off circuit tap changer with +/-5% in steps of 2.5% on HV side for station transformer & 4% impedance with losses as per CBIP.	3	nos.	-	-
b	Lighting transformer of 415/415V, 50kVA, Dry type, two winding, 3 phase, Dyn11, 50Hz, with 4% impedance.	3	nos.	-	-
4	**SITC of Diesel Generator sets with AMF panel for Emergency power Backup for 33/11 kV Substations (250KVA)-CBIP-4**	3	nos.	-	-

DETAILED COST ESTIMATE & SCHEDULE OF ELECTRICAL WORKS FOR POWER DISTRIBUTION SYSTEM OF ATAL PURAM TOWNSHIP					
S.No.	Description	Qty	Units	Applicablr Rate (Rs)	Amount (Rs)
1	2	3	4	5	7
5	**3 way- outdoor 11kV RMU in the 11kV ring with FPI (Fault passage indicator) and FRTU (Field remote terminal unit) for SCADA integaration & Smart meter for AMI system with following configuration and as per specification::**	14	no.	-	-
a	2 nos. incomer Load break switch			-	-
b	1 nos of outgoing VCB			-	-
6	**4 way- outdoor 11kV RMU in the 11kV ring with FPI (Fault passage indicator) and FRTU (Field remote terminal unit) for SCADA integaration & Smart meter for AMI system with following configuration and as per specification::**	24	no.	-	-
a	2 nos. incomer Load break switch			-	-
b	2 nos of outgoing VCB			-	-
7	**5 way- outdoor 11kV RMU in the 11kV ring with FPI (Fault passage indicator) and FRTU (Field remote terminal unit) for SCADA integaration & Smart meter for AMI system with following configuration and as per specification::**	51	no.	-	-
a	2 nos. incomer Load break switch			-	-
b	3 nos of outgoing VCB			-	-
8	**Design & SITC of 33 & 11kV Cables and terminations**			-	-
8.1	SITC of XLPE insulated, Aluminum conductor E grade, three core, stranded, Aluminium conductor, screened by extruded semi-conducting compound for the conductor, cross-linked poly ethylene (XLPE) insulated, screened by extruded semi-conducting compound for the insulation followed with copper tape and inner and outer extruded PVC sheath compound Type-ST2 and unarmoured of following sizes to be laid in ducts. Miscellaneous items to complete the installation are included in the scope. Removal of empty drums, cartoons & making the site normal as instructed by Client is included in the scope.			-	-
a	33KV(E), 3C X 300 sq.mm(Interconnected cables between ESS-1 and ESS-3 are not included in the EPC package, but infrastructure provisions for these cables must be considered)	11537	mtrs.	-	-
b	11KV(E), 3C X 300 sq.mm(interconnection) Interconnected cables between ESS-1 and ESS-3 are not included in the EPC package, but infrastructure provisions for these cables must be considered	7368	mtrs.	-	-
c	11KV(E), 3C X 300 sq.mm(Ring)	34147	mtrs.	-	-
8.2	3-core XLPE UG cable Heat shrinkable straight through Jointing kits			-	-
a	33KV(E), 3C X 300 sq.mm	24	nos.	-	-
b	11KV(E), 3C X 300 sq.mm(interconnection)	15	nos.	-	-
b	11KV(E), 3C X 300 sq.mm(Ring)	71	nos.	-	-
8.3	Indoor heat shrinkable type termination kits suitable for following sizes of , XLPE insulated Aluminum conductor, E grade, unarmoured cable.			-	-
a	33KV(E), 3C X 300 sq.mm	30	nos.	-	-
b	11KV(E), 3C X 300 sq.mm	40	nos.	-	-
8.4	Outdoor heat shrinkable type termination kits suitable for following sizes of , XLPE insulated Aluminum conductor, E grade, unrmoured cable.			-	-
a	33KV(E), 3C X 300 sq.mm	0	nos.	-	-
b	11KV(E), 3C X 300 sq.mm	220	nos.	-	-
9	**Design & SITC of LV Cables**			-	-

DETAILED COST ESTIMATE & SCHEDULE OF ELECTRICAL WORKS FOR POWER DISTRIBUTION SYSTEM OF ATAL PURAM TOWNSHIP					
S.No.	**Description**	**Qty**	**Units**	**Applicablr Rate (Rs)**	**Amount (Rs)**
1	**2**	**3**	**4**	**5**	**7**
9.1	Design of 650V/1100V XLPE Aluminum conductor through cable trench, confirming to relevant & latest IEC, Indian standards and State electricity regulations for the following sizes. The work shall be inclusive of supply of all accessories required for laying of 415V cable as end termination kits, straight through joint kits etc as required in project Specification.:			-	-
a	3.5Cx240Sq mm XLPE AL Cable	1800	mtrs.	-	-
b	3.5Cx150Sq mm XLPE AL Cable	28856	mtrs.	-	-
10	**Design & SITC of Earthing system & Lightning protection**			-	-
10.1	32 mm Dia MS Rod for Main Earth mat	2100	mts	-	-
10.2	Chemical Earthing with 3 meter long, 40 mm dia MS rod for Earth Electrodes	260	nos.	-	-
10.3	SITC of Earth conductor of the following sizes to be laid in ground / in cable trays, jointing by welding, connecting to equipments, painting to welded portion by black bitumen paint and with all necesary hardware. For outdoor areas excavation, backfilling and removal of excess soil etc.			-	-
a	50x10 mm, GI strip	240	m	-	-
b	50x6 mm, GI strip (For LT panel/ cable trays etc.)	360	m	-	-
c	25x5 mm, GI strip (For PDB, LDB etc.)	50	m	-	-
d	8 swg, GI strip (For Push Button Station, Junction Boxes etc)	562	m	-	-
10.4	PIPE SLEEVE (100mm HDP)	12	nos.	-	-
10.5	20mm dia GS rod for Vertical Air Termination for Lightning protection	34	nos.	-	-
10.6	25x6 mm, GI strip for Lightning protection	1155	mts.	-	-
10.7	Test Link for Lightning protection System	1	nos.	-	-
11	**415V LT panel & APFC Panel**	3	no.	-	-
11.1	Design, manufacture, testing at manufacturers works, supply, packing, forwarding and delivery including transit insurance from place of storage/ manufacturer's works to erection site, installation, commissioning and performance demonstration of the following metal enclosed microprocessor based ACB/MCCB switchgear with Overcurrent and Earth fault protection.			-	-
a	2 nos. Incoming with 800 Amperes ACB			-	-
b	1 nos. Bus-Coupler with 800 Amperes ACB			-	-
c	2 nos. Outgoing with 400 Amperes MCCB			-	-
d	5 nos. Outgoing with 250 Amperes MCCB			-	-
e	6 nos. Outgoing with 100 Amperes MCCB			-	-
f	9 nos. Outgoing with 63 Amperes MCCB			-	-
11.2	Design, manufacture, testing at manufacturers works, supply, packing, forwarding and delivery including transit insurance from place of storage/ manufacturer's works to erection site, installation, commissioning and performance demonstration of the following APFC panel with APFC relay with 100kVA capacitor bank of following configuration- 1x50 kVAR+1x25kVAR+2x10kVAR+1x5kVAR			-	-
12	**Civil & Auxiliary systems cost for 33/11kV substation building**			-	-
12.1	Civil cost for 33/11kV substation building with RCC frameworks, cable trench, transformer foundation, internal wiring etc. complete in all respects.	**3**	Lot	-	-
12.2	Auxiliary systems	3	Lot	-	-
a	Electrical Auxiliaries (ACDB, DCDB, , UPS, Sealed Lead Acid Plante type Batteries (`1) x 100% rated battery associated with 2 x 100% float cum boost chargers, UPS, Lighting,Flood light fixture with control gear (non-integral), LED type fixtures for control building, corrosion proof light fixtures for battery room, wiring and conduiting, emergency light fixtures, exit sign. power sockets & plugs, exhaust fans_corrission proof, lighting mast, MLDB, AC distribution boards for normal and emergency power, welding sockets, etc with all complete works etc.)			-	-

DETAILED COST ESTIMATE & SCHEDULE OF ELECTRICAL WORKS FOR POWER DISTRIBUTION SYSTEM OF ATAL PURAM TOWNSHIP					
S.No.	**Description**	**Qty**	**Units**	**Applicablr Rate (Rs)**	**Amount (Rs)**
1	**2**	**3**	**4**	**5**	**7**
i	40W RECESSED TYPE LED fixtures for 33 / 11 kV Substation Building (in all rooms having false ceiling such as Staff Room, Control Room, Admin. Office, Pantry etc.) including all necessary accessories	16	Nos.	-	-
ii	40W SURFACE TYPE LED fixtures for 33 / 11 kV Substation Building (in all rooms having true ceiling such as Switchgear Room, corrosion proof light fixtures for Battery Room etc.) including all necessary accessories	16	Nos.	-	-
iii	20W SURFACE TYPE LED fixtures for 33 / 11 kV Substation Building (for staircase) including all necessary accessories	6	Nos.	-	-
iv	8W exit sign Fixture WALL/SURFACE MOUNTED, 240V, 50Hz., 1PHASE with 2 hours battery back-up	3	Nos.	-	-
v	45W Pole mounted LED fixture for outdoor lighting for Substation building	10	Nos.	-	-
vi	7 meter long hot dip galvanised steel Octagonal pole with single arm with all required accessories	10	Nos.	-	-
vii	LT Cables & associated accessories like clamps, glands, lugs and straight joints etc.			-	-
	Supplying, storing, laying 1.1kV grade XLPE insulated aluminium/ copper conductor armoured cable on exiting cable tray in trenches, including cutting, peeling terminating and connecting cable with 1.1kV grade brass double compression cable gland and crimped aluminium/ copper lugs in respective DBs switches etc.			-	-
	3.5Cx300sqmm AL 415volt ,1.1kV	495	Meter	-	-
	3.5Cx95sqmm AL 415volt ,1.1kV	82.5	Meter	-	-
	3.5Cx35sqmm AL 415volt ,1.1kV	330	Meter	-	-
	2Cx16 sqmm , AL 415volt , 1.1kV	825	Meter	-	-
	4Cx 2.5 sqmm , CU wire	495	Meter	-	-
	1Cx 2.5 sqmm , CU wire	3300	Meter	-	-
viii	Point wiring, circuiting, conduiting of all the LUMINAIRES of 33/11 kV Substation (for all substations)	1	Lot	-	-
	Wiring for circuit/ submain wiring alongwith earth wire with the 2 X 2.5 sq. mm + 1 X 2.5 sq. mm earth wire of FRLS PVC insulated copper conductor, single core cable in surface/ recessed steel conduit as required.			-	-
	Wiring for light point/ fan point/ exhaust fan point/ call bell point with 1.5 sq.mm FRLS PVC insulated copper conductor single core cable in surface / recessed steel conduit, with piano type switch, phenolic laminated sheet, suitable size MS box and earthing the point with 1.5 sq.mm FRLS PVC insulated copper conductor single core cable etc. as required.			-	-
ix	240V AC, 6/16A, 50Hz., 1PHASE, 5PIN duplex power receptacles (SURFACE MOUNTED)	26	Nos.	-	-
x	415V AC, 63A, 50Hz., 3PH+N+E with disconnecting switch welding receptacles, IP55 (WEATHERPROOF)	7	Nos.	-	-
xi	4 WAY LIGHTING DISTRIBUTION BOARD (LDB) AS PER SLD IN LIGHTING LAYOUT	3	Nos.	-	-
xii	POWER DISTRIBUTION BOARD (PDB)	3	Nos.	-	-
xiii	THREE WAY JUNCTION BOXES	83	Nos.	-	-
xiv	FOUR WAY JUNCTION BOXES	10	Nos.	-	-
xv	110V/275Ah Plante type battery in Transparent SAN container, Lead Acid Battery consisting of 55 nos. of 2V/275Ah along with Stand, Electrolyte & Accessories. Design, manufacture and supply of Automatic Float (27 Amps) and Float cum Boost (62 Amps) Battery Charging Equipment suitable for 110 Volts 275AH PLANTE battery	3	Nos.	-	-
xvi	CABLE TRAY			-	-
	900 mm width x 75 mm depth x 2 mm thickness Perforated Cable Tray	495.00	mts.	-	-
	600 mm width x 75 mm depth x 2 mm thickness Perforated Cable Tray	800.25	mts.	-	-
	TEE-BEND- 900MM	33.00	nos.	-	-
	TEE-BEND- 600MM	47.85	nos.	-	-
	90 DEGREE BEND-900MM	-	nos.	-	-

DETAILED COST ESTIMATE & SCHEDULE OF ELECTRICAL WORKS FOR POWER DISTRIBUTION SYSTEM OF ATAL PURAM TOWNSHIP					
S.No.	Description	Qty	Units	Applicablr Rate (Rs)	Amount (Rs)
1	2	3	4	5	7
	90 DEGREE BEND-600MM	36.30	nos.	-	-
	REDUCER 900MM TO 600MM	16.50	nos.	-	-
b	Mechanical Auxiliaries (HVAC, Fire Hydrant, Fire Detection & Alarm, etc.) including security & surveillance system	3	Lot	-	-
c	Control & instrumentation Cables & terminations etc.	3	Lot	-	-
d	Communication equipments including EPBAX, Basic card (of each type), Optical Interface/SFP's (of each type), Interface Cards (of each type), Patch Cords (each length) & Digital Protection Coupler etc	3	Lot	-	-
13	**Civil cost for RMU & CSS foundation**			-	-
a	Civil cost for making foundation of 11kV outdoor type RMUs at plots, complete in all respects.	89	Nos.	-	-
b	Civil cost for making foundation of 11/0.433kV outdoor type CSS, complete in all respects.	69	Nos.	-	-
c	Civil cost for making foundation of LT panel & Feeder pillars, complete in all respects.	169	Nos.	-	-
14	**Design & SITC of Smart Grid & SCADA System**			-	-
14.1	Design, Manufacture, Supply at site, Transportation from place of storage to erection site, Erection including all civil works, Testing and Commissioning and handing over of complete Substation automation system, Providing smart control, metering & communication between 33 kV substations, RMUs, CSS including SCADA, hardware, software, instruments, cables & required accessories to make the system complete & provide smart power system.	1	Lot	-	-
a	**SCADA/ADMS IT Hardware- Located at (33/11kV Substation-3)**			-	-
i	SCADA/ADMS	2	Nos.	-	-
ii	FEP server with interface switches	2	Nos.	-	-
iii	ISR server	2	Nos.	-	-
iv	NMS server	2	Nos.	-	-
v	WEB server	2	Nos.	-	-
vi	Development server (PDS)	1	No.	-	-
vii	Dispatcher Training Simulator server (DTS)	1	No.	-	-
viii	Server for AMI (MDMS, HES etc.)	2	Nos.	-	-
ix	Workstation with dual TFT Monitors	2	Nos.	-	-
x	Developmental & DTS console with one TFT	2	Nos.	-	-
xi	80-inch industrial grade full HD monitor	1	No.	-	-
b	**Storage & Backup Devices**			-	-
i	External RAID Mass storage device (for 12 months online backup)	1	No.	-	-
ii	External DAT drive	2	Nos.	-	-
c	**Switches**			-	-
i	Layer II switch (SCADA/ADMS/ Dual LAN) (48 ports)	2	Nos.	-	-
ii	Layer II switch (Development system) 24 ports	1	No.	-	-
d	**Routers**			-	-
i	Router for interfacing SCADA/ADMS with DMZ System	1	No.	-	-
e	**Security System (DMZ)**			-	-
i	Web server with load balancing	2	Nos.	-	-
ii	Router for IT system	2	Nos.	-	-
iii	Layer II switch (24 ports)	2	Nos.	-	-
iV	Firwall (Internal & External with different makes)	4	Nos.	-	-
f	**Other Active Devices**			-	-
i	GPS Time synchronization system (with Time, Day & Date Digital Display)	2	Set	-	-

DETAILED COST ESTIMATE & SCHEDULE OF ELECTRICAL WORKS FOR POWER DISTRIBUTION SYSTEM OF ATAL PURAM TOWNSHIP					
S.No.	Description	Qty	Units	Applicablr Rate (Rs)	Amount (Rs)
1	2	3	4	5	7
g	**Printers**			-	-
i	A4 Size Color inkjet printer	1	Set	-	-
ii	A4 Size Network B/W Laser printer	1	Set	-	-
iii	A4 size All in one Color Laser printer	1	Set	-	-
h	**Cabling System**			-	-
i	Cable, Jacks, 24 Port Jack Panel, Patch Chords, 42U Rack & KVM Switch etc.	1	Lump Sum	-	-
i	**Any other hardware to meet satisfactory functional /performance requirement of Smart Grid, SCADA, ADMS, AMI system etc. as per requirement/ standards**	1	Lump Sum	-	-
j	**Mandatory Spares for Control Centre**			-	-
i	Mandatory and miscellaneous spares for Control Centre	1	Lump Sum	-	-
k	**Software for Control Centre - Located at MRSS**			-	-
i	SCADA Software	1	Lump Sum	-	-
ii	ISR Software			-	-
iii	ADMS Software	1	Lump Sum	-	-
iv	Smart Grid and AMI Software	1	Lump Sum	-	-
v	DTS Software			-	-
vi	Security Software - Data Security, Application Security, Security Intelligence, etc.	1	Lump Sum	-	-
vii	Database for SCADA/ADMS (enterprise edition)	1	Lump Sum	-	-
viii	Network Management Software (NMS)	1	Lump Sum	-	-
l	**RTUs- Located at 33/11kV 2 nos. of Distribution S/S**			-	-
i	RTU base equipment comprising panels, racks, sub-racks, Power Supply modules, CPU, interfacing equipment, required converters & all other required items/accessories including complete wiring for all modules for locations mentioned	3	Set	-	-
ii	Multifunction transducers	As required	No.	-	
iii	Contact Multiplying Relays (CMRs)	As required	No.	-	
iv	Heavy duty relays for CB trip/Close	As required	No.	-	
v	Heavy duty relays for Raise/Lower OLTC	As required	No.	-	
vi	Dummy Breaker Latching Relays	As required	No.	-	
vii	Weather transducer - wind speed	1	No.	-	-
viii	Weather transducer - rainfall	1	No.	-	-
ix	Weather transducer - Humidity	1	No.	-	-
x	Weather transducer -Temperature	1	No.	-	-
xi	Weather transducer -Wind Direction	1	No.	-	-
xii	DC Transducer for Station analog parameters	As required	No.	-	
xiii	Router for substation	6	No.	-	-
xv	1 B/W laser printer	3	No.	-	-
xvi	IEC 61850 compliance Ethernet switch	6	No.	-	-
xvii	Any other hardware to meet functional /performance requirement	1	Lot	-	-
m	**Software for Local Data Monitoring System (LDMS) - Located at 33/11kV 3 nos. of Distribution S/S**			-	-
i	LDMS software	3	No.	-	-
ii	Any other software to meet functional /performance requirement	1	Lump Sum	-	-
n	**TEST EQUIPMENTS for RTU- Located at 33/11kV 3 nos. of Distribution S/S**			-	-
i	RTU Database Configuration & Maintenance Software tool	As required	No.	-	
ii	Master Station cum RTU Simulator & Protocol analyzer software tool	As required	No.	-	
iii	Laptop PC for above software tools along with interfacing hardware including Hub	As required	No.	-	
o	**MANDATORY SPARES FOR RTU- Located at 33/11kV 3 nos. of Distribution S/S**			-	-
i	Mandatory and miscellaneous spares for RTU	1	Lump Sum	-	-

DETAILED COST ESTIMATE & SCHEDULE OF ELECTRICAL WORKS FOR POWER DISTRIBUTION SYSTEM OF ATAL PURAM TOWNSHIP					
S.No.	Description	Qty	Units	Applicablr Rate (Rs)	Amount (Rs)
1	2	3	4	5	7
p	**Auxiliary Power Supply (APS) for SCADA/ADMS**			-	-
i	UPS (15 KVA rating) running in parallel redundant mode, with individual battery set for minimum 2hr backup duration at MRSS	1	Set	-	-
ii	UPS (5kVA rating) running in parallel redundant mode, with individual battery set for minimum 2hr backup duration at 33/11kV Distribution	3	Set	-	-
q	**Mandatory Spares for all UPS- Located**			-	-
i	Mandatory and miscellaneous spares for UPS at MRSS	1	Lump Sum	-	-
ii	Mandatory and miscellaneous spares for UPS at 33/11kV Distribution Substations	2	Lump Sum	-	-
r	**Installation & Commissioning**			-	-
i	Installation, Testing and Commissioning of complete SCADA/ADMS control centre, AMI, RTUs, FRTUs, Integration etc	1	Lump Sum	-	-
ii	Integration with legacy applications & Data Migration (If required)	1	Lump Sum	-	-
iii	Training of Employees - Professional Training	1	Employees	-	-
iv	Training of Employees - End User Training	1	Employees	-	-
s	**AMC of the system for 5 years**	1		-	-
15	**SAFETY ITEMS, TOOL KITS, TESTING KITS & OTHER MISCELLANEOUS ITEMS**			-	-
15.1	**SAFETY ITEMS**			-	-
a	Rechargeable LED hand torch	30	Nos.	-	-
b	Safety Helmet - PVC	30	Nos.	-	-
c	Safety Shoes (Electrical Safety)	30	Pair	-	-
d	Rubber hand Gloves(1.1KV) Commander	30	Pair	-	-
e	Safety double adjustable belts(Karam)	15	Nos.	-	-
f	Safety Items as per the requirement of electrical inspector as under First Aid Box, Shock treatment chart, Rubber matts 8 mm thick, 4 Fire buckets with sand & M.S. Hooks / stand, Helmet, Hand gloves and, Fire extinguisher (2 Nos)	6	Lump Sum	-	-
g	Danger Board 33KV/11KV/LT	30	Nos.	-	-
15.2	**TOOL KIT**			-	-
a	Adhesive Insulation Tape	15	Nos.	-	-
b	Discharge rod for 33 KV / 11KV	15	Set	-	-
c	Screw Driver set-840	15	Set	-	-
d	Screw Driver set-935	15	Set	-	-
e	Neon Tester 813	15	Nos.	-	-
f	Hammer 200 gm	15	Nos.	-	-
g	Hack Saw frame	15	Nos.	-	-
h	Hack saw blades	15	Nos.	-	-
i	Adjustable spanner	15	Nos.	-	-
j	wire Stripper	15	Nos.	-	-
k	Combinational Pliers	15	Nos.	-	-
l	Side Cutting Pliers	15	Nos.	-	-
m	Measuring tape	15	Nos.	-	-
n	Hand Drill Machine	15	Nos.	-	-
o	Punch	15	Nos.	-	-
p	Knife	15	Nos.	-	-
q	Spanner Set	15	Set	-	-
r	Tool Bag	15	Nos.	-	-
s	Nose Pliers	15	Nos.	-	-
t	Drill Bit 3/10 Concrete (JK)	15	Nos.	-	-
	TOTAL OF A in Rs.				**-**
Compact Substations,Service Feeder Pillars & Duct bank (B)					

DETAILED COST ESTIMATE & SCHEDULE OF ELECTRICAL WORKS FOR POWER DISTRIBUTION SYSTEM OF ATAL PURAM TOWNSHIP					
S.No.	**Description**	**Qty**	**Units**	**Applicablr Rate (Rs)**	**Amount (Rs)**
1	**2**	**3**	**4**	**5**	**7**
1	**Design & SITC of Compact substation (CSS) in complete consisting of 11KV motorized 3 Way RMU (2 Isolator & 1 VCB), 11KV/433V Dry type transformer with ECBC-2017 and LT panel with APFC, Smart metering & FRTU for scada integration complete in all respect as per specifiction**				
a	Supply of 11/0.433kV, 250kVA Compact Substation, for LT services	**29**	nos.	-	-
c	Supply of 11/0.433kV, 400kVA Compact Substation, for LT services	37	nos.	-	-
d	Supply of 11/0.433kV, 250kVA Compact Substation, for Road lighting / Pumping station, landscape / kiosks etc.	3	nos.	-	-
2	**Design & SITC of Feeder Pillar**			-	
a	Consumer Feeder Pillar Box 24x1phase or 10X3 phase(1No 63A+9No 32A)	**169**	nos.	-	-
3	**DUCT BANK**			-	
a	**Civil cost for construction of duct bank of various size as per duct bank layout which including excavation, laying of three HDPE ducts (in each layer) in two, three or four layers, sand cushioning, protective covering and back refilling the trench etc.**	1	Lot	-	
b	**Civil cost for construction of total 241 numbers of manholes of various sizes at every 30m and some of the stretegic locations as specified in duct bank layout which includes Excavation, RCC works etc.**	1	Lot	-	
c	**Design, Manufacture, Supply at site, Transportation from place of storage to erection site, Testing and Commissioning of High Density polyethylene (Permenant lubricant HDPE- Pipe - 200mm /8'' PE 100 grade; wall thickness in between(14.80 mm to 16.50mm) and SDR 13.5 pressure rating) pipes & accessories including joints, spacer, bends etc as per requirement.**	30987	mtrs	-	-
	TOTAL OF B in Rs.				**-**
	Total of A+B in Rs.				**-**
	Total cost excluding GST (In Rs.)				**-**

SMART STREET LIGHTING AREA BASED DEVELOPMENT , ATAL PURAM Township ,Agra					
SCHEDULE OF QUANTITIES FOR EXTERNAL LIGHTING SYSTEM					
S.No	**DESCRIPTION**	**QTY**	**UNIT**	**Applicable Rate (Rs)**	**Amount (Rs)**
1	Design, manufacture, supply, inspection, handling, assembling, affecting proper connections, testing and commissioning of 14 SWG CRCA sheet steel fabricated cubical **outdoor** type **Main Feeder Panel ,** floor mounting, dust & vermin proof, front operated construction, double door enclosure class - IP 65, powder coated after proper treatment with 9 tank process with top/bottom removable gland plates, as required, double compression type cable glands, earth bus, hinged and lockable doors to achieve dust and vermin proof complete with all inter connections small wiring by min. 2.5 sq. mm. FRLS copper wires, ckt labels etc. The Aluminium Bus Bar shall be of suitable length, 600 volts, 3 phase 50 Hz TPN, electrolytic aluminium as per IS 8623 . The panel feeders shall be suitable for terminating suitable nos. 3.5 / 4 core armoured aluminium cable as required.			₹ 0.00	0.00
	INCOMER : 02 nos. 125 AMP FP MCCB (25 KA)			₹ 0.00	0.00
	BUS BAR : 250 AMP, 500 Volts, 3 phase 50 HZ TPN high conductivity electrolytic Aluminium bus bar of suitable length, insulated by heat shrinkable sleeves. The current density of bus bar shall be minimum 1.00 sq mm / amp.			₹ 0.00	0.00
	OUT GOINGS :			₹ 0.00	0.00
	05 nos. 63 AMP FP MCCB (25 KA)	8	Nos.	₹ 0.00	0.00
2	Supply , installation testing and commissioning of **outdoor type external lighting feeder pillar** of suitable size made out of M.S. sheet 2mm thick (14 SWG) duly compartmentalized, double door with locking arrangement (IP-65), duly fixed on MS angle iron frame work of size 50mm x 50mm x 6mm, 90 cm long legs out of which 45 cm duly grouted in cement concrete 1:2:4 (1 cement : 2 sand :4 stone aggrete 20mm) and having following accessories mounted inside the cubical panel i/c connection, inter connection with aluminium thimbles, earthing with two nos. earth struds duly painted with power coating and 9 tank process of approved shade complete etc. as required.			₹ 0.00	0.00
	Smart feeder Panel-10kVA-10kVA rated Switching point controller system (SPCS) with GPRS, Timer, Energy measurement systems and switching controllers with outgoing as required to feed 32 luminaires for individual control of luminaire.	37	Nos.	₹ 0.00	0.00
3	**CABLES**			₹ 0.00	0.00
(Ii)	Supply, Laying and testing of aluminium conductor **cable** PVC insulated armoured, served, sheathed 1100 volts grade upto 3m **below ground level** in dwc pipe/ duct bank/ground with protection. The armouring of the cable shall be properly connected with the earth conductor including fixing of palm or pin type AL cable socket (lug) / end terminations to the cable leads, insulating with tape and making connections with brass / nickle plated double compression gland, providing cable tags complete in all respect including supply of lugs and compression glands etc complete upto the satisfaction of Engineer-in-charge.			₹ 0.00	0.00
a	16 sqmm 3.5 core	30500	M	₹ 0.00	0.00
a	25 sqmm 3.5 core	7600	M	₹ 0.00	0.00
(Ii)	Supply, Laying and testing of aluminium conductor **cable** XLPE insulated armoured, served, sheathed 1100 volts grade upto 3m **below ground level** in dwc pipe/ duct bank/ground with protection. The armouring of the cable shall be properly connected with the earth conductor including fixing of palm or pin type AL cable socket (lug) / end terminations to the cable leads, insulating with tape and making connections with brass / nickle plated double compression gland, providing cable tags complete in all respect including supply of lugs and compression glands etc complete upto the satisfaction of Engineer-in-charge.			₹ 0.00	0.00
b	150 sqmm 3.5 core	9468	M	₹ 0.00	0.00
c	300 sqmm 3.5 core	7453	M	₹ 0.00	0.00
4	**SITC OF EXTERNAL LIGHTING FIXTURES / POLE**			₹ 0.00	0.00
1	Supply Installation, testing and commissioning of LED Luminaire 150W for streetlight application with Dimmable driver and integrated SLC including connection with 3x1.5 sqmm flexible fire retardant copper connecting wire of required length complete as required for outdoor application.	242	Nos	₹ 0.00	0.00
2	Supply Installation, testing and commissioning of LED Luminaire 120W for streetlight application with Dimmable driver and integrated SLC including connection with 3x1.5 sqmm flexible fire retardant copper connecting wire of required length complete as required for outdoor application.	344	Nos	₹ 0.00	0.00
3	Supply Installation, testing and commissioning of LED Luminaire 90W for streetlight application with Dimmable driver and integrated SLC including connection with 3x1.5 sqmm flexible fire retardant copper connecting wire of required length complete as required for outdoor application.	441	Nos	₹ 0.00	0.00
5	Supply Installation, testing and commissioning of LED Luminaire 45W for streetlight application with decorative connection with 3x1.5 sqmm flexible fire retardant copper connecting wire of required length complete as required for outdoor application.	96	Nos	₹ 0.00	0.00
6	Supply Installation, testing and commissioning of LED Luminaire 35W/40W for streetlight application with decorative including connection with 3x1.5 sqmm flexible fire retardant copper connecting wire of required length complete as required for outdoor application.	141	Nos	₹ 0.00	0.00
7	Supply Installation, testing and commissioning of high-quality integrated LED Flood light 464W/relavent wattage for streetlight application at junctions to get average 50lux with Dimmable driver and non-integrated SLC including connection with 3x1.5 sqmm flexible fire retardant copper connecting wire of required length complete as required for outdoor application.	24	Nos	₹ 0.00	0.00
8	Supply Installation, testing and commissioning of high-quality integrated LED Flood light 440W/relavent wattage for streetlight application at junctions to get average 50lux with Dimmable driver and non-integrated SLC including connection with 3x1.5 sqmm flexible fire retardant copper connecting wire of required length complete as required for outdoor application.	18	Nos	₹ 0.00	0.00
9	Supply Installation, testing and commissioning of Hot-Dip Galvanized conical 9m height Poles for Street Lighting with decorative Single arm brackets, IS 2062 for base plate with door opening arrangements, including suitable boards, bakelite sheet and MCBs as per IS specifications suitable to withstand the wind speed of 47 m/sec.	803	Nos	₹ 0.00	0.00
10	Supply Installation, testing and commissioning of Hot-Dip Galvanized conical 9m height Poles for Street Lighting with decorative double arm brackets, IS 2062 for base plate with door opening arrangements, including suitable boards, bakelite sheet and MCBs as per IS specifications suitable to withstand the wind speed of 47 m/sec.	112	Nos	₹ 0.00	0.00
11	Supply Installation, testing and commissioning of Hot-Dip Galvanized conical 6m height Poles for Street Lighting with decorative brackets, IS 2062 for base plate with door opening arrangements, including suitable boards, bakelite sheet and MCBs as per IS specifications suitable to withstand the wind speed of 47 m/sec.	237	Nos	₹ 0.00	0.00
12	Supply & fixing of 16 mtr High mast shaft of approved make with rising system hot dip glavanized inside & out side dip,heaving pole sheet thickness 3 mm. Top dia minium 150 mm, Bottom dia 360 mm base plate 32 mm thick suitable for wind velocity as per IS 875 part 3 & having no circumferential weld, with accessories for high mast such as head frame suitable for 6 to 12 luminaries & its control gear boxes 1.5 HP power tool moter, 3 point suspension system with steel wire rope 6 mm dia, double drum winch, including making suitablefoundation as per manufature drawing/ site reuimentalong with foundation bolts nuts, washers, anchor platesetc completee in all respect	3	Nos	₹ 0.00	0.00
13	Web application charges per luminaire & on cloud hosting (annual subscription)	1069	Nos	₹ 0.00	0.00
14	SMS Alerts Charges (Yearly – for 50,000 SMS),	1	Nos	₹ 0.00	0.00

SMART STREET LIGHTING AREA BASED DEVELOPMENT , ATAL PURAM Township ,Agra					
SCHEDULE OF QUANTITIES FOR EXTERNAL LIGHTING SYSTEM					
S.No	**DESCRIPTION**	**QTY**	**UNIT**	**Applicable Rate (Rs)**	**Amount (Rs)**
4	**G.I. EARTHING**			₹ 0.00	0.00
1	Supply and burying of 600 mm *600 mm*6mm Gi plate vertically for earthling with its top at least 3 meters below ground level complete with 20mm dia G.I. pipe and if un nel for watering and one earthling lead of one no 8 to 10 SWG copper wire in 15mm dia G.I. piper and copper wire will be extra 30 mm square C.I. frame with hinged cover misery housing alternate layers of charcoal coke and salt at least 150 mm thick alluring etc. complete in all respect PWD Sch.No. 704 ED-I (296) dt. 07.11.2023	90	Nos	₹ 0.00	0.00
2	Supplying and laying 25 mm X 5 mm G.I strip at 0.50 metre below ground as strip earth electrode, including connection/ terminating with G.I. nut, bolt, spring, washer etc. as required. (Jointing shall be done by overlapping and with 2 sets of G.I. nut bolt & spring washer spaced at 50mm)	450	M	₹ 0.00	0.00
3	Supplying and laying 6 SWG G.I. wire at 0.50 metre below ground level for conductor earth electrode, including connection/ termination with GI thimble etc. as required.	38100	M	₹ 0.00	0.00
4	Supplying and laying of 63 mm dia (OD-63 mm & ID-51 mm nominal) DWC HDPE pipe ISI marked along with all accessories like socket, bend, couplers etc. conforming to IS 14930, Part II complete with fitting and cutting, jointing etc. in the existing trench, complete as required for cable laying including transportation and accessories required complete in all respect.	35859	M	₹ 0.00	0.00
	TOTAL (excluding tax)				**0.00**
	Total of Cost in Rs.				**0.00**

COST ESTIMATE FOR TRACK & FOOTPATH

Item	Bill Description	Unit	Quantity		Applicable Rate	Amount	Amount
			Track	Pathway		Track	Pathway
1	Preparation and consolidation of sub grade with power road roller of 8 to 12 tonne capacity after excavating earth to an average of 22.5cm depth, dressing to camber and consolidating with road roller including making good the undulations etc. and re-rolling the subgrade and disposal of surplus earthwith lead upto 50 metres.	Sqm	-	82,988		-	-
2	Construction of granular sub-base by providing close graded Material conforming to specifications, mixing in a mechanical mix plant at OMC, carriage of mixed material by tippers to work site, for all leads & lifts, spreading in uniform layers of specified thickness with motorgrader on prepared surface and compacting with vibratory power rollerto achieve the desired density, complete as per specifications and directions of Engineer-in-Charge. With material conforming to Grade-I (size range 75 mm to 0.075 mm) having CBR Value-30	Cum	2,324	15,330		-	-
3	Supply & Laying of I shaped (Zigzag) **Precast Interlocking tiles** of thickness 60 to 100mm (Compressive strength not less then 30Mpa and weight 4.50k9) lncluding 0.30mm thick local sand base levelling and dressing of surface to required level and slope, filling joints with local sand all complete work. 80 mm (Rubber molded coloured)	Sqm	33,217	71,034	-	-	-
4	Providing and laying cement concrete in 1:2:4 (1 Cement: 2 coarse sand :4 graded stone aggregate 40 mm noffrinal size) and curing complete, lncluding cost of form work. ln Foundation and floors	Cum	497	965	-	-	-
5	Cast in Situ Cement Concrete M20 kerb (Construction of cement concrete kerb with top and bottom width 115 and 165 mm respectively, 250 mm high in M 20 grade PCC on M-10 grade foundation 150 mm thick, foundation having 50 mm projection beyond kerb stone, kerb stone laid with kerb laying machine, foundation concrete laid manually, all complete as per clause 408)	Rm	22,083	39,503	-	-	-
	Cost Estimates of Cycle Track & Footpath					**-**	**-**
	Total Cost						**-**

COST ESTIMATE FOR SEWERAGE NETWORK

Sl. No.	Description of work	Total Quantity		Applicable Rate (in. Rs.)	Amount (in Rs.)
1	Earth work in excavation by mechanical means (Hydraulic excavator) / manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, for all lift, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.				
	EWE Quantity up to 1.50m depth	43308	cum		
2	Extra for every additional lift of 1.5 m or part thereof in excavation / banking excavated or stacked materials.				
	All kinds of soil	27694	cum		
3	Extra rates for quantities of works, executed:				
	In or under water and/or liquid mud, including pumping out water as required	2574	cum		
	In or under foul position, including pumping out water as required	2574	cum		
4	Carting of surplus excavated rock/Soil within a lead of 5Km from the site to a distance suitable including loading charges, cost & conveyance, dumping, labour charges and other incidental and operational charges etc., complete.	8797	cum		
5	Providing and laying cement concrete in 1:4:8 (1 Cement:4 coarse sand :8 graded stone aggregate 40 mm nominal size) and curing complete, Including cost of form work. in Foundation and floors.	2405	cum		
6	Providing granular bedding having width = outer dia of pipe (Bc) + 500mm, thickness below pipe = 0.25Bc or 100mm (whichever is higher) and haunching = 0.5Bc, with graded hard crusher broken stone of 100% passing through 20mm sieve, 20 to 50 % passing through 10mm sieve and 100 % retain on 6.3mm sieve, laying in layers of thickness 10/15cm including ramming, consolidation etc complete for all type of pipes of following sizes as per drawing and or as directed by EIC	11009	sqm		
7	Open timbering in trenches including strutting and shoring complete (measurements to be taken of the face area timbered):				
	up to 1.50 Mts.	77232	sqm		
8	Close timbering over areas including strutting, shoring and packing cavities (wherever required) etc. complete. (Measurements to be taken of the face area timbered):				
	Depth exceeding 1.5 m but not exceeding 3 m	45632	sqm		
9	Close timbering over areas including strutting, shoring and packing cavities (wherever required) etc. complete. (Measurements to be taken of the face area timbered):				
	Depth exceeding 4.50 Mts.				
	Double staging from 6.50 to 8.50 Mts.	1725	sqm		
10	Providing Barricading for Trenches using 80 - 100 mm dia Wooden Ballies as vertical post, atleast 1.5m above ground level and atleast 30-45 cm below ground level at a spacing of 3 m. Two rows of PVC Tape (preferably red in colour) strip barricading horizontal strip securely tied by the vertical members. Vertical members shall be painted in red and white colour. Rate is inclusive removal and cleaning of site complete in all respect.	51488	metre		
11	Providing, lowering, laying, aligning, fixing in position and jointing at all level/ depths full round HDPE DWC (double wall corrugated) pipes of SN8 grade as per IS 16098 (Part 2) amended upto date in trenches in complete including all material, labour, sectional hydro testing (including the cost and conveyance of water to site for testing) and commissioning as per Technical Specifications, drawings and as per direction of EIC. Note : E/w to be measured and paid separately. Length of pipe shall be measured in between the outer wall of two manholes / Inspection chambers. Pipe in the manhole/inspection chamber's wall shall deemed to be included in the item of manhole/inspection chamber shall not be payable				
	200mm mm DWC Waste Water Lines	20955	metre		
	250mm mm DWC Waste Water Lines	1310	metre		
	300mm mm DWC Waste Water Lines	648	metre		
	400mm mm DWC Waste Water Lines	1855	metre		
	500mm mm DWC Waste Water Lines	535	metre		
	600mm mm DWC Waste Water Lines	322	metre		
12	Providing at site, lowering & laying in trenches, aligning & jointing of RCC pipes NP3 class (with s/s ends) IS: 458 - 1988 (amended up to date) marked and pipes from 300 mm upto 2000 mm manufactured through vertical / vibrated casting process all levels with Rubber gaskets (EPDM/SBR) for sewer lines as per IS: 5382 (including cost of Rubber gaskets lubricants) as per drawing, sectional hydro testing of the sewer pipe line (including cost and conveyance of water to site for testing) etc., complete as directed by Engineer. Note : E/w to be measured and paid separately. Length of pipe shall be measured in between the outer wall of two manholes / Inspection chambers. Pipe in the manhole/inspection chamber's wall shall deemed to be included in the item of manhole/inspection chamber shall not be payable.				

Sl. No.	Description of work	Total Quantity		Applicable Rate (in. Rs.)	Amount (in Rs.)
	700mm dia RCC NP3 Waste water Lines	118	metre		
13	Add extra for manufacturing of RCC pipe with Sulphate Resistant Cement instead of OPC/PPC cement				
	700mm dia RCC NP3 Waste water Lines	118	metre		
14	Providing arranging and Hydraulic testing of following RCC sewer pipe line as per IS: 783 code of practice and / or as directed by Engineer-in-charge complete including cost of water.				
	700mm dia RCC NP3 Waste water Lines	118	metre		
15	Construction of circular manhole 0.90m internal dia at bottom and 0.56m dia at top (using Sulfate Resisting Cement) as per type design/drawing along sewer lines and provided with tight fitting pre-cast SFRC manhole cover and frame of 560 mm dia., of approved make and quality including supply and fixing of plastic encapsulated M.S. foot rests. The manhole shall be of Reinforced cement concrete M30 grade mix (One sulphate resistant cement, one and half sand, three aggregate) using 20mm ISS gauge HBBG metal from the approved quarry including mixing, laying, consolidating, curing cost and conveyance of all materials to site with inner smooth finishing, Benching and channeling should be provided in the manhole and suitable diameter pipes for House service connection to be left in the Manholes as directed by the Engineer in-charge. The rate shall include earthwork, backfilling, and removal of surplus earth and depositing within 500m, de-watering wherever necessary, barricading, provision of danger lights etc. complete				
	0.90m dia. and Overall depth up to 1.50m	383	each		
16	Extra depth for circular type manhole 0.90m internal dia (at bottom) beyond 0.90 m to 1.50 m	514	metre		
17	Construction of circular manhole 1.20m internal dia at bottom and 0.56m dia at top (using Sulfate Resisting Cement) as per type design/drawing along sewer lines and provided with tight fitting circular shape 560 mm dia SFRC manhole cover with frame - E.H.D. - 35, of approved make and quality including supply and fixing of plastic encapsulated M.S. foot rests. The manhole shall be of Reinforced cement concrete M30 grade mix (One sulphate resistant cement, one and half sand, three aggregate) using 20mm ISS gauge HBBG metal from the approved quarry including mixing, laying, consolidating, curing cost and conveyance of all materials to site with inner smooth finishing, Benching and channeling should be provided in the manhole and suitable diameter pipes for House service connection to be left in the Manholes as directed by the Engineer in-charge. The rate shall include earthwork, backfilling, and removal of surplus earth and depositing within 500m, de-watering wherever necessary, barricading, provision of danger lights etc. complete				
	1.20m dia. 2.30m depth	327	each		
18	Extra depth for beyond 2.30m depth	415	metre		
19	Construction of circular manhole 1.50m internal dia at bottom and 0.56m dia at top (using Sulfate Resisting Cement) as per type design/drawing along sewer lines and provided with tight fitting circular shape 560 mm dia precast R.C.C. manhole cover with frame - E.H.D. - 35, of approved make and quality including supply and fixing of plastic encapsulated M.S. foot rests. The manhole shall be of Reinforced cement concrete M30 grade mix (One sulphate resistant cement, one and half sand, three aggregate) using 20mm ISS gauge HBBG metal from the approved quarry including mixing, laying, consolidating, curing cost and conveyance of all materials to site with inner smooth finishing, Benching and channeling should be provided in the manhole and suitable diameter pipes for House service connection to be left in the Manholes as directed by the Engineer in-charge. The rate shall include earthwork, backfilling, and removal of surplus earth and depositing within 500m, de-watering wherever necessary, barricading, provision of danger lights etc. complete				
	1.50m dia. above 2.30m	208	each		
20	Extra depth for circular type manhole 1.50 m internal dia (at bottom) beyond 2.30 m :	262	metre		
21	Providing orange colour safety foot rest of minimum 6mm thick plastic encapsulated as per IS: 10910 on 12 mm dia steel bar conforming to IS: 1786 having min. cross sectional area 23mmx25mm and overall min. length 263 mm and width as 165mm with min. 112 mm space between protruded legs having 2mm tread on top surface by ribbing or check ring besides necessary and adequate anchoring projections on tail length on 138 mm as per standard drawing and suitable to withstand the bendtest and chemical resistance test as per specifications and having manufacturers permanent identification mark to be visible even after fixing, including fixing in manholes with 30x20x15 cm cement concrete block 1:3:6 (1 cement : 3 coarse sand :6 graded stone aggregate 20mm nominal size) complete as per design	5138	each		
INSTECTION CHAMBERS 450mm dia (internal), 900mm depth FOR PLOTS					
22	Excavation in foundation in ordinary soil (Loam, Clay or Sand) Including lift upto 1.50 m and lead upto 3Om and including filling watering and ramming of excavated eafth into the trenches or into the space between the building and the sides of foundation trenches or into the plinth and removal and disposal of surplus earth as directed by the Engineer Incharge upto a distance of 30m from the foundation trenches.				
	All kinds of soil.	1210	cum		

Sl. No.	Description of work	Total Quantity		Applicable Rate (in. Rs.)	Amount (in Rs.)
23	Providing, fixing of Plastic HDPE Circular Inspection Chamber made from 100% virgin UV Stabilized special roto moulding grade Polyethylene (PE) material having internal diameter of 600mm, shall provide access for cleaning and inspection, to be used in buried sewers for gravity system. Chamber shall be made as per EN 13598-1 for use in non- pressure underground sewerage system. It shall be used for receiving / connecting solid wall plain surface (HDPE) or structured wall corrugated DWC) pipes etc. by use of appropriate transition adaptors; and/or for changing the direction of drainage / sewerage runs. Chamber shall have a base and riser shaft of internal diameter 600mm. Chambers shall be provided with arrangement for 4 nos. connections at the base and shall be designed to receive / connect various diameter pipes. Chamber shaft also shall be designed to receive / connect anywhere at the shaft level. Chamber base / shaft shall receive maximum of pipe having OD of 315mm. Chamber shall have integrated base benching. The riser shaft outside shall be reinforced with horizontal and vertical ribs of minimum 20mm thick and a projection of 40mm to enhance the products resistance to compression and anchoring in the soil. These ribs shall provide lift-retention system in case of ground water. Chamber shall be placed on PCC M-10 grade (1:4:8) 150mm thick, 800mm dia foundation, etc. complete with curing, compaction and form work, supplying and fixing heavy duty SFRC manhole cover as per IS 12592 (Part I and II) complete in all respect including testing for water tightness (including the cost of RCC load distribution ring and SFRC manhole frame and cover) as per specification and the direction of the Engineer. {Note: Excavation of earth work, road cutting and non-cohesive backfilling material (quarry dust / rock sand, etc., depending on native soil condition)}, compaction, etc.				
	for HDPE Road side inspection chamber of 1200 mm depth	1202	each		
	for HDPE Road side inspection chamber of 1500 mm depth	475	each		
24	Providing and making connection to the manhole/ road side chamber/ property chamber by cutting hole in wall, making good the same with brick work/ stone masonry work in cement mortar 1:4, plaster in cement mortar 1:3, encasement of pipe at manhole with 75mm thick M15 grade concrete etc complete as directed by EIC	1678	each		
25	Excavating trenches of required width for pipes, cables, etc including excavation for sockets, and dressing of sides, ramming of bottoms, depth upto 1.5 m, including getting out the excavated soil, and then returning the soil as required, in layers not exceeding 20 cm in depth, including consolidating each deposited layer by ramming, watering, etc. and disposing of surplus excavated soil as directed, within a lead of 50 m :				
	160mm dia Pipe from inspection chamber to sewer manhole	5033	metre		
26	Providing and laying cement concrete in 1:4:B (1 Cement:4 coarse sand :B graded stone aggregate 40 mm nominal size) and curing complete, Including cost of form work. in Foundation and floors.				
	150mm ID DWC Sewage Pipe Lines	377	cum		
27	Providing, lowering, laying, aligning, fixing in position and jointing at all level/ depths full round HDPE DWC (double wall corrugated) pipes of SN8 grade as per IS 16098 (Part 2) amended upto date in trenches in complete including all material, labour, sectional hydro testing (including the cost and conveyance of water to site for testing) and commissioning as per Technical Specifications, drawings and as per direction of Engineer. Note : E/w to be measured and paid separately. Length of pipe shall be measured in between the outer wall of two manholes / Inspection chambers. Pipe in the manhole/inspection chamber's wall shall deemed to be included in the item of manhole/inspection chamber shall not be payable				
	150mm ID DWC Sewage Pipe Lines	5033	metre		
Total					

COST ESTIMATE FOR STP

Sl.NO	Description of Work	Quantity	Unit	Rate (in Rs)	Amount (in Rs)
1	Designing, providing, constructing, hydraulic testing, commissioning and giving satisfactory trials of 12 MLD STP with SPS for inlet Sewage parameters BOD=300, COD=600, TSS=600, TKN 55, pH= 6.5 to 7.5 based on SBR technology consisting of Inlet Chamber, Screen Chamber, Grit Detritus Tanks and Biological CASP Basins, Chlorine Contact Tank, Chlorinator with Chlorinator shed & tonner Shed, Chemical Storage & Dosing shed with dosing Equipments, Sludge Sump, Gravity Sludge Thickener, Sludge dewatering system equipment and building, sludge storage shed, necessary piping work with required valves, Mechanical & Instrumentation Works,gates, storm water drains and rain water harvesting system, bypass drains, roads & pathways, landscaping, Compound wall with gates, Administration Block cum Laboratory, Laboratory Equipments, staff quarters, Tools and Plants, Spare Parts, ESR and Tanker Filling points, Metering Room, Guard Room etc. complete as turnkey job with all involved civil, electrical, instrumentation and mechanical works inclusive of following items, units as per detailed specification for civil, electrical, instrumentation and mechanical components with all duties and taxes, etc. complete to achieve BOD < 10 mg/L, COD < 10 mg/L, TSS < 5 mg/L, to get reusable quality of water for flushing use in residential and commercial/ horticultural purposes. outlet parameters shall also include TN < 10 mg/L, Nh3N < 1 mg/L and TP < 0.5 mg/L, total colifom MPN/100 ml 10, odourless) with full automation including PLC-SCADA and Instrumentation, reuse arrangement (storage - GLR, OHSR and pumps) and treated effluent disposal line for treated wasre water 1 KM as per specifications	12	MLD		
TOTAL					

Cost Estimates for Main Gate					
Sl.No.	**Description of work**	**Unit**	**Qty**	**Applicable Rate**	**Amount**
1	**Civil Work**				
1.0	Cleaning Jungles including uprooting of trunk vegetation grass, bushes, wood trees and sapling of girth upto 30cm measured at a height of 1 meter above ground level and removal of rubbish upto a distance of 50 meters out side the periphery of area cleared.	Sqm	228.00		-
2.0	Excavation in foundation in ordinary soil (Loam, Clay or Sand) Including lift upto 1.50 m and lead upto 30m and including filling watering and ramming of excavated earth into the trenches or into the space between the building and the sides of foundation trenches or into the plinth and removal and disposal of surplus earth as directed by the Engineer lncharge upto a distance of 30m from the foundation trenches.	Cum	243.00	0.00	-
3.0	Providing and laying cement concrete in 1:2:4 (1 Cement : 2 coarse sand :4 graded stone aggregate 20 mm nominal size) and curing complete, Including cost of form work. In Foundation and floors.	Cum	21.02	0.00	-
4.0	Providing and laying in position machine batched and machine mixed design mix M-25 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying and including the cost of centering, shuttering, finishing but excluding reinforcement, including admixtures in recommended proporlions as per lS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer-incharge. (Note :- Cement content considered in this item is @ 330 kg/cum. Excess/ less cement used as per design mix is payable /			0.00	-
5.1	All works upto plinth level up to floor V level.	Cum	124.31	0.00	-
5.2	All works above plinth level up to floor V level.	Cum	120.42	0.00	-
6.0	Steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete up to plinth level & above plinth.	Kg	15,274	0.00	-
7.0	Providing precast cement concrete Jali 1:2:4 (1 cement : 2 coarse sand(zone-III) : 4 graded stone aggregate 6mm nominal size), reinforced with 1.6 mm dia mild steel wire, including centering and shuttering, roughening cleaning, fixing and finishing in cement mortar 1:3 (1 cement: 3 fine sand) etc. complete, excluding plastering of the jambs, sills and soffits.	Sqm	1,056	0.00	-

Cost Estimates for Main Gate					
Sl.No.	**Description of work**	**Unit**	**Qty**	**Applicable Rate**	**Amount**
8.0	Wall lining butch work upto 10m height with Dholpur stone 40 mm thick rough facing on the exposed surface with stone strips of minimum length 300 mm and required width, including embedding every tenth layer and bottom most layer in masonry or concrete after making necessary chases of size 75x75 mm and by providing layer of 75 mm thick strips i/c 12 mm thick bed of cement mortar 1:3 (1 Cement : 3 coarse sand) i/c ruled pointing in white cement mortar 1:2 (1 white cement : 2 stone dust) with an admixture of pigment to match the shade of stone complete as per direction of Engineer-in-charge.	Sqm	720	0.00	-
9.0	Extra for stone work for wall lining on exterior walls of height more than 10 m from ground level for every additional height of 3 m or part there of.	Sqm	58	0.00	-
10.0	Providing and fixing expandable fasteners of specified size with necessary plastic sleeves and galvanised M.S. screws including drilling holes in masonry work /CC/ R.C.C. and making good etc. complete. 50 mm long	each	12,442	0.00	-
11.0	Providing and fixing adjustable stainless steel cramps of approved quality, required shape and size, adjustable with stainless steel nuts, bolts and washer (total weight not less than 260 gms), for dry stone cladding fixed on frame work at suitable location, including making necessary recesses in stone slab, drilling required holes etc complete as per direction of the Engineer-in-charge.	each	3,110	0.00	-
12.0	15 mm Cement plaster with cement mortar in proportion of l:4 cement & coarse sand of single coat for exterior plastering upto floor two level including internal rounded angles chamfers, and rounded angles not exceeding 80 mm. ln girth and finished even and smooth.	Sqm	288	0.00	-
13.0	Finishing walls with textured exterior paint of required shade New work (Two or more coats applied @ 328 ll lo sqm) over and including priming coat of exterior primer applied @ 2.20k9/10 sqm supply of all labour material and T&P required for proper completion of work.	Sqm	288	0.00	-
	Civil Cost				**-**
	Electrical Cost @12.5% on Civil Cost			LS	**-**
	Total Amount for Development of Main Gate 1				**-**
	Total Amount for Development of Main Gate 2				-
	Total Amount for Development of Main Gates (2nos)				-

Cost Estimates Of External Boundary Wall					
Item No.	**Description**	**Unit**	**Quantity**	**Applicable Rate**	**Amount**
1.00	Excavation in foundation in ordinary soil (Loam, Clay or Sand) Including lift upto 1.50 m and lead upto 3Om and including filling watering and ramming of excavated eafth into the trenches or into the space between the building and the sides of foundation trenches or into the plinth and removal and disposal of surplus earth as directed by the Engineer Incharge upto a distance of 30m from the foundation trenches. Mannual (Small work)	Cum	992.34	0.00	-
2.00	Providing and laying cement concrete in 1:4:8 (1 Cement:4 coarse sand :B graded stone aggregate 40 mm nominal size) and curing complete, Including cost of form work, in Foundation and floors.	Cum	91.19	0.00	-
3.00	Providing and laying in position machine batched and machine mixed design mix M-25 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying and including the cost of centering, shuttering, finishing but excluding reinforcement, including admixtures in recommended proportions as per lS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer-incharge. Note :- Cement content considered in this item is @ 330 kg/cum. Excess/ less cement used as per design mix is payable / recoverable	Cum	-	0.00	-
	All work up to Plinth level.	Cum	236.55	0.00	-
	All works above plinth level upto floor V level.	Cum	174.87	0.00	-
4.00	Steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete above plinth level. Thermo-Mechanically Treated bars of grade Fe-500 D or more.	Kg	58,108.21	0.00	-
5.00	Class-150 (Non Modular) brick work in 1:4 cement and Coarse sand mortar in foundation and plinth including supply of all materials,labour and T&P etc. required for proper completion of the work.	Cum	598.77	0.00	-
6.00	Add extra to Item No. 1 to 4 above for super structure above plinth level upto floor five level including necessary cutting and moulding of brick work as required and also including honey combed brick work in thickness of wall more than12cm.	Cum	598.77	0.00	-
7.00	Washed stone grit plaster on exterior walls height upto '10 metre above ground level, in two layers, under layer 12 mm cement plaster 'l:4 (1 cement: 4 coarse sand), furrowing the under layer with scratching tool, applying cement slurry on the under layer @ 2 Kg of cement per square metre, top layer 15 mm cement plaster 1:11 212 (1 cement: 1/2 coarse sand : 2 stone chipping'10 mm nominal size), in panels with groove all around as per approved pattern, including scrubbing and washing the top layer with brushes and water to expose the stone chippings ,complete as per specification and direction of Engineer-in- charge (payment for providing grooves shall be made separately). (Any Color with White	Sqm	6,047.02	0.00	-
8.00	Forming groove of uniform size in the top layer of washed stone gr t plaster as per approved pattern using wooden battens, nailed to the under layer, including removal of wooden baitens, repair to the edges of panels and finishing the groove complete as per specifications and directon of the Engineer-in-charge'15 mm wide and 15 mm deep groove	Rmt	2,860.80	0.00	-
9.00	Finishing Walls with textured exterior paint of required shade New work (Two or more coats applied @328II lo sqm) over and including priming coat of exterior primer applid @ 2.20k9/10 sqm supply of all labour material and T&P required for proper completion of work.	Sqm	2,860.80	0.00	-
10.00	Stone work, plain in copings, cornices, string courses and plinth courses, upto 75 mm thick in Cement mortar 1:6 (1 cement : 6 coarse sand) including pointing with white cement mortar 1:2 (1 white cement : 2 stone dust) with an admixture of pigment matching the stone shade. Red sand stone	Cum	10.430	0.00	-
	Total Cost of Compound wall for Park of 1192.00 Running metre				**-**

COST ESTIMATE FOR ARBORICULTURE

SL. NO	DSR-2020	DESCRIPTION	UNIT	Applicable Rate	Total Quantity	AMOUNT (in Rs.)
1	2.1	Trenching in ordinary soil up to a depth of 60 cm including removal and stacking of serviceable materials and then disposing of surplus soil, by spreading and neatly leveling within a lead of 50 m and making up the trenched area to proper levels by filling with earth or earth mixed with sludge or / and manure before and after flooding trench with water (excluding cost of imported earth, sludge or manure).	Cum	100.00	22005.79	
2	2.2	Supplying and stacking of good earth at site including royalty and carriage upto 5 km complete (earth measured in stacks will be reduced by 20% for payment).	Cum	0.00	10782.84	-
3	2.3	Supplying and stacking sludge at site including royalty and carriage upto 5 km complete (sludge measured in stacks will be reduced by 8% for payment).	Cum	0.00	3234.85	-
4	2.4	Supplying and stacking at site dump manure from approved source, including carriage upto 5 km complete (manure measured in stacks will be reduced by 8% for payment)	Cum	0.00	3234.85	-
	2.4.1	Screened through sieve of I.S. designation 20 mm	Cum	0.00	1078.28	-
	2.4.2	Screened through sieve of I.S. designation 16 mm	Cum	0.00	1078.28	-
	2.4.3	Screened through sieve of I.S. designation 4.75 mm	Cum	0.00	1078.28	-
5	2.6	Uprooting weeds from the trenched area after 10 to 15 days of its flooding with water including disposal of uprooted vegetation.	Sqm	0.00	45811.50	-
6	2.8	Spreading of sludge, dump manure and/or good earth in required thickness as per direction of officer-in-charge (cost of sludge, dump manure and / or good earth to be paid separately).	Cum	0.00	14017.69	-
7	2.9	Mixing earth and sludge or manure in the required proportion specified or directed by the Officer-in-charge.	Cum	0.00	14017.69	-
8	2.34	Providing & laying Selection no. 1 grass turf with earth 50mm to 60mm thickness on existing ground prepared with proper level and ramming with required tools wooden and than rolling the surface with light roller make the surface smoothen and light watering the same, as per direction of officer in charge	Sqm	0.00	14541.49	-
9	2.14	Digging holes in ordinary soil and refilling the same with the excavated earth mixed with manure or sludge in the ratio of 2:1 by volume (2 parts of stacked volume of earth after reduction by 20% : 1 part of stacked volume of manure after reduction by 8%) flooding with water, dressing including removal of rubbish and surplus earth, if any, with all leads and lifts (cost of manure, sludge or extra good earth if needed to be paid for separately) :-		0.00	0.00	-
	2.14.1	Holes 1.2 m dia and 1.2m deep	Each	0.00	1718.47	-
	2.14.2	Holes 90 cm dia and 90 cm deep	Each	0.00	1718.47	-
10	2.54	Anti termite treatment by digging pits 30 cm deep and 4 cm dia, 6 to 7 holes around the tree using chemical emulsion at the rate of 1.5 liter per hole in two time or more application to get the trees free from termite infection chemicals used Chlorpyriphos 20% EC in the ratio of 1% concentration and as per direction of officer-in-charge.	Each	0.00	3436.94	-
11	2.57	Plantation of Trees, Shrubs, and Hedge at site i/c watering and removal of unserveiceable material's as per direction of officer in charge (excluding cast of plant & water).		0.00	0.00	-
	2.57.1	Trees Plant	Each	0.00	3436.94	-
	2.57.2	Shrubs Plant	Each	0.00	45811.50	-
	2.57.3	Hedge Plant / Ground cover	Each	0.00	16213.21	-
		Total Cost of Sub-heads (in Rs.)				**-**
	LIST OF TREES					
12	7.69	Providing and stacking of Plumeria alba of height 120-135 cm. with 2-3 branches in bags of size 30 cm as per direction of the officer-in-charge.	Each	0.00	538.00	-
13	7.58	Providing and stacking of Mimusops elengi (Maulsri) of height 150-165 cm. in big poly bag of size 25 cm as per direction of the officer-in-charge.	Each	0.00	538.00	-
14	7.72	Providing and stacking of Plumeria rubra of height 120-150 cm. with 3-4 branches and thick stem in big size HDPE bags as per direction of the officer-in-charge.	Each	0.00	194.00	-
15	8.43	Providing and stacking of Largerstroemia indica of height 90-105 cm. multibranched in poly bags of size 25 cm as per direction of the officer-in-charge.	Each	0.00	194.00	-
16	7.17	Providing and stacking of Cassia siamea of height 150-165 cm. in big poly bags of size 25 cm as per direction of the officer-in-charge.	Each	0.00	267.00	-
17	7.13	Providing and stacking of Butea frondosa (Flame of Forest) of height 60-75 cm. in big poly bags of size 25 cm as per direction of the officer-in-charge.	Each	0.00	690.00	-
18	7.64	Providing and stacking of Phyllanthus emblica (Amla) of height 150-165 cm. in Big HDPE Bag as per direction of the officer-in-charge.	Each	0.00	690.00	-
19	7.81	Providing and stacking of Schleichera trijuga (Kusum) of height 150-165 cm. in big poly bags of size 25 cm as per direction of the officer-in-charge.	Each	0.00	99.94	-
		Total Cost of Trees (in Rs.)				**-**
	LIST OF PALMS					
20	5.11	Providing and Displaying Bismarckia Palm 115 to 180 cm ht., well developed 12 and above good color fresh and healthy leaves in 40 cm Cement Pot as per direction of the officer-incharge.	Each	0.00	56.50	-
21	7.44	Providing and stacking of Foxtail palm of ht. 240-270 cm bottom girth 35-40 cm well developed in big size HDPE bags as per direction of the officer-in-charge.	Each	0.00	56.50	-
22	7.12	Providing and stacking of Bottle palm of ht. 270-300 cm bottom girth 40-50 cm well developed in big HDPE bags as per direction of the officer-in-charge	Each	0.00	56.50	-
23	7.41	Providing and stacking of Fishtail palm of ht. 270-300 cm bottom girth 40-50 cm well developed in big size HDPE bags as per direction of the officer-in-charge.	Each	0.00	56.50	-
		Total Cost of Palms (in Rs.)				**-**
	LIST OF SHRUBS & HEDGE PLANTS					
24	9.4	Providing and stacking of Bougainvillea (Variety Butiana, Lady Mary Baring, Mahara,Mohan,Scarlet Queen, Variegated, Glabra Formosa, Peruviana Odissi, Paratha, Subhra,Thimma, Spectabilis L.N Birla, Refulgens) of height 30 cm. to 45 cm. with 2-3 branches in 20 cm size of Earthen pots / Plastic pots & as per direction of the officer-in-charge.	Each	0.00	3272.25	-
25	8.35	Providing and stacking of Hibiscus rosasinensis of height 45-60 cm. with 3-4 branches in earthen pots of size 20 cm as per direction of the officer-in-charge.	Each	0.00	3272.25	-
26	3.76	Providing and displaying of Rhapis Excelsa Palm plant, having ht. 75 cm to 90 cm with 12 to 15 equal suckers, well developed, full of fresh & healthy leaves from bottom to top in 25 cm size Earthen pot/Plastic pot & as per direction of the officer-in charge.	Each	0.00	3272.25	-
27	3.86	Providing and Displaying of Schefflera green 3 in 1 well developed with fresh, healthy and attractive foliage from having 45 cm to 60 cm ht. in 25 cm size Earthen pot/Plastic pot/as per direction of officer-in-charge.	Each	0.00	4363.00	-
28	8.7	Providing and stacking of Tecoma stans of height 45-60 cm. branched in earthen pots of size 20 cm as per direction of the officer-in-charge.	Each	0.00	4363.00	-
29	6.7	Providing and stacking of Clerodendrum inerme of ht. 20 cm to 30 cm multi branched in 15 cm size of Earthen Pot/Plastic Pot & as per direction of the officer-in-charge.	Each	0.00	4363.00	-
30	6.12	Providing and stacking of Duranta Golden, having ht.15 to 20 cm bushty shape with fresh and healthy leaves in 15 cm size of Earthen Pot/Plastic Pot & as per direction of the officer-in-charge.	Each	0.00	4363.00	-
31	7.27	Providing and stacking of Ficus benjamina (green) of height 150-165 cm., bushy with healthy branches and lush green foliage in big size HDPE bags as per direction of the officer-in-charge.	Each	0.00	3272.25	-
32	8.30	Providing and stacking of Gardenia jasminoides of height 45-60 cm. with 3-4 branches in earthen pots of size 20 cm as per direction of the officer-in-charge.	Each	0.00	3272.25	-
33	8.31	Providing and stacking of Hamelia patens of height 30-45 cm. with 3-4 branches in poly bags of size 20 cm as per direction of the officer-in-charge.	Each	0.00	4363.00	-
34	8.46	Providing and stacking of Murraya exotica of height 45-60 cm. in poly bags of size 15 cm as per direction of the officer-in-charge.	Each	0.00	4363.00	-
35	8.50	Providing and stacking of Nerium oleander (kaner) of height 60-75 cm. with 5-6 branches in poly bags of size 25 cm as per direction of the officer-in-charge.	Each	0.00	3272.25	-
		Total Cost of Shrubs & Hedges (in Rs.)				**-**
	LIST OF GROUND COVERS					
36	6.1	Providing and stacking of of Cuphea chinensis of ht. 20-30 cm full of branches and healthy foliage in 15 cm size of Earthen Pot / Plastic Pot & as per direction of the officer-in-charge.	Each	0.00	2366.55	-
37	6.2	Providing and stacking of Alternanthera species of height 15 cm to 20 cm, full of branches and foliage in 15 cm size of Earthen Pot/Plastic Pot & as per direction of the officer-in-charge.	Each	0.00	1972.12	-
38	6.31	Providing and stacking of Wedelia trilobata,full of leaves in 15 cm size of Earthen Pot/Plastic Pot & as per direction of the officer-in-charge.	Each	0.00	1972.12	-
39	6.11	Providing and stacking of Dianella variegated, with 3 to 4 variegated leaves in 20 cm size of Earthen Pot / Plastic Pot & as per direction of the officer-in-charge.	Each	0.00	1972.12	-
40	3.30	Providing and displaying of Aglaonema Parrot Jungle (three in one), having ht. 30 cm and above with 20 to 25 leaves, well developed, fresh & healthy in 25 cm size of Earthen pot/Plastic pot & as per direction of the officer in-charge.	Each	0.00	1972.12	-
41	6.20	Providing and stacking of Ophiopogon jaburan (variegated), full of variegated leaves in 15 cm size of Earthen Pot/Plastic Pot & as per direction of the officer-in-charge.	Each	0.00	2958.18	-
42	6.29	Providing and stacking of Tradescantia, full of leaves in Earthen Pot/Plastic Pot of size 15 cm. as per direction of the officer-in-charge.	Each	0.00	545.45	-
43	4.8	Providing and Displaying Begonia rex having 15 to 23 cm ht., well developed with fresh & healthy foliage with 10 to 12 flowers in bloom in 20 cm Earthen Pot/Plastic Pot and as per direction of the officer-in-charge.	Each	0.00	545.45	-
44	6.13	Providing and stacking of Euphorbia milli hybrid variety, having ht.30 cm to 45 cm with multi branch, full bloom, fresh and healthy leaves in 20 cm size of Earthen Pot/Plastic Pot & as per direction of the officer-in-charge.	Each	0.00	545.45	-
45	4.39	Providing and Displaying Kalanchoe Hybrid variety in different colour well developed with fresh & healthy folliage in full bloom in 20 cm Earthen pot/Plastic Pot and as per direction of the officer-in-charge.	Each	0.00	818.18	-

46	4.35	Providing and Displaying Impatiens in different colour well developed fresh and healthy (3 in one) well bloomed in 25 cm Earthen Pot/Plastic Pot and as per direction of the officer-in-charge.	Each	0.00	545.45	-
		Total Cost of Ground covers (in Rs.)				**-**
		Tree Guard and Grating				
47	MR	FRP Precast Tree Grating	Each	0.00	3211.00	-
48	2.26	Providing and fixing M. S. tree guard 45 cm square in plan, height 1.20 metre above ground level and 0.40 metre below ground level. The vertical members shall consist of four nos. angle iron of size 25x25x3 mm, 1.6 m long, one at each corner and 8 nos flat iron of size 25x3 mm, 1.2 m long. The vertical mambers shall be welded to 4 nos. 25x6 mm M. S. flats placed horizontally around the vertical member of the cage. One name plate of 1 mm thick M.S. sheet of size 250x100 mm shall be welded to the tree guard near the middle height and lettered CPWD/ PWD/ any other approved name. The tree guard shall be fixed to the ground by making suitable holes and by embedding four corners leg in the ground, including refilling the earth, compaction etc. complete. The tree guard shall be painted with two or more coats of synthetic enamel paint of approved brand and manufacture over a coat of primer, complete in all respect.	Each	0.00	3211.00	-
		Total Cost of Tree Guard and Gratings				**-**
		Total exclusive GST (in Rs.)				**-**

Cost Summary for Development of Park		
Sl.No	**Component**	**Total Amount Rs.**
1	Development of Hardscape Work	-
2	Development of Compund Wall	-
3	Development of Landscaping Work	-
4	Development of Outdoor Playing Furnitures	-
5	Development of Outdoor Gym Equipment	-
6	Development of Miscellaneous work	-
	Total Development Cost for Park	**-**

Cost Estimate for Hardscape for Park					
Item No.	**Description**	**Unit**	**Quantity**	**Applicable Rate**	**Amount**
1	Excavation in foundation in ordinary soil (Loam, Clay or Sand) lncluding lift upto 1.50 m and lead upto 3Om and including filling watering and ramming of excavated eafth into the trenches or into the space between the building and the sides of foundation trenches or into the plinth and removal and disposal of surplus earth as directed by the Engineer lncharge upto a distance of 30m from the foundation trenches. Mannual (Small work)	Cum	6754.6	0.00	0.00
2	Construction of granular sub-base by providing close graded Material conforming to specifications, mixing in a mechanical mix plant at OMC, carriage of mixed material by tippers to work site, for all leads & lifts, spreading in uniform layers of specified thickness with motor grader on prepared surface and compacting with vibratory power roller to achieve the desired density, complete as per specifications and directions of Engineer-in-Charge. With material conforming to Grade-I (size range 75 mm to 0.075 mm) having CBR Value 30	Cum	4108.1	0.00	0.00
3	Disposal of building rubbish/ malba/ similar unserviceable, dismantled or waste material by mechanical transport including loading, transporting, unloading to approved municipal dumping ground for lead upto 10 km for all lifts, complete as per directions of Engineer-in-charge. Note - item to be applicable in urban areas having directions for restricted hours for movement/ plying of load carrying motor vehicle of 3.5 cum or more	Cum	3534.1	0.00	0.00
4	Providing and laying cement concrete in 1:2:4 (1 Cement: 2 coarse sand :4 graded stone aggregate 40 mm noffrinal size) and curing complete, lncluding cost of form work, ln Foundation and floors.	Cum	1713.4	0.00	0.00
5	Class-150 (Non Modular) brick work in 1:4 cement and Coarse sand mortar in foundation and plinth including supply of all materials, labour and T&P etc. required for proper completion of the work.	Cum	7357.59		
6	Providing and laying 500x500x40 mm thick Turf paver (Turfpave XD) on 150 mm thick sub grade of compacted bed of 20 mm thick nominal size stone aggregate and base course and filling with 150 mm thick jamuna sand, including spreading, well ramming, consolidating and finishing smooth etc. all complete as per direction of Engineer-in-charge.	Sqm	13543.2	0.00	0.00
7	Supply & Laying of I shaped (Zigzag) **Precast lnterlocking tiles** of thickness 60 to 100mm (Compressive strength not less then 30Mpa and weight 4.50k9) lncluding 0.30mm thick local sand base levelling and dressing of surface to required level and slope, filling joints with local sand all complete work. 80 mm (Rubber molded coloured)	Sqm	4162.5	0.00	0.00
8	Providing and laying Polished Granite ,et Black stone flooring in req0ired design and patterns, in linear as well as curvilinear portions of the building all complete as per the architectural drawings with 18 mm thick stone slab over 20 mm (average) thick base of cement mortar 1:4 (1 cement : 4 coarse sand) laid and jointed with cement slurry and pointing with white cement slurry admi)ed with pigment of matching shade including rubbing, curing	Sqm	4312.8		

9	Kota Stone slab flooring 20 mm (average) thick base aid over and joinied with grey cement slurry mixed wiih pigment to maich the shade of the slab, includlng rubbing and polishing complete with base of cement mortar 1 :4 (1 cement:4 coarse sand) :25 mm thick	Sqm	8697.6	0.00	0.00
10	Providing and fixing 10x10x7.50 cm Granite stone block hand cut and chisel dressed on top, for paving in floors, drains etc. laid over 20mm thick base mortar 1:4 (1 cement : 4 coarse sand) with joints 10mm wide filled with same mortar including ruled pointing etc. complete as per direction of engineer-in-charge.	Sqm	1411.2	0.00	0.00
11	Providing & laying 36 mm EPDM Rubber Flooring with including fixing chemicals.	Sqm	7292.7	0.00	0.00
12	Cement concrete flooring 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate)finished with a floating coat of neat cement, including cement slurry, but excluding the cost of nosing of steps etc. complete. 40 mm thick with 20 mm nominal size stone aggregate	Sqm	1208.7	0.00	0.00
13	Steel work welded in built up sections/ framed work, including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer using structural steel etc. as required. In gratings, frames, guard bar, ladder, railings, brackets, gates and similar works.	Kg	9210.204	0.00	0.00
14	Painting with synthetic enamel paint of approved brand and manufacture of required colour to give an even shade: Two or more coats on new work over an under coat of suitable shade with ordinary paint of approved brand and manufacture.	Sqm	360	0.00	0.00
	Cost Estimates of Hardscape for Park				**0.00**

COST ESTIMATE FOR HORTICULTURE FOR PARK						
SL. NO.	**DSR- 2020**	**DESCRIPTION**	**UNIT**	**Applicable Rate**	**QTY.**	**AMOUNT (in Rs.)**
1	2.10	Trenching in ordinary soil up to a depth of 60 cm including removal and stacking of serviceable materials and then disposing of surplus soil, by spreading and neatly leveling within a lead of 50 m and making up the trenched area to proper levels by filling with earth or earth mixed with sludge or / and manure before and after flooding trench with water (excluding cost of imported earth, sludge or manure).	Cum	0.00	66291.73	0.00
2	2.20	Supplying and stacking of good earth at site including royalty and carriage upto 5 km complete (earth measured in stacks will be reduced by 20% for payment).	Cum	0.00	32483.99	0.00
3	2.30	Supplying and stacking sludge at site including royalty and carriage upto 5 km complete (sludge measured in stacks will be reduced by 8% for payment).	Cum	0.00	9747.44	0.00
4	2.40	Supplying and stacking at site dump manure from approved source, including carriage upto 5 km complete (manure measured in stacks will be reduced by 8% for payment)	Cum	0.00	7942.53	
	2.4.1	Screened through sieve of I.S. designation 20 mm	Cum	0.00	2872.55	0.00
	2.4.2	Screened through sieve of I.S. designation 16 mm	Cum	0.00	2872.55	0.00
	2.4.3	Screened through sieve of I.S. designation 4.75 mm	Cum	0.00	2872.55	0.00
5	2.60	Uprooting weeds from the trenched area after 10 to 15 days of its flooding with water including disposal of uprooted vegetation.	Sqm	0.00	74978.40	0.00
6	2.80	Spreading of sludge, dump manure and/or good earth in required thickness as per direction of officer-in-charge (cost of sludge, dump manure and / or good earth to be paid separately).	Cum	0.00	20773.52	0.00
7	2.90	Mixing earth and sludge or manure in the required proportion specified or directed by the Officer-in-charge.	Cum	0.00	20773.52	0.00
8	2.10	Grassing with selection No. 1 grass including watering and maintenance of the lawn for 60 days or more till the grass forms a thick lawn, free from weeds and fit for mowing including supplying good earth, if needed (the grass and earth shall be paid for separately).		0.00	0.00	
	2.10.1	In rows 5 cm apart in either direction	Sqm	0.00	0.00	0.00
	2.10.2	With grass Turf	Sqm	0.00	90393.12	0.00
9	2.34	Providing & laying Selection no. 1 grass turf with earth 50mm to 60mm thickness on existing ground prepared with proper level and ramming with required tools wooden and than rolling the surface with light roller make the surface smoothen and light watering the same, as per direction of officer in charge	Sqm	0.00	34111.36	0.00
10	2.14	Digging holes in ordinary soil and refilling the same with the excavated earth mixed with manure or sludge in the ratio of 2:1 by volume (2 parts of stacked volume of earth after reduction by 20% : 1 part of stacked volume of manure after reduction by 8%) flooding with water, dressing including removal of rubbish and surplus earth, if any, with all leads and lifts (cost of manure, sludge or extra good earth if needed to be paid for separately) :		0.00	0.00	
	2.14.1	Holes 1.2 m dia and 1.2m deep	Each	0.00	1233.60	0.00
	2.14.2	Holes 90 cm dia and 90 cm deep	Each	0.00	1233.60	0.00
11	2.54	Anti termite treatment by digging pits 30 cm deep and 4 cm dia, 6 to 7 holes around the tree using chemical emulsion at the rate of 1.5 liter per hole in two time or more application to get the trees free from termite infection chemicals used Chlorpyriphos 20% EC in the ratio of 1% concentration and as per direction of officer-in-charge.	Each	0.00	2523.20	0.00
12	2.56	Anti termite treatment of lawn area through premise 30.50% I P. one liter premise diluted in 499 liters water and applying solution @ 1.00 litre solution per sqm lawn or bed area.(two application) i/c cost of chemical)and as per direction of officer-in-charge.and as per direction of officer-in-charge.	Sqm.	0.00	90293.60	0.00

13	2.57	Plantation of Trees, Shrubs, and Hedge at site i/c watering and removal of unserveiceable material's as per direction of officer in charge (excluding cast of plant & water).		0.00	0.00	
	2.57.1	Trees Plant	Each	0.00	2523.20	0.00
	2.57.2	Shrubs Plant	Each	0.00	74978.40	0.00
	2.57.3	Hedge Plant / Ground cover	Each	0.00	99048.00	0.00
		Total Cost of Sub-heads (in Rs.)				**0.00**
	List of Trees					
14	7.70	Providing and stacking of Bauhinia blakeana (Kachnar) of height 120-150 cm. in big poly bags of size 25 cm as per direction of the officer-in-charge.	Each	0.00	307.20	0.00
15	7.84	Providing and stacking of Tabebuia sp. of height 150-165 cm. in big polybags of size 25 cm as per direction of the officer-in-charge.	Each	0.00	302.40	0.00
16	7.69	Providing and stacking of Plumeria alba of height 120-135 cm. with 2-3 branches in bags of size 30 cm as per direction of the officer-in-charge.	Each	0.00	304.00	0.00
17	7.58	Providing and stacking of Mimusops elengi (Maulsri) of height 150-165 cm. in big poly bag of size 25 cm as per direction of the officer-in-charge.	Each	0.00	217.60	0.00
18	7.72	Providing and stacking of Plumeria rubra of height 120-150 cm. with 3-4 branches and thick stem in big size HDPE bags as per direction of the officer-in-charge.	Each	0.00	830.40	0.00
19	8.43	Providing and stacking of Largerstroemia indica of height 90-105 cm. multibranched in poly bags of size 25 cm as per direction of the officer-in-charge.	Each	0.00	80.00	0.00
20	7.40	Providing and stacking of Alstonia scholaris of height 150-165 cm. in bag of size 25 cm as per direction of the officer-in-charge.	Each	0.00	76.80	0.00
21	7.14	Providing and stacking of Callistemon lanceolatus of height 150-165 cm. in big poly bags of size 25 cm as per direction of the officer-in-charge.	Each	0.00	44.80	0.00
22	7.17	Providing and stacking of Cassia siamea of height 150-165 cm. in big poly bags of size 25 cm as per direction of the officer-in-charge.	Each	0.00	41.60	0.00
23	7.82	Providing and stacking of Spathodea campanulata of height 150-165 cm. in big poly bags of size 25 cm as per direction of the officer-in-charge.	Each	0.00	36.80	0.00
24	7.88	Providing and stacking of Terminalia arjuna of height 150-165 cm. in big polybags of size 25 cm as per direction of the officer-in-charge.	Each	0.00	33.60	0.00
25	7.24	Providing and stacking of Delonix regia (Gulmohar) of height 150-165 cm. in big poly bags of size 25 cm as per direction of the officer-in-charge.	Each	0.00	44.80	0.00
26	7.80	Providing and stacking of Bauhinia purpurea (Kachnar) of height 150-165 cm. in big poly bags of size 25 cm as per direction of the officer-in-charge.	Each	0.00	59.20	0.00
27	7.18	Providing and stacking of Cassia javanica of height 120-150 cm. in big poly bags of size 25 cm as per direction of the officer-in-charge.	Each	0.00	56.00	0.00
28	7.16	Providing and stacking of Cassia fistula (Amaltash) of height 120-135 cm. in big poly bags of size 25 cm as per direction of the officer-in-charge.	Each	0.00	43.20	0.00
29	7.36	Providing and stacking of Ficus religiosa (Peepal) of height 150-165 cm. in big poly bags of size 30 cm as per direction of the officer-in-charge.	Each	0.00	41.60	0.00
30	7.28	Providing and stacking of Ficus bengalensis (Bargad) of height 120-135 cm. in big poly bags of size 25 cm as per direction of the officer-in-charge.	Each	0.00	40.00	0.00
31	7.30	Providing and stacking of Albizzia lebbek of height 150-165 cm. in bag of size 25 cm as per direction of the officer-in-charge.	Each	0.00	12.80	0.00
32	7.13	Providing and stacking of Butea frondosa (Flame of Forest) of height 60-75 cm. in big poly bags of size 25 cm as per direction of the officer-in-charge.	Each	0.00	9.60	0.00
33	7.64	Providing and stacking of Phyllanthus emblica (Amla) of height 150-165 cm. in Big HDPE Bag as per direction of the officer-in-charge.	Each	0.00	9.60	0.00
34	7.81	Providing and stacking of Schleichera trijuga (Kusum) of height 150-165 cm. in big poly bags of size 25 cm as per direction of the officer-in-charge.	Each	0.00	9.60	0.00
35	7.90	Providing and stacking of Bombax ceiba of height 150-165 cm. in big poly bags of size 25 cm as per direction of the officer-in-charge.	Each	0.00	9.60	0.00
Total Cost of Trees (in Rs.)						**0.00**
	List of Palms					

19	5.11	Providing and Displaying Bismarckia Palm 115 to 180 cm ht., well developed 12 and above good color fresh and healthy leaves in 40 cm Cement Pot as per direction of the officer-incharge.	Each	0.00	3780.18	0.00
20	7.44	Providing and stacking of Foxtail palm of ht. 240-270 cm bottom girth 35-40 cm well developed in big size HDPE bags as per direction of the officer-in-charge.	Each	0.00	1801.36	0.00
21	7.12	Providing and stacking of Bottle palm of ht. 270-300 cm bottom girth 40-50 cm well developed in big HDPE bags as per direction of the officer-in-charge	Each	0.00	1643.12	0.00
22	7.41	Providing and stacking of Fishtail palm of ht. 270-300 cm bottom girth 40-50 cm well developed in big size HDPE bags as per direction of the officer-in-charge.	Each	0.00	1875.92	0.00
		Total Cost of Palms (in Rs.)				**0.00**
	List of Shurbs & Hedge Plants					
23	9.40	Providing and stacking of Bougainvillea (Variety Butiana, Lady Mary Baring, ahara,Mohan,Scarlet Queen, Variegated, Glabra Formosa, Peruviana Odissi, Paratha, Subhra,Thimma, Spectabilis L.N Birla, Refulgens) of height 30 cm. to 45 cm. with 2-3 branches in 20 cm size of Earthen pots / Plastic pots & as per direction of the officer-in-charge.	Sqm	0.00	11206.40	0.00
24	8.35	Providing and stacking of Hibiscus rosasinensis of height 45-60 cm. with 3-4 branches in earthen pots of size 20 cm as per direction of the officer-in-charge.	Sqm	0.00	8715.20	0.00
25	3.76	Providing and displaying of Rhapis Excelsa Palm plant, having ht. 75 cm to 90 cm with 12 to 15 equal suckers, well developed, full of fresh & healthy leaves from bottom to top in 25 cm size Earthen pot/Plastic pot & as per direction of the officer-in charge.	Sqm	0.00	11108.64	0.00
26	3.86	Providing and Displaying of Schefflera green 3 in 1 well developed with fresh, healthy and attractive foliage from having 45 cm to 60 cm ht. in 25 cm size Earthen pot/Plastic pot/as per direction of officer-in-charge.	Sqm	0.00	13742.40	0.00
	8.70	Providing and stacking of AlpiniaVariegated(threeinone)havinght.30cmandabove,withfreshandhealthyvariegatedfoliagein25cmsizeofEarthenPot/PlasticPot&as per directionof the officer-in-charge.	Each	0.00	396.80	0.00
	6.70	ProvidingandDisplayingVincadifferentcolour6to8welldevelopedbranchinfullbloomstackedwithgreenpaintedBamboo stick in 25	Each	0.00	2753.60	0.00
	6.12	ProvidinganddisplayingofCrotonGoldenplant,havinght.45cmto60cmwith2to3branches,welldeveloped,freshandhealthyfoliagein25cmsizeofEarthenpot/Plasticpotas per direction of the officer-in-charge.	Each	0.00	2043.20	0.00
	7.27	ProvidingandstackingofCaesalpiniapulcherrimaspeciesofheight45-60cm.inearthenpotofsize20cmasperdirectionof the officer-in-charge.	Each	0.00	2612.80	0.00
	8.30	ProvidinganddisplayingofPhilodendronXanaduhaving15to20leaves,welldevelopedwithfulloffresh&healthyleavesin25cmsizeofEarthenpot/Plasticpot&asperdirection of the officer-in-charge.	Each	0.00	204.80	0.00
	8.31	ProvidinganddisplayingofDracaenamahatmaplant,havinght.30cmto45cm,welldeveloped,freshandhealthyfoliagein20cmsizeofEarthenpot/Plasticpot&asperdirection of the officer-in-charge.	Each	0.00	1932.80	0.00
	8.46	ProvidingandstackingAllamandacatharticaofheight30cmto45cm.in20cmsizeofEarthenpots/Plasticpots&asperdirection of the officer-in-charge.	Each	0.00	2627.20	0.00
	8.50	ProvidinganddisplayingofDracaenaSongofIndia(threeinone),havinght.30cmandabove,multibranched,welldevelopedwithfreshandhealthyleavesin25cmsizeofEarthenpot/Plasticpot&asperdirectionoftheofficer-in-charge.	Each	0.00	2640.00	0.00

1	8.70	Providing and stacking of Tecoma stans of height 45-60 cm. branched in earthen pots of size 20 cm as per direction of the officer-in-charge.	Each	0.00	2385.60	0.00
2	6.70	Providing and stacking of Clerodendrum inerme of ht. 20 cm to 30 cm multi branched in 15 cm size of Earthen Pot/Plastic Pot & as per direction of the officer-in-charge.	Each	0.00	240.00	0.00
3	6.12	Providing and stacking of Duranta Golden, having ht.15 to 20 cm bushty shape with fresh and healthy leaves in 15 cm size of Earthen Pot/Plastic Pot & as per direction of the officer-in-charge.	Each	0.00	240.00	0.00
4	7.27	Providing and stacking of Ficus benjamina (green) of height 150-165 cm., bushy with healthy branches and lush green foliage in big size HDPE bags as per direction of the officer-in-charge.	Each	0.00	180.80	0.00
5	8.30	Providing and stacking of Gardenia jasminoides of height 45-60 cm. with 3-4 branches in earthen pots of size 20 cm as per direction of the officer-in-charge.	Each	0.00	180.80	0.00
6	8.31	Providing and stacking of Hamelia patens of height 30-45 cm. with 3-4 branches in poly bags of size 20 cm as per direction of the officer-in-charge.	Each	0.00	240.00	0.00
7	8.46	Providing and stacking of Murraya exotica of height 45-60 cm. in poly bags of size 15 cm as per direction of the officer-in-charge.	Each	0.00	240.00	0.00
8	8.50	Providing and stacking of Nerium oleander (kaner) of height 60-75 cm. with 5-6 branches in poly bags of size 25 cm as per direction of the officer-in-charge.	Each	0.00	180.80	0.00
1	8.58	Providing and stacking of Tabernaemontana coronaria (Chandni single) of height 45-60 cm. in earthen pots of size 20 cm as per direction of the officer-in-charge.	Each	0.00	180.80	0.00
2	8.61	Providing and stacking of Tabernaemontana coronaria (chandni variegated) of height 45-60 cm. with 3-4 branches earthen pots of size 20 cm as per direction of the officer-in-charge.	Each	0.00	240.00	0.00
3	5.10	Providing and Displaying Bird of paradise well developed with fresh & healthy 90 to 120 cm ht in 30 cm Earthen Pot/ Plastic Pot as per direction of the officer-in-charge.	Each	0.00	361.60	0.00
4	6.10	Providing and stacking of Alpinia Variegated (three in one) having ht. 30 cm and above, with fresh and healthy variegated foliage in 25 cm size of Earthen Pot / Plastic Pot & as per direction of the officer-in-charge.	Each	0.00	180.80	0.00
5	4.83	Providing and Displaying Vinca different colour 6 to 8 well developed branch in full bloom stacked with green painted Bamboo stick in 25	Each	0.00	361.60	0.00
6	3.30	Providing and displaying of Croton Golden plant, having ht. 45 cm to 60 cm with 2 to 3 branches, well developed, fresh and healthy foliage in 25 cm size of Earthen pot/Plastic pot as per direction of the officer-in-charge.	Each	0.00	240.00	0.00
7	8.40	Providing and stacking of Caesalpinia pulcherrima species of height 45-60 cm. in earthen pot of size 20 cm as per direction of the officer-in-charge.	Each	0.00	180.80	0.00
8	3.72	Providing and displaying of Philodendron Xanadu having 15 to 20 leaves, well developed with full of fresh & healthy leaves in 25 cm size of Earthen pot/Plastic pot & as per direction of the officer-in-charge.	Each	0.00	240.00	0.00
9	3.50	Providing and displaying of Dracaena mahatma plant, having ht. 30 cm to 45 cm, well developed, fresh and healthy foliage in 20 cm size of Earthen pot/Plastic pot & as per direction of the officer-in-charge.	Each	0.00	481.60	0.00
10	9.10	Providing and stacking Allamanda cathartica of height 30 cm to 45 cm. in 20 cm size of Earthen pots / Plastic pots & as per direction of the officer-in-charge.	Each	0.00	240.00	0.00
11	3.44	Providing and displaying of Dracaena Song of India (three in one), having ht. 30 cm and above, multibranched, well developed with fresh and healthy leaves in 25 cm size of Earthen pot/Plastic pot & as per direction of the officer-in-charge.	Each	0.00	540.80	0.00
12	8.19	Providing and stacking of Euphorbia pulcherrima (dark red double bracts) well branched of height 60-75 cm. in earthen pots of size 25 cm as per direction of the officer-in-	Each	0.00	240.00	0.00
13	5.30	Providing and Displaying Acalypha red well developed with fresh & healthy 30 to 45 cm ht. in 20 cm size Earthen Pot/ Plastic Pot as per direction of the officer-in-charge.	Each	0.00	240.00	0.00
	List of Ground Covers				0	**0.00**
27	6.10	Providing and stacking of of Cuphea chinensis of ht. 20-30 cm full of branches and healthy foliage in 15 cm size of Earthen Pot / Plastic Pot & as per direction of the officer-in-charge.	Each	0.00	7174.40	0.00
28	6.20	Providing and stacking of Alternanthera species of height 15 cm to 20 cm, full of branches and foliage in 15 cm size of Earthen Pot/Plastic Pot & as per direction of the officer-in-charge.	Each	0.00	5758.40	0.00

29	6.31	Providing and stacking of Wedelia trilobata,full of leaves in 15 cm size of Earthen Pot/Plastic Pot & as per direction of the officer-in-charge.	Each	0.00	5395.20	0.00
30	6.11	Providing and stacking of Dianella variegated, with 3 to 4 variegated leaves in 20 cm size of Earthen Pot / Plastic Pot & as per direction of the officer-in-charge.	Each	0.00	9960.00	0.00
31	3.30	Providing and displaying of Aglaonema Parrot Jungle (three in one), having ht. 30 cm and above with 20 to 25 leaves, well developed, fresh & healthy in 25 cm size of Earthen pot/Plastic pot & as per direction of the officer in-charge.	Each	0.00	6798.40	0.00
32	6.20	Providing and stacking of Ophiopogon jaburan (variegated), full of variegated leaves in 15 cm size of Earthen Pot/Plastic Pot & as per direction of the officer-in-charge.	Each	0.00	8236.80	0.00
33	6.29	Providing and stacking of Tradescantia, full of leaves in Earthen Pot/Plastic Pot of size 15 cm. as per direction of the officer-in-charge.	Each	0.00	8409.60	0.00
34	4.80	Providing and Displaying Begonia rex having 15 to 23 cm ht., well developed with fresh & healthy foliage with 10 to 12 flowers in bloom in 20 cm Earthen Pot/Plastic Pot and as per direction of the officer-in-charge.	Each	0.00	5742.40	0.00
35	6.13	Providing and stacking of Euphorbia milli hybrid variety, having ht.30 cm to 45 cm with multi branch, full bloom, fresh and healthy leaves in 20 cm size of Earthen Pot/Plastic Pot & as per direction of the officer-in-charge.	Each	0.00	9571.20	0.00
36	4.39	ProvidingandDisplayingKalanchoeHybridvarietyindifferentcolourwelldevelopedwithfresh&healthyfoliageinfullbloomin20cmEarthenpot/PlasticPotandasperdirection of the officer-in-charge.	Each	0.00	3636.80	0.00
37	4.35	ProvidingandDisplayingImpatiensindifferentcolourwelldevelopedfreshandhealthy(3inone)wellbloomedin25cmEarthenPot/PlasticPotandasperdirectionoftheofficer-in-charge.	Each	0.00	3804.80	0.00
38	6.80	Providing and stacking of Chlorophytum (Green), full of leafy suckers in 15 cm size of Earthen Pot/Plastic Pot & as per direction of the officer-in-charge.	Each	0.00	400.00	0.00
39	6.16	Providing and stacking of Iresine herbstii, of height 20-25 cm. full of branches well developed in 15 cm size of Earthen Pot/Plastic Pot & as per direction of the officer-in-charge.	Each	0.00	400.00	0.00
40	6.24	Providing and stacking of Setcreasea purpurea full of variegated leaves in 15 cm size of Earthen Pot/Plastic Pot as per direction of the officer-in-charge	Each	0.00	600.00	0.00
41	6.28	Providing and stacking of Syngonium variegated,of height 20-30 cm. with 2-3 suckers healthy foliage in Earthen Pot/Plastic Pot of size 15 cm. as per direction of the officer-in-charge.	Each	0.00	400.00	0.00
42	3.90	Providing and displaying of Spathiphyllum (peace Lilly), having 15 cm to 25 cm ht. blooming stag with fresh & healthy foliage well developed in 15 cm of Earthen pot/plastic pot & as per direction of the officer-in-charge	Each	0.00	320.00	0.00
		Total Cost of Ground covers (in Rs.)				**0**
		Grand Total exclusive of GST (in Rs.)				**0.00**

Cost Estimates Of Compound wall					
Item No.	**Description**	**Unit**	**Total Quantity**	**Applicable Rate (Rs)**	**Amount (Rs)**
1	Excavation in foundation in ordinary soil (Loam, Clay or Sand) lncluding lift upto 1.50 m and lead upto 3Om and including filling watering and ramming of excavated eafth into the trenches or into the space between the building and the sides of foundation trenches or into the plinth and removal and disposal of surplus earth as directed by the Engineer lncharge upto a distance of 30m from the foundation trenches. Mannual (Small work)	Cum	93.28	0.00	-
2	Providing and laying cement concrete in 1:4:8 (1 Cement:4 coarse sand :B graded stone aggregate 40 mm nominal size) and curing complete, lncluding cost of form work, in Foundation and floors.	Cum	8.61	0.00	-
3	Providing and laying in position machine batched and machine mixed design mix M-25 grade cement concrete for reinforced cement concrete work, using cement content as per approved design mix, including pumping of concrete to site of laying and including the cost of centering, shuttering, finishing but excluding reinforcement, including admixtures in recommended proportions as per lS: 9103 to accelerate, retard setting of concrete, improve workability without impairing strength and durability as per direction of Engineer-incharge. Note :- Cement content considered in this item is @ 330 kg/cum. Excess/ less cement used as per design mix is payable / recoverable separately.	Cum	-	0.00	-
	All work up to Plinth level.	Cum	22.19	0.00	-
	All works above plinth level upto floor V level.	Cum	10.53	0.00	-
4	Steel reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete above plinth level. Thermo-Mechanically Treated bars of grade Fe-500 D or more.	Kg	4,824.83	0.00	-
5	Class-150 (Non Modular) brick work in 1:4 cement and Coarse sand mortar in foundation and plinth including supply of all materials,labour and T&P etc. required for proper completion of the work.	Cum	14.10	0.00	-
6	Add extra to Item No. 1 to 4 above for super structure above plinth level upto floor five level including necessary cutting and moulding of brick work as required and also including honey combed brick work in thickness of wall more than12cm.	Cum	14.10	0.00	-

Cost Estimates Of Compound wall					
Item No.	**Description**	**Unit**	**Total Quantity**	**Applicable Rate (Rs)**	**Amount (Rs)**
7	Washed stone grit plaster on exterior walls height upto '10 metre above ground level, in two layers, under layer 12 mm cement plaster 'l:4 (1 cement: 4 coarse sand), furrowing the under layer with scratching tool, applying cement slurry on the under layer @ 2 Kg of cement per square metre, top layer 15 mm cement plaster 1:11 212 (1 cement: 1/2 coarse sand : 2 stone chipping'10 mm nominal size), in panels with groove all around as per approved pattern, including scrubbing and washing the top layer with brushes and water to expose the stone chippings ,complete as per specification and direction of Engineer-in- charge (payment for providing grooves shall be made separately). (Any Color with White Cement)	Sqm	131.38	0.00	-
8	Forming groove of uniform size in the top layer of washed stone grit plaster as per approved pattern using wooden battens, nailed to the under layer, including removal of wooden battens, repair to the edges of panels and finishing the groove complete as per specifications and direction of the Engineer-in-charge : 15 mm wide and 15 mm deep groove	Sqm	131.38	0.00	-
9	Steel work welded in built up sections/ framed work, including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer using structural steel etc. as required. In gratings, frames, guard bar, ladder, railings, brackets, gates and similar works.	Kg	4,032.00	0.00	-
10	Painting with synthetic ename paint of approved brand and manufacture to give an even shade Two or more coats on new work includlng cost of all materials, labour T&P etc. required for proper completion of work Wood and steel	Sqm	201.60	0.00	-
11	Stone work, plain in copings, cornices, string courses and plinth courses, upto 75 mm thick in Cement mortar 1:6 (1 cement : 6 coarse sand) including pointing with white cement mortar 1:2 (1 white cement : 2 stone dust) with an admixture of pigment matching the stone shade. Red sand stone	Cum	2.25	0.00	-
	Total Cost of Compound wall for Park of 438.00 Running metre				-

Cost Summary for Outdoor Gym Equipments					
Sl.No	**Description of Work**	**Unit**	**Quantity**	**Rate Rs.**	**Amount Rs.**
1	Pullup Bars	Nos.	10	-	-
2	Parallel Bars	Nos.	10	-	-
3	Chest Press	Nos.	10	-	-
4	Leg Press	Nos.	10	-	-
5	Aerobic Stepper	Nos.	10	-	-
6	Air walker	Nos.	10	-	-
7	Balance Beam	Nos.	10	-	-
8	Situp Bosrd Station	Nos.	10	-	-
9	Squat Rack	Nos.	10	-	-
10	Monkey Bar	Nos.	10	-	-
	Total Cost Summary for Outdoor Gym Equipments				**-**
	TOTAL COST FOR Outdoor Gym Equipments				**-**

COST ESTIMATE FOR MISCELLANEOUS WORK FOR PARK					
Sl. No.	**Description of Item**	**Unit**	**Quantity**	**Applicable Rate**	**Amount**
1	Supply & Fixing of Benches of 1550 X 610 X 550 mm Complete as per Approved drawings & Specifications or as per directions of Engineer-in-charge.Size: 1550L X 610W X 550H mm.	Nos.	624.00	-	-
2	Waste Container/ Mobile Container 120 ltr	Nos.	520.00	-	-
3	Pathway & Street Lighting Supply, installation, testing and commissioning of LED street / compound / high mast /pathway/ landscaping lighting for the entire campus.	Sqm	39,912.44	-	-
4	Decorative Designer lamp post made of Galvanised Mild Steel Pipes fitted with cast aluminium fixture duly polyrethane paint coated fitted with 30watt. LED Lamp and 2 nos. LED Tubes(T-8).	Nos.	1,036.00	-	-
5	Supply 8, fixing of Bollad made (Double Side) out of 2mm thick aluminium sheet face to be covered with high intensity prismatic grade iype lV sheeting ' Legends , letters , numerals and borders etc should be as per MoRIH specification No-801.3.7. Welded poly shaped to make it monolithic pillar size 1200 mm high Bollard is having a frame 900x600 mm and 600 mm dia for fixation made out of 35 x 35 x 5 mm angle iron and from side ls fully cover. (size of foundalion 0.45x0.45x0.60m)	Nos.	90.00	-	-
6	providing and flxing of retro-reflectorised caulionary, mandalory and informalory sign as per IRC 167-2012 made of high intensily grade sheeting type lV vide clause 801.3, fixed over aluminium sheeting 15 mm thick supported on a mild steel angle iron post 75 mm x 75 mm x 6 mm ilrmly fixed to the ground by means of properly designed foundation with M 15 grade cement concrete 45 cm x 45 cm x 60 cm. 60 cm below ground level as per approved drawing. The Retro reflective sheeting shall be lested for a cerliilcate of having the sheeling tested for coetflcient of retro reflection, daytime colour and luminance, shrinkage, flexibility, liner removal, adhesion, impact resistance, specular gloss and flrngus resistance 3 years outdoor weatherrng anci ils having passed lhese lesls shall be obtained from lnternational/ Government Laboratory/ Institute by the manufacturer of the sheeting and in case the cerlillcate is obtained from lnternatlonal condition, it should also be obtained from lndian condiuon within 3 years of launching of product by the manufacture in abroad. Alternalively, a certiflcate conforming to ASTI\,4 Specillcation (0 4956-09) on artiflcial accelerated weathering requirements from a reputed labo.atory in lndia can be accepted provisionally. ln such a situation, the Employer / Client, if so deskes, could seek for a eformance guarantee which would be released after receipt of cerlificate meeting the requirement of three years olrtdoor weathering of the sheeting as per IRC 67.2012. Legends,lellers, numerals and borde.s etc should be as per AIoRTH speciflcation No-801.3.7 . Proof of the same in form of government report shall	LS	-	-	
	ii) 60 cm eqLrilateral trinqle with difflnitation plate (20cm X 60cm)	No.	2,978.00	-	0
	x) 30X90 cm (LefrRight) Object Hazard	No.	466.00	-	0
7	Excavation for roadwork in soil with hydraulic excavator of 0.9 cum bucket capacity including cutting and loading in tippers, trimmlng bottom and side slopes, in accordance with requirements of lines, grades and cross sections, and transporting to the embankment location within all lifts and lead upto '1000 m including cost of all materials, T&P, labour, cartage for proper completion of work as per direction of Enginee-in-Charges	Cum.	4,086.00	-	-
8	Water Irriagation distribution Line	Rm	15,439.04	-	-
9	Providing and fixing of Fountain with all required equipments including necessary civil work for development of fountain	LS			
	Cost of MISC. WORK				**-**

Cost Summary for Outdoor Playing Furnitures for Park					
Sl.No	**Description of Work**	**Unit**	**Quantity**	**Rate Rs.**	**Amount Rs.**
1	Outdoor Playground Slides	Nos.	15	-	-
2	Monkey Bar Swing	Nos.	15	-	-
3	Swing	Nos.	15	-	-
4	Merry Go Round Swing	Nos.	15	-	-
5	Seesaw Swing	Nos.	15	-	-
	Total Cost Summary for Outdoor Playing Furnitures				**-**

COST ESTIMATE FOR ICT

Sl.No	Description of Work	Unit	Quantity	Rate Rs.	Amount Rs.
1	Supply, instalation, testing and commissioning of IP based CCTV systems comprising of PTZ/ fixed cameras, cabeling, recording, display system and hardware software support.				0
	Total				**0**

COST ESTIMATE FOR SOLID WASTE MANAGEMENT					
Sl.No	**Description of Work**	**Unit**	**Quantity**	**Rate Rs.**	**Amount Rs.**
A	Waste Management				
1	Collection and Transportation				
a	Door to door collection of segregated solid waste from source in segregated manner (wet and dry separately) and transportation of collected wet and dry solid waste separately to the relevant processing site up to 15km from project site boundary & monitoring through IoT based hardware integration, to monitor the real-time progress of the waste collection in terms of percentage route covered, along with establishment of Centralized Control Room including of service for mobile application for citizens and web portal & mobile application for Authority during the tenure of contract period as per the direction of Engineer-in-charge, including fuel charges, remuneration of manpower (driver & Helper), maintenance cost for each vehicle etc.				0.00
	Population between 1,00,000 to 5,00,000	4292	per HH		0.00
b	Providing & supplying Collection Bucket wheel barrows of 120 Litres Mobile Container for Solid Waste With lid	116	Each		0.00
c	Providing & supplying Hopper Garbage Tipper Dumper mounted on Four Wheeler including one year guarantee with third party converage, etc. complete as directed by Engineer in-Charge.	2	Each		0.00
d	Providing & supplying Rear End Loading Refuse Compactor of 6.0 cum including one year guarantee with third party converage, etc. complete as directed by Engineer in-Charge.	2	Each		0.00
2	Providing of Vermiculture Treatment for Organic Waste	1	Each		0.00
3	Compost Screeing system with belt Conveyor: Providing, erecting, & giving tril test of components of compost screening system with belt conveyor of 25 TPD. This screening system is intended to screening of compost in mechanizedway i.e. feeding of consted garbage by means of front end loader and collection of screened compost by means of belt conveyor and oversized unscreened collection is also done by nelt conveyor thus to drastically reduces the handling of garbage by human being and enhances the production capacity of the system.	2	Each		0.00
4	Providing, erecting & giving trial test of components of twin shaft shredder machine of capacity minimum 10 TPD. Machine consisting sorting conveyor, screw conveyor and shredding machine including transportation, loading, unloading, one year gurantee with third party converage, etc. complete as directed by Engineer in-Charge. Entire machine exposed surface is ground and to be painted with enamel paint of desired shade of Engineer in-Charge.	2	Each		0.00
5	Construction of Transfer Station of 1000sqm built up area with sufficient space for receiving, storage, transfer, office and administration, toilets and equipment and maintenance area, Along with Electrical System, Plumbing System, HVAC System and Fire Protection System.	1	Job		0.00
6	Providing, supplying & fixing weigh bridge of 50MT capacity with 1.0 meter x 1.0 meter platform size with micro controller based fully electronic weighbridges are equipped with high precision assuring the accuracy and reliability of the product. Loadcells which are repairable and accurate at all corners of the weighbridge, mounting it all over the civil column. The rates of weighbridge are including all material, labour, transportation, loading, unloading, etc. cost complete as directed by Engineer in-Charge.	2	Each		0.00
	Grand Total				0.00

VOLUME IV

FRONT END ENGINEERING DESIGN (FEED)/ DESIGN BASIS REPORT

Table of Contents

Chapter 1: Introduction

1.1 Project Background

Agra Development Authority is developing a Green Field Township Project of 140.5 Ha around the Kakua – Bhandai villages in Agra. This comprehensive initiative aims to enhance every aspect of the township, from infrastructure development to environmental sustainability.

At its core, this project will prioritize the creation of green spaces, recreational areas, and sustainable infrastructure. The development plan includes the establishment of parks, gardens, and open spaces to foster community engagement and promote a healthier lifestyle. Additionally, modern amenities such as efficient water and waste management systems, energy-efficient lighting, and smart transportation solutions will be integrated to ensure environmental sustainability.

Furthermore, the project will focus on fostering economic growth and social cohesion within the township. This entails the development of commercial and residential zones, as well as the provision of essential services such as schools, healthcare facilities, and community centers. By creating a vibrant and inclusive environment, the project aims to improve the overall quality of life for residents while also attracting investment and promoting economic development.

The Agra Development Authority intends to collaborate with various stakeholders, including local communities, government agencies, and private enterprises, to ensure the successful implementation of the project. Through extensive consultation and engagement, the authority seeks to incorporate diverse perspectives and expertise to maximize the project's impact and sustainability.

This document details out the tender specifications, to ensure that all parties involved in a project have a clear understanding of the project's requirements and expectations.

1.2 Atal Puram Township Location

The Site is situated in between the two villages, in proximity of the Agra Gwarlior highway on the east and NH 44 National highway to the south. The Geographical coordinates of the site are 27° 4.439'N, 77° 58.601'E.

Kakua and Bhandai villages are in Barauli Ahir Block in Agra District of Uttar Pradesh State, India. The villages are located at 14 km towards South from District headquarters Agra, 12 km from Barauli Ahir, and 347 km from the state capital Lucknow.

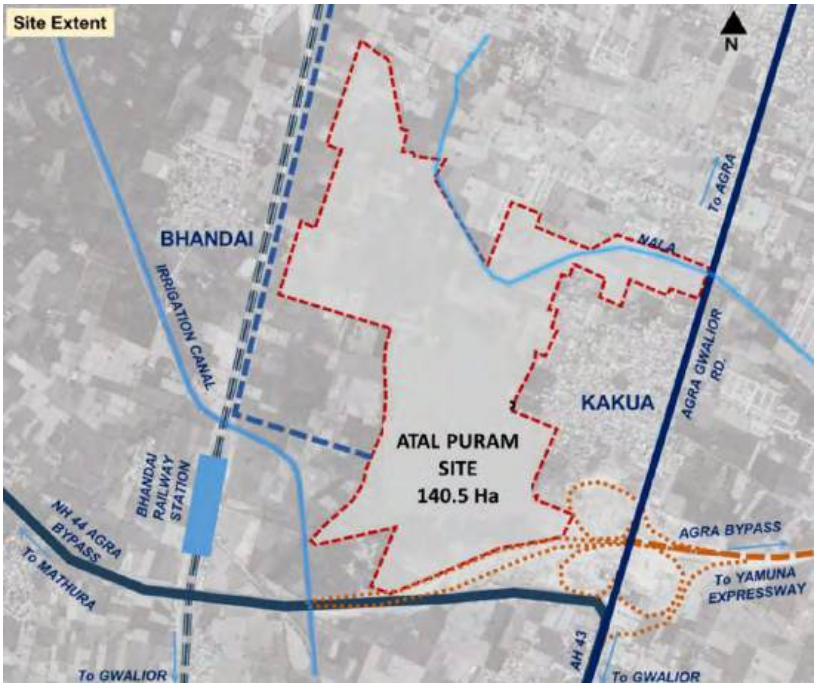
The nearby villages to Bhandai are: Kakua (2 km), Itaura (2 km), Jarua Katra (2 km), Bad (2 km), Bain Khera (3 km). Agra, Shamsabad, Achhnera, Rajakhera are the nearby cities to Bhandai. Bhahai (1 km), Kaboolpur (2 km), Bhandai (2 km), Itaura (2 km), Kuthawati (2 km) are the nearby villages to Kakua.

Map 1: *Atal Puram Site Location*

The Atal Puram Site is well connected by the roadways and railways. The Agra Gwalior highway and NH 44 run adjacent to the site. The site location is at 1.15 km from the Bhandai Railway station, at 12 km from the Agra Cant. Railway station and at 12.5 km and Agra fort railway station. Similarly, the site is located at 11.6 km from the Idgah Bus terminal, 12 km from Bijli Nagar Bus terminal.

The site is presently characterized by expansive agricultural land, with its surroundings delineated as follows: to the east, it is adjacent to Kakua village and Agra Gwalior Road; to the south, it borders Agra Bypass Road; to the west, it is bordered by Bhandai Village and a railway line; and to the north, it is flanked by a nala (water channel) and further agricultural fields.

The site for the Atal Puram Township falls within the boundaries of the Agra Master Plan, 2031 (Draft).



Map 2: *Atal Puram Site Boundary*

1.3 Atal Puram Layout Plan

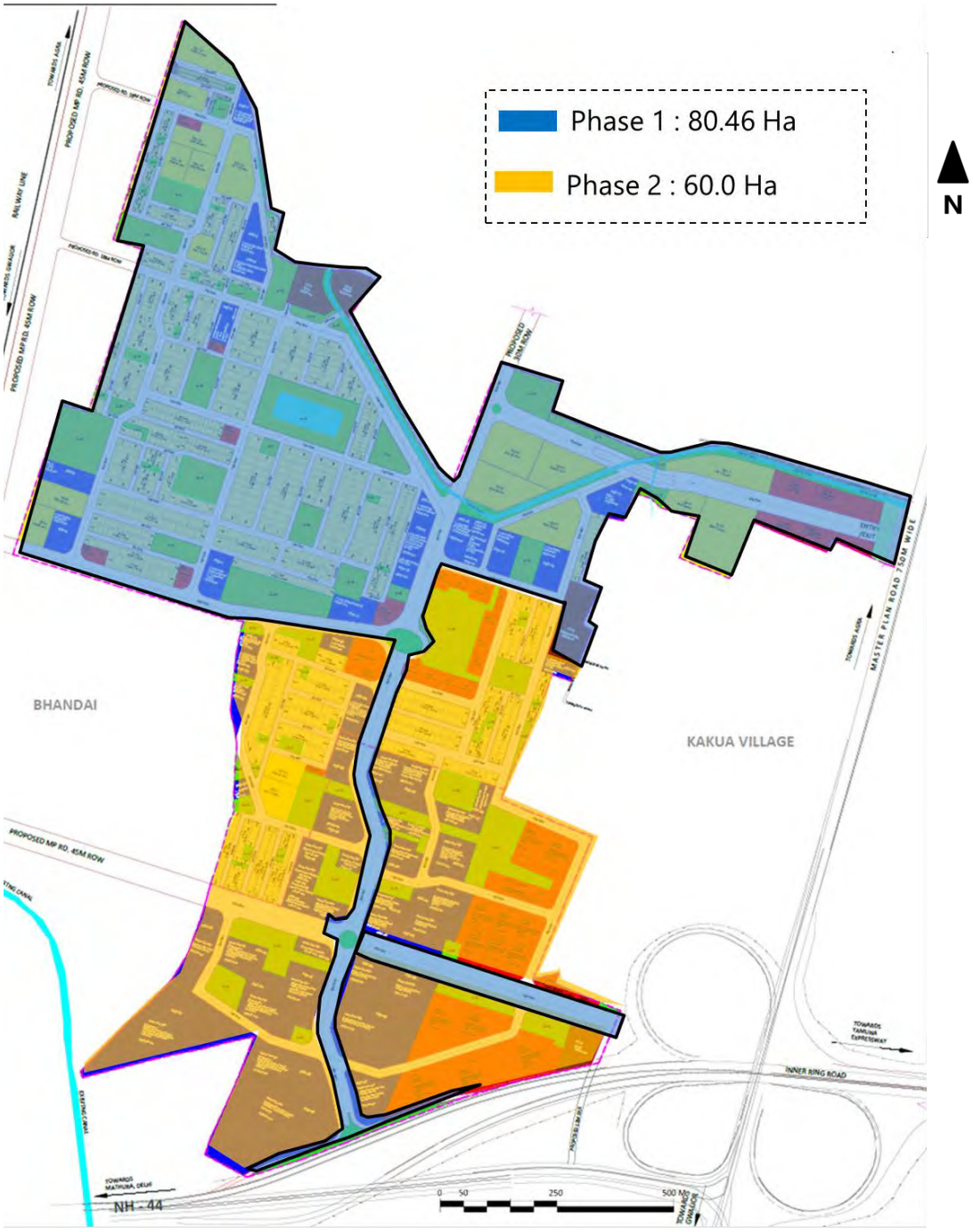
A contiguous land parcel of approximate 140.5 Ha has been acquired by ADA for the project in the Kakua Bhandai village area. A detailed layout plan has been prepared and sanctioned by Agra Development Authority for the Atal Puram Township site.

The approach road to the site is from the Agra Gwalior Road located on the eastern side which provides optimal accessibility for through movement of traffic from Agra. The Site has direct access to the Agra bypass road from the southern side. Additionally, there is an egress point on to Agra Bypass Road which facilitates the movement towards Agra city through the proposed LVUP.

Map 3: Detailed Layout Plan

1.4 Development Phasing

The contractor will undertake the development of the site as per the below phasing plan. The total time for completion of the project (both phases included) will be 30 months from the start date.



Map 4: Atal Puram Development Phasing

Chapter 2: Site Grading

2.1 Introduction

Site levelling and grading works to be done considering balanced cut & fill up to possible extent to minimise the borrow earth from the outside of site.

Cutting and filling quantities to be finalised after adjustment of earthwork for roads, plot areas excavation. Filling quantities will be calculated on the total earth volume taking into consideration after deducting the earth scrubbing, vegetation and bulkage factor during compacted fill.

2.2 Grading Strategy

The grading of Atal Puram Township will be done in such a way, so as to allow maximum percolation of water into the ground and reducing amount of surface water runoff into the outfall drains/ nalas.

This will be achieved through detention ponds provided within each neighbourhood level parks and the large detention pond within the central green area.

Parks are proposed within each neighbourhood, which will have a detention pond to hold the excess water during heavy rains. All the run-off from the surrounding areas of these parks will be first collected in these ponds and the excess water will flow into the drains. These ponds will not have water during dry seasons.

The site slopes from south to north. The highest level is at 168.5m along the Agra Bypass and lowest level is at 162.0m near the natural drainage channel passing through the site. It is a relatively flat site with a gentle slope.

The drainage network will be designed in such a manner that looking from south to north, the left side of the central 36.0 m ROW will first drain and collect into the central detention pond, and when the pond reaches it's capacity, it will overflow into the natural drain/nala. The right side of the central 36.0m ROW will drain directly into the natural drainage channel flowing through the site.

This method of creating detention ponds at regular intervals will increase the percolation and help in recharging the ground water. It will also control the run off into the drains and reduce the chances of flooding and water logging.

The table below shows the net quantity of cutting required to achieve the desired drainage system. This quantity will be further revised and optimized once the road finished levels and drain invert levels are finalized. As of now the average cutting and filling is around $\pm$2.0m, which will be further reduces.

Table 1: Site Cut-Fill Summary

Description	2D area Sqm	Cut (Cu.M)	Fill (CuM)	Net
Site grading for Atal Puram Township	1384963.39 Sqm	483952 Cu.M.	470681 Cu.M.	13271 Cu.M.<Cut>

Map 5: Site Grading Plan

Chapter 3: Storm Drain Network

3.1 Introduction

Based on the topography of the site a comprehensive Storm Drain system is proposed. The runoff generated from the plot shall be conveyed through a drains to the main sewer line by gravity and discharge in to the natural drainage system i.e the nearby existing drain.

3.2 Existing Drainage System

At present the entire storm runoff generated is discharge into the existing drain running along the boundary of the project area In the north. At present, existing drain is receiving runoff from the adjoining field, which contains the nutrients and support in the eutrophication. The drain is also associated with the dumping of waste and need to be dredged up to the bed level. The existing drain runoff from the north to eastern side of the project area along the boundary. Some of the photo of the existing drain depicts the actual scenario.

Figure 1: plantation in the drain

Figure 2: Solid waste dumped in the existing drain

As the project area is open field and does not have habitation, internal drains does not exists in the project.

3.3 Design Brief

The gravity drainage system is mainly considered because it gives better results and also incurs less capital and operational costs. The collection system will be designed based on CPHEEO manual and using Sewer CAD software.

3.3.1 Drains

For design purposes, runoff for the drains is presumed to be steady and uniform. The drains are aligned with positive slopes as much as possible and follow the gravity flow. As a design practice, the Manning's equation to be used to model flows in sewers, which are assumed to be open channel flows. Manning's equation is popular due to the ease of manipulation and because it can readily be expressed in graphic form as design charts.

3.3.2 Design formula

Manning's formula shall be adopted for the design of gravity sewers. Were,

V = velocity in m/sec in partial flow conditions

N = Manning's roughness coefficient

R = Hydraulic radius (m)

S = Hydraulic gradient

Q = Flow rate m^3/sec

A = Cross sectional area (m^2)

The values of Manning's Roughness Coefficient (n) for various drains materials are given in the table below.

Table 2: *Roughness Coefficient Considerations*

Pipe Channel	Roughness Coefficient, n
Cement concrete, with collar joints, good	0.013
Cement concrete, with collar joints, fair	0.015
Concrete, spun with socket-spigot joints (RCC and PSC)	0.011
Steel, welded	0.013
Steel, riveted	0.017
Steel, slightly tuberculate	0.020
Steel, spun cement mortar lining	0.011
Cast Iron, unlined	0.013
Cast Iron, spun cement mortar lining	0.011
Plastic (PVC) smooth/ DWC Pipes	0.010

Source: CPHEEO Manual

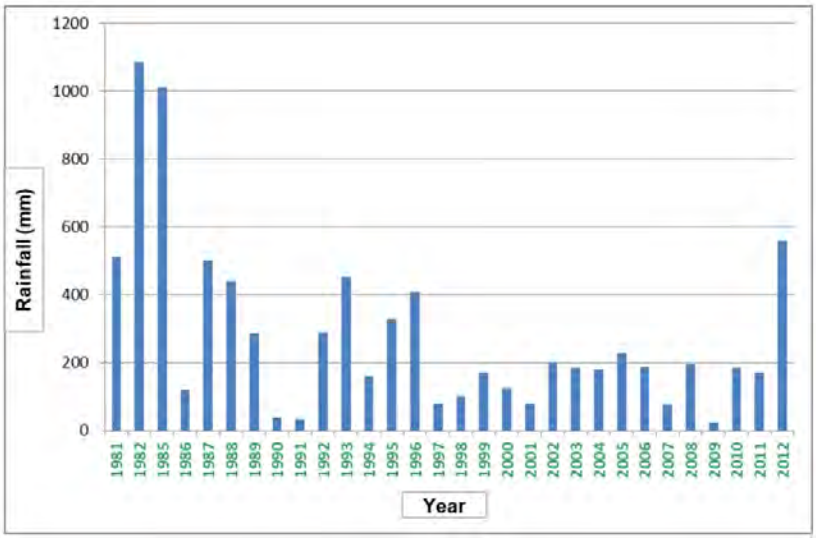
3.3.3 Minimum and Maximum Velocity

To maintain self-cleaning velocities in the drains, it is usual practice to maintain a minimum velocity of 0.6 m/sec i.e. Self-cleaning velocity is to be provided.

To avoid scouring and erosion of sewer pipes caused by sand and other gritty material the maximum velocity in gravity sewers is recommended not to exceed 3.0 m/sec, as per section 3.15.3 of the CPHEEO Manual.

3.3.4 Rainfall Analysis / Interpretation

The rainfall data available for Agra for 24-hour rainfall depth for a period of 30 years (1981 to 2012) were used for the past 30 years and is furnished below.



Rain fall has exceeded the average rain fall for about 9 years and for major periods the annual rain fall is below average. To generate IDF curves and for forecasting the rain fall intensities for various return periods, the following statistical methods are adopted.

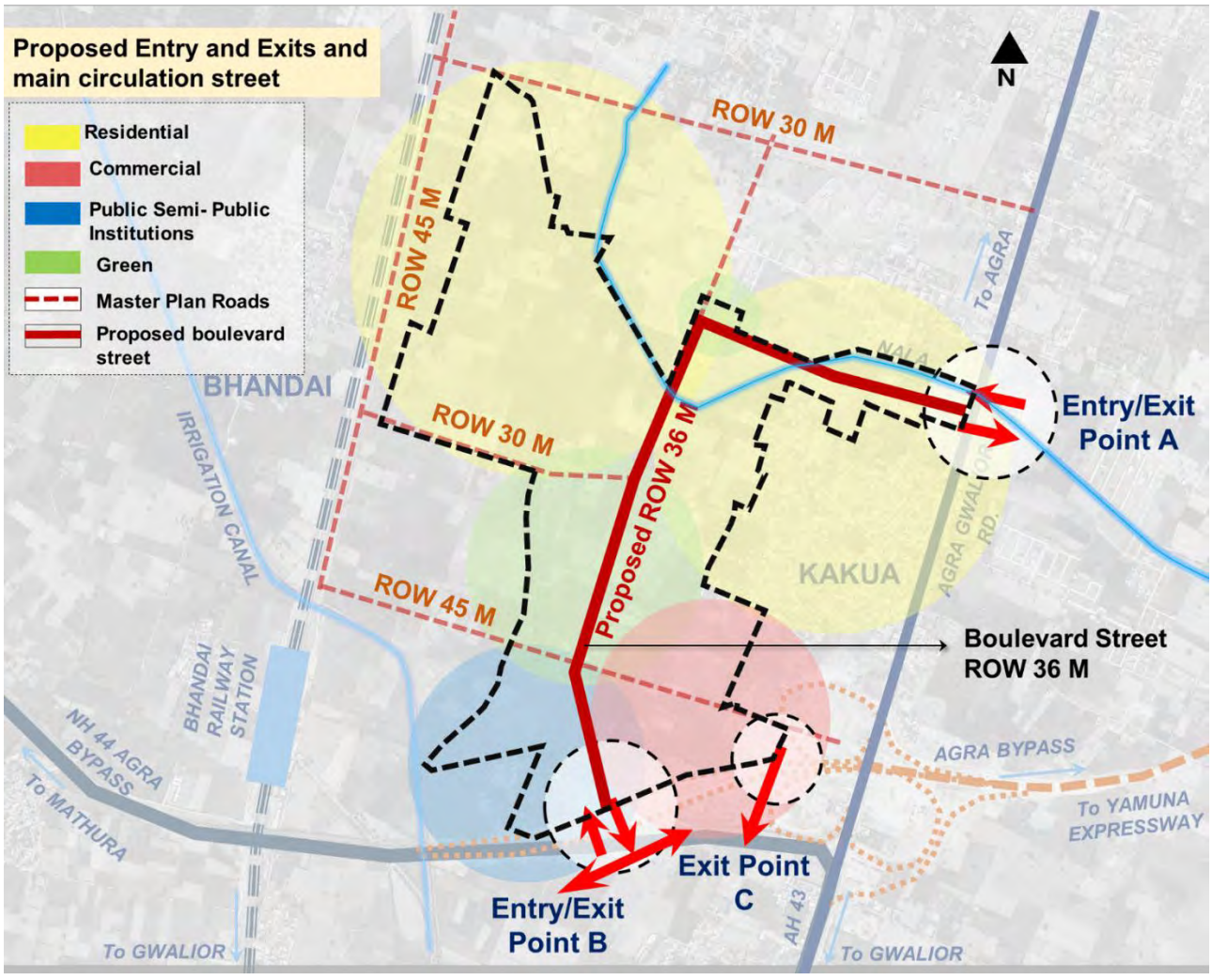
• Method based on Least Squares Principle • Annual exceedance with IMD 1/3rd Rule Method & Gumbel's equation

Minutes Return Period	
Minutes	**2 Year**
5	145.5
10	91.6
15	69.93
20	57.73
25	49.75
30	44.05
35	39.74
40	36.37
45	33.63
50	31.34
55	29.41
60	27.77

Chapter 4: Roads

4.1 Classification of Roads in the Township

The Atal Puram Township Site has its major ingress/egress facilitated from the Agra Gwalior Road mentioned as Point A in the map below located on the eastern side which provides optimal accessibility for through movement of traffic from Agra. The Site has direct access to the Agra bypass road mentioned as Point B in the southern side. Additionally, there is an egress point C which facilitates the movement towards Agra city through the proposed local vehicle underpass thus ensuring optimal movement to the city destined traffic.



Map 6: Index map and Proposed Entry / Exit of the Township

Basic classification of the roads in the township is in 6 levels where the road network comprises of 24.44% of the total site area. As described earlier, the proposed roads in the site are planned to further facilitate and integrate with the roads depicted in the Draft Agra master plan 2031. The Kakua Bhandai Township has 22771.4 m (22.771 km) of total road length. The Site comprises of 45 m ROW Arterial Road which constitutes 9.57% of the total road network. It runs along the railway line, and further connects to another 45m ROW road that crosses the

site. It connects to the main boulevard street having 36 m ROW that runs along the site. It acts as a central axis road constituting 21.54% of the road network. On the Northern side, the Central spine of the township is connected by the 30m ROW Sub Arterial Road which constitutes 5.97% of the total road network. Further, the township has roads of 18m ROW along the residential zones which constitute 33.90% of total road network. Local roads of 12m ROW comprise of 11.05% of road network. Other roads of 9m ROW comprise of 16.50% and 7.5 m ROW of 0.57 % of road network.

Two entry/exit point has been proposed on south side with existing NH as well as at north side of the project boundary with Existing Agra Gwalior Road which is indicated as Point A and point B in the index map. One exit has also been proposed which is marked as point C in index map.

4.2 Detailed Road Network with Road Sections

The following road sections have been proposed within the township. The proposed typical cross section (TCS) is marked below.

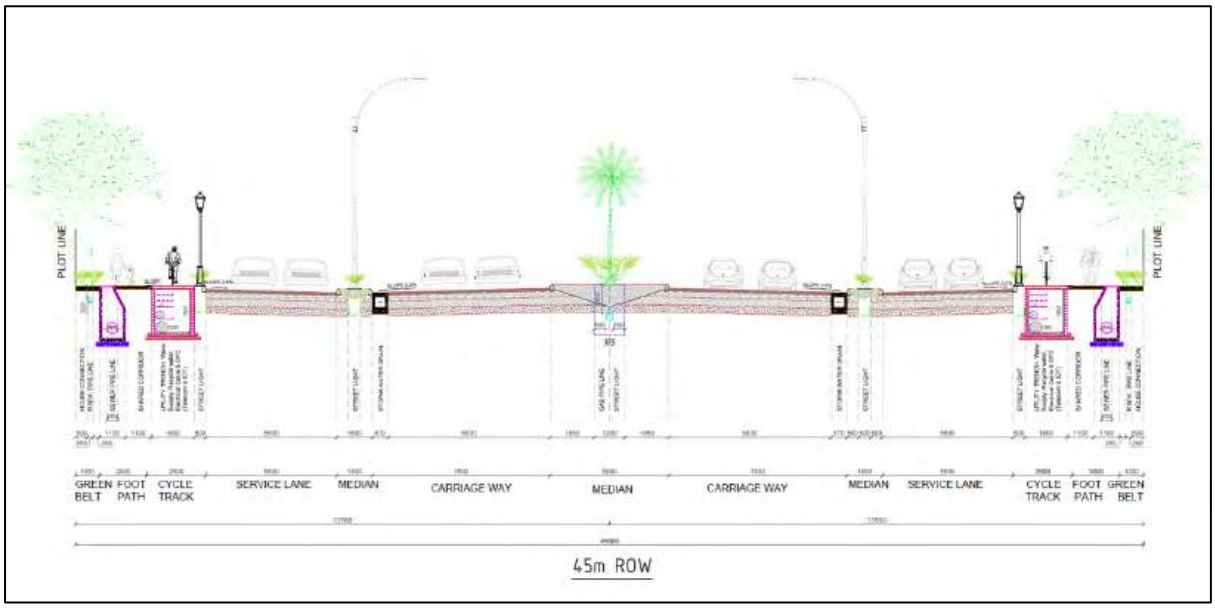


Figure 3: Road section- 45 M ROW

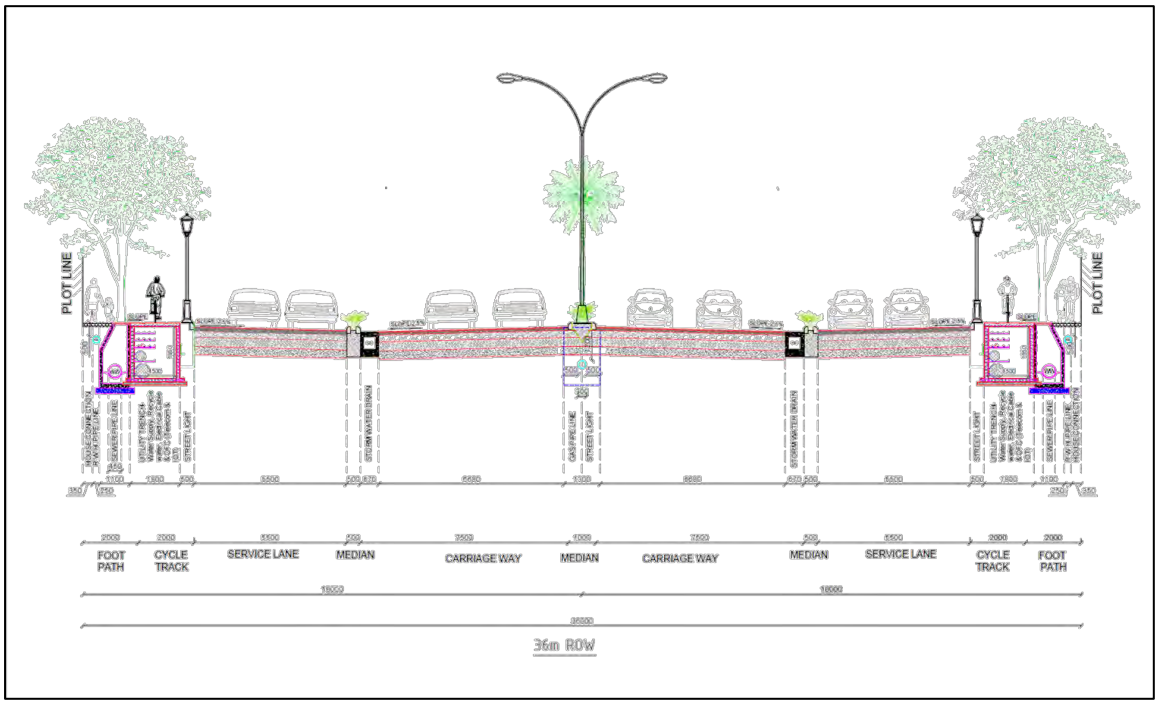


Figure 4: Road section- 36 M ROW

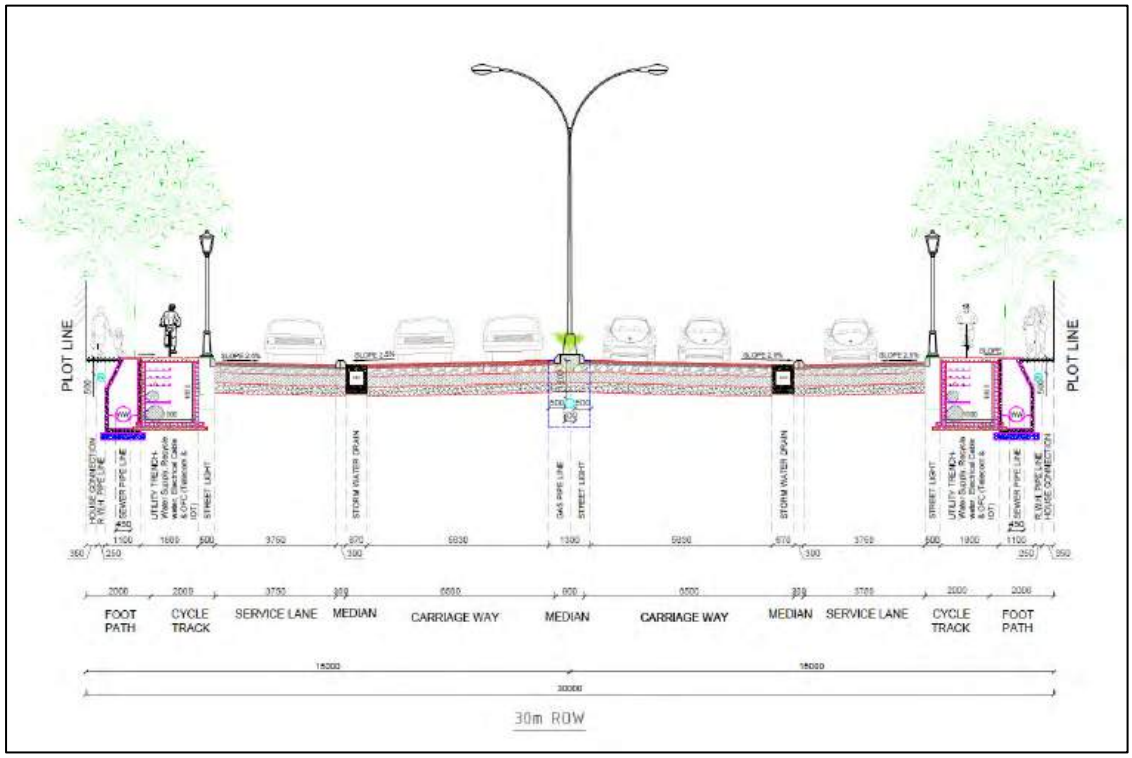


Figure 5: Road Section - 30 M ROW

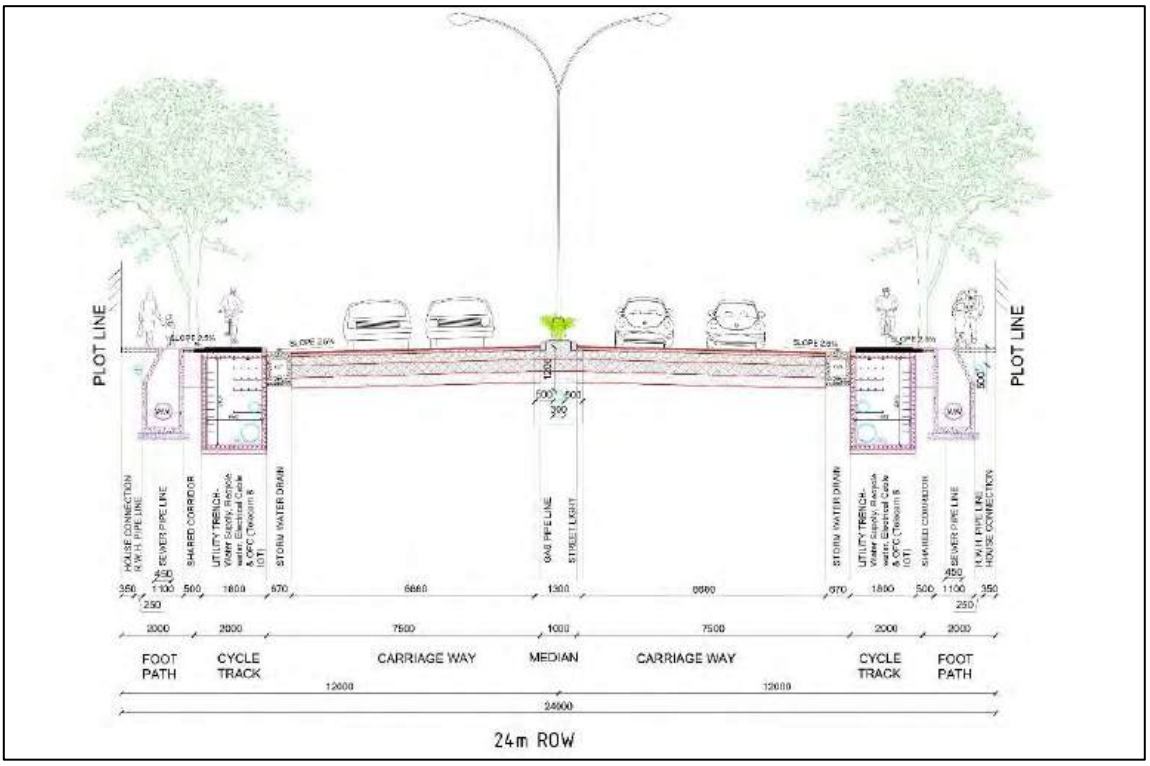


Figure 6: Road Section - 24 M ROW

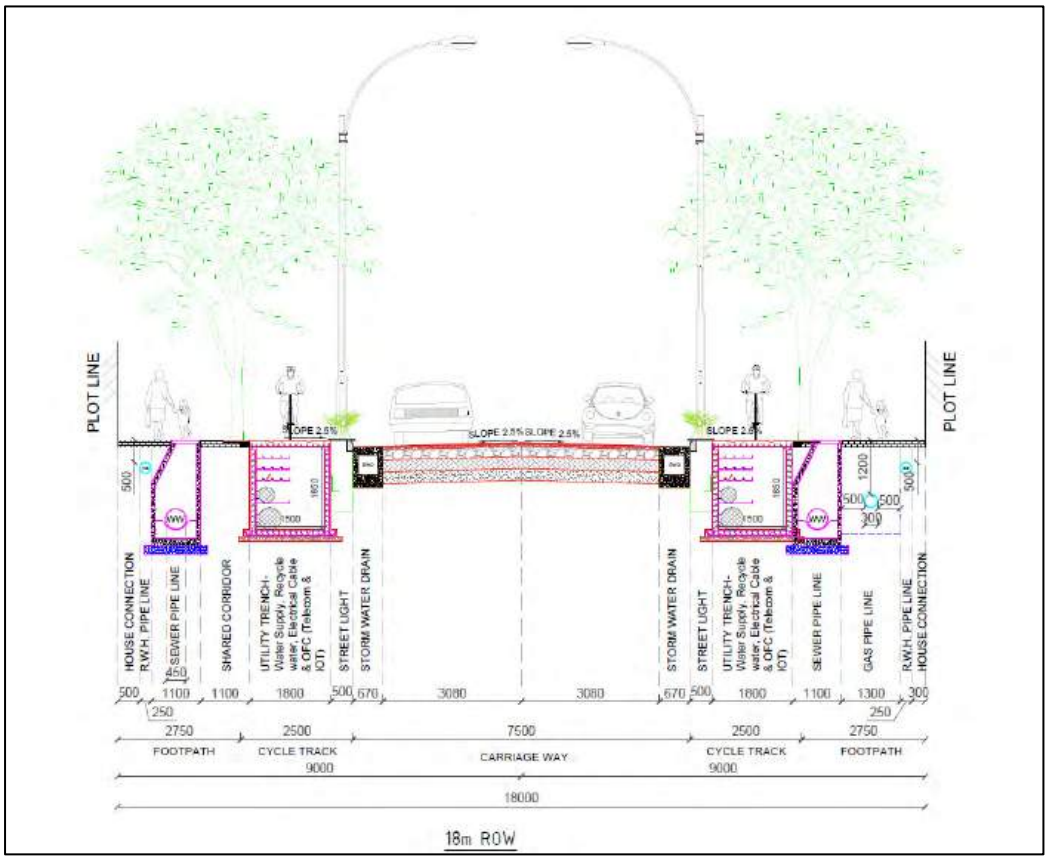


Figure 7: Road Section - 18 M ROW

Figure 8: Road Section – 12 & 9 M ROW

4.3 Road Classification

Five categories of roads are provided as below

Table 3: Categories of Road

Type of Roads	ROAD WIDTH	ROAD LENGTH (M)
Entry Road from South	7.0 M ROW	500.00
Other Road	7.5 M ROW	297.27
Collector Road - Type 1	9.O M ROW	7134.06
Collector Road - Type 2	12.O M ROW	3582.84
Collector Road - Type 3	18.O M ROW	7328.29
Sub arterial Road	30.O M ROW	774.00
Arterial Road Type 2	36.O M ROW	2327.76
Arterial Road Type 1	45.O M ROW	827.19
TOTAL		22771.40

4.4 Brief Design Standard

Table 4: Brief Design Standard

Geometric parameters	**Internal Roads**				
	Generally followed			Exceptions	Remarks
Design speed (kmph)	60 kmph			20 kmph	Exceptional speed is applicable at junctions
	40 kmph				
	30 kmph				
Min. horizontal radius (m)	Design Speed	Radius		Radius	
	(kmph)	(m)		(m)	
	60	150		20m	Exceptional radius is applicable at junctions
	40	70			
	30	40			
	20	20			
Cross-fall / Camber (%)	2.50%			-	-
Super-elevation (%)	4.00%				-
Maximum Longitudinal gradient (%)	4%			-	-
Minimum Longitudinal gradient (%)	0.20%			-	-
Minimum "K" for vertical curve	Design Speed	min k for stopping sight distance		-	-
	(kmph)	crest curve	sag curve	-	-
	60	26.7	15	-	-
	50	15	10	-	-
	40	8.4	6.6	-	-
	30	3.8	3.5	-	-
Carriage way width (m)	3.5m (single Lane) 7.0m (2-Lane) 14.0m (4-Lane)			-	-

	21.0m (6-Lane)		
Extra Widening (m)	1.5m to 0.6m	-	-
Codes and Manual	IRC-86-2018, IRC-SP23, IRC-37:2018, IRC SP-84: 2019, IRC-58:2015, IRC-2, AASHTO, IRC- 106:1990		

4.5 Design Basis, Standards and Specifications:

Details	Code name
	IRC: 86-2018 Geometric design standard for Urban roads and street
	IRC: 73-1973 Geometric design standard for rural highways
	IRC: 38 Guidelines for the design of horizontal curve
	IRC: 23 Vertical curves for highways
Pavement Design	Overlay & strengthening
	IRC 115-2014 for designing and strengthening requirements of existing pavement
	New Pavement
	IRC:58-2015 for design of rigid pavements
	IRC 37-2018 for design of flexible pavements
Traffic analysis	IRC: 64-1990 Guideline for capacity of roads in rural areas
	IRC:106-1990 Guideline for capacity of roads in urban areas
Drainage Design	IRC: 42 2014 Guidelines for road drainage
	IRC: 50-2013
Rotary design	IRC 65-1976
Road Delineator	IRC: 79-2019 Guidelines for road delineator
Interlocking block pavement	IRC: SP: 63-2018 Guidelines for the use of Interlocking block pavement
Cycle track	IRC: 11-2015 Recommended practice for design and layout of cycle track
Road Furniture & Roadside Facilities	IRC: 67-2012 Code of Practice for Road Signs
	IRC: 35-2015: Code of Practice for Road Markings

Details	Code name
	Related standards of IRC Manual of Specification &MoRT&H publications

4.6 Finalization of Road levels

→ Road levels at various cardinal points are fixed after reviewing the storm water drainage levels at various outlet points and finalised above the same.

→ Efforts has been made to optimise cut fill earthwork quantities in accordance with land grading.

4.7 Horizontal Alignment

The horizontal alignment is designed with design speed adopted in concept design for different category of roads by considering maximum 4% Super elevation. However, at few locations design speed corresponding to its respective type could not be maintained due to site constraints.

Table 5: Designed Horizontal Alignment (Minimum Radius)

Design Speed (kmph)	Radius (m)
80	265
60	150
40	70
30	30

Source: IRC Manual

4.8 Vertical Alignment

The terrain is partly rolling and partly flat. Vertical alignment is designed with minimum road gradient required at flat surface, for storm water drainage. Min K value is adopted for design vertical curves corresponding to design speed.

Table 6: Designed Vertical Alignment

Design Speed (kmph)	**crest curve**	**sag curve**
	min k for Intermediate sight distance	min k value
60	26.7	15
40	8.4	6.6
30	3.8	3.5

Source: IRC Manual

Minimum longitudinal grades to be considered as 0.2% based on AASHTO provisions to keep cut-fill economical.

Vertical curves should be provided at all grade changes exceeding those indicated in below mentioned table. As per clause 9.3 of IRC 86-2018 The minimum lengths of vertical curves for satisfactory aberrance and maximum grade change without a vertical curve is also given in below mentioned table.

Table 7: Minimum Length of Vertical Curves for satisfactory aberrance

Sl no	Design speed	Maximum grade change (%) not require da vertical curve	Minimum length of vertical curve (m)
1	20	1.5	15
2	30	1.5	15
3	40	1.2	20
4	50	1	30
5	60	0.8	40
6	70	0.6	50
7	80	0.6	50

Source: clause 9.3 of IRC 86-2018

Minimum longitudinal grades to be considered as 0.2% based on AASHTO provisions to keep cut-fill economical. Efforts have been made to keep the grade line smooth that matches with the character of the terrain.

4.9 Camber/ Cross Fall

To facilitate efficient disposal of rainwater from the surface, suitable cross fall shall be provided as per IRC 86. The cross-fall details for various surface of roads are listed below in the following table.

Table 8: Cross Fall

Surface Category	Cross Fall (%)
Bituminous	2.5%
Cement Concrete	2.0%
Granular/ Earthen Shoulder	2.5%/ 3.0%

4.10 CBR of existing sub-grade soil

For the determination of CBR values of existing soil sub-grade, three different compaction energy levels were employed, using dynamic compaction by 10 blows, 30 blows and 65 blows with a rammer of 4.89-kg in weight, while remolding the test specimen. OMC, whichever was

higher, was maintained while remolding the test specimens. Penetration test was conducted on test specimens, using CBR testing machine after completion of immersion in water for a period of 4 - days. Surcharge weight of 12.5 kg was kept throughout on the specimen during testing. CBR values were determined corresponding to 2.5 mm and 5.0-mm penetrations. A correlation between the dry densities (obtained corresponding to different levels of compaction) and 4-days soaked CBR value was established. CBR value against observed field dry density was thus determined for the sub-grade soil taken from test pits. The computed CBR values are included in the same attachment. Value ranges from min 10.42% maximum16.67%.

4.11 Pavement Design

Trial pits was excavated within the site. CBR Values have been considered for pavement design from the test result of the soil taken from trial pits. Value ranges from min 10.42% maximum16.67%. Pavement will be designed considering the min value of CBR Value of 10%.

Flexible pavement is proposed for all the roads in the project.

4.11.1 General

The proposed pavement on the project stretch is mainly flexible in nature. The general design Procedure for the flexible pavement for the proposed road as new construction of whole stretch as per the guidelines of IRC: 37-2018 – “Guidelines for the design of Flexible Pavements”.

New pavement design is based on the design traffic (MSA) and the subgrade strength (soaked CBR).

4.11.2 Methodology of Pavement Design

The flexible pavements are usually referred as a layered structure comprising generally bituminous surface like Bituminous Concrete (BC) and Dense Bituminous Macadam (DBM), Wet Mix Macadam (WMM) base and Granular Sub-Base (GSB) course of finite thickness, resting on subgrade of minimum thickness of 500 mm. The thickness design of these layers principally depends on the subgrade CBR and the traffic loads that the pavement has to carry during its design life. Ideally, the flexible pavement is built to such a depth that stresses on any given layer should not cause unwarranted rutting, fatigue, shoving, or other differential movements which may result in an uneven wearing surface. The chief function of the surfacing course is to provide a smooth wearing surface, resistant to traffic. However, the wearing course can provide some shearing resistance to the base structure and some added resistance to deformation.

Base courses are usually layers of aggregates that must possess high resistance to deformation in order to withstand the higher pressures imposed by wheel loads. High –quality processed aggregates are usually required, which also provide good internal drainage sub bases and generally made up of locally available aggregates, satisfying codal specification/requirements.

The design methodologies widely used for the flexible pavement design are Indian Road Congress (IRC) method, AASHTO methods and Asphalt Institute Method. For this project latest IRC (IRC:37-2018) method is used for designing the flexible pavement.

4.11.3 Design of New Flexible Pavement

IRC: 37-2018 method is adopted for the design which is based on the empirical – analytical approach, and provides catalogues for design of flexible pavements. The design inputs required for pavement design are explained as follows.

Design Theory

The pavement design method is based on elastic response of the pavement to traffic stresses (i.e. each of the materials in the pavement structure behaves in an elastic manner). The materials in the pavement are characterized by parameters whose values are determined from field and laboratory testing. The method assumes that failure will not occur as a result of permanent deformation of granular or bound materials (and this assumption will be valid as long as good construction procedures are followed, and the pavement is not subjected to very high wheel loads such as can be caused by a very heavily overloaded vehicle). The method also assumes that loss of pavement serviceability can occur due to:

- fatigue of bitumen bound or cemented layers due to repetitions of tensile strains at the bottom of such layers; and/or
- Permanent deformation of the sub-grade due to repeated vertical compressive strains induced in the sub-grade

The critical locations for pavement failure are therefore the bottom of bitumen bound layers (where tensile strains occur) and the top of the sub-grade (where compressive strains occur).

The base course and sub-grade are structural elements of the pavement. In conjunction with the overlying bituminous surface, their purpose is to distribute traffic wheel loads over the whole foundation. To perform this function, we build the base course and sub-grade with the necessary internal strength properties.

Bituminous pavement layers have both tensile and compressive strength to resist internal stresses. For example, the figure below shows how wheel load (W) slightly deflects the pavement structure, causing both tensile and compressive stresses within the pavement.

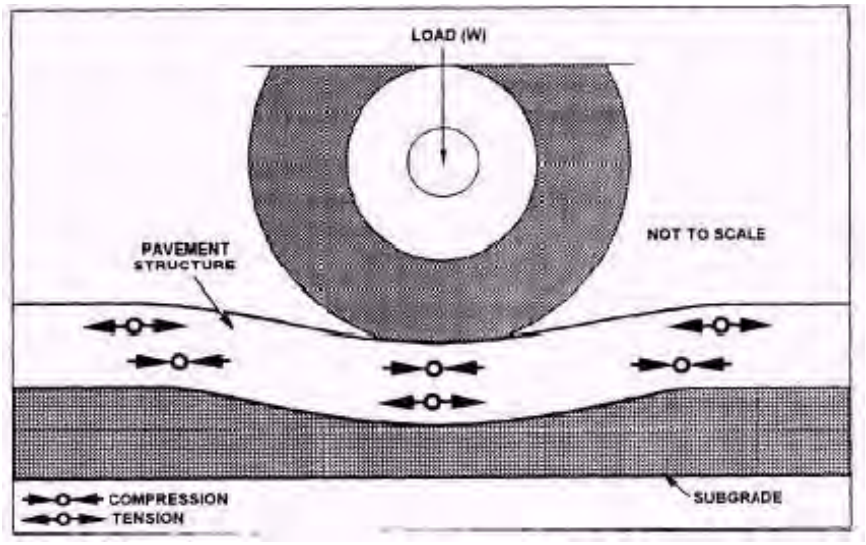


Figure 9: Pavement Deflection Results in Tensile and Compressive Stresses in Pavement Structure

Required total thickness of the pavement layers is determined by engineering design procedure. Factors considered in the procedure are as follows:

- Traffic to be served initially and over the design service life of the pavement
- Strength and other pertinent properties of the prepared sub-grade
- Strength and other influencing characteristics of the materials available or chosen for the layers (or courses) in the total pavement structure
- Special factors such free swelling property of existing soil

Design of New Flexible Pavement

Design of new pavement has been carried out based on IRC 37-2018 “Guidelines for the Design of Flexible Pavements” for design life of 30 years. Procedure for the same is given below:

Step 1: To find out initial traffic in the year of completion of construction in terms of the number of the number of commercial vehicles per day (CVPD)

Step 2: To determine traffic growth rate factor by studying the past trends of traffic growth

Step 3: Design life of Pavement

Step 4: To find out Vehicle Damage Factor to convert the number of commercial vehicles of different axle loads and axle configuration to the number of standard axle load repetition. It may be obtained by conducting axle load survey at site.

Step 5: To find out lane distribution factor of traffic over the carriageway

Step 6: To determine design traffic in cumulative number of standard axles (msa) by the following formula mentioned below:

$N= [365 \times \{(1+r)^n-1]/r\}] \times A \times D \times F$

Where,

N = Cumulative number of standard axles to be catered for in the design in terms of msa

A = Initial traffic in the year of completion of construction in terms of number of commercial vehicles per day in each direction

D = Lane Distribution Factor

n = Design life in years = 30 years

r = Annual growth rate of commercial vehicles

F = Vehicle damage factor

Design Period

Pavement design life is the period for which the initial design of pavement crust layers shall be designed. Design life should not be referred as terminal stage of crust beyond which crust becomes unusable. A design life of 30 years for flexible pavement has been considered for the design purposes.

Lane Distribution Factor:

As per clause 4.5 of of IRC: 37-2018, Lane distribution factor is described below:

Two-lane two-way roads

The design should be based on 50 per cent of the total number of commercial vehicles in both the

Dual carriageway roads

The design of dual two-lane carriageway roads should be based on 75 per cent of the number of

commercial vehicles in each direction. For dual three-lane carriageway and dual four-lane

carriageway, the distribution factors shall be 60 per cent and 45 per cent respectively.

Traffic Growth Rate:

The Traffic Growth rates taken into consideration for the study as per clause 4.2.2 of IRC 37-2018

Step 7: To determine total pavement thickness and crust composition by charts/graphs with respect to CBR and cumulative number of standard axles.

For 45 m,36 m 30 m ROW, the Cumulative Number of Standard Axles considered for design is = ***20 msa.***
For 18 m,12 m, 9 m,7.5 m ROW, the Cumulative Number of Standard Axles considered for design is = ***10 msa.***

Considering minimum 10% CBR value, the pavement composition as per Figure 12.6 (plate 6) of IRC 37-2018 is stated below:

Table 9: Pavement Composition

Pavement Layers		
	20 msa	10 msa
BC	40	30
DBM	70	50
WMM	250	250
GSB	200	200

4.12 Bridges and Culverts:

Wherever Existing Water Channel Crossings will require, minor bridges have been proposed. Culverts to be proposed at cross drainage and near outlet points. Total 51 nos. culvert has been proposed.
Two No's LVUP (Light vehicular Underpass) with lateral width 12m and vertical clearance 4.5 m have been proposed for the tertiary exit. The detailed structure list is attached below

Sl. No	**Design Chainage (km)**	**Span Arrangement (m)**	**Width (m)**	**Road no**	**Type of Structure**	**Recommendation**
1	0+300	1 X 10	65	R36-04	Minor Bridge	New Construction
2	0+256	1 X 10	24	R18-13	Minor Bridge	New Construction
3	0+291	1 X 10	37	R36-03	Minor Bridge	New Construction
4	0+105	1X12X4.5	15.1	R12-01	LVUP	Reconstruction-(culvert)
5	0+140	1X12X4.5	15.1	R12-01	LVUP	Reconstruction-(culvert)

4.13 Intersections

Since, anticipated traffic volume is high in this kind of area development project the smooth traffic movement prevails over high speed, all the intersections are kept at grade only. Thus, the basic requirements for the design of intersections in this case was to cater to safe movements for the traffic and to provide them full traffic information by way of traffic signs, pavement markings and traffic signals, if required in future. Further, simplicity and uniformity has been considered as the guiding principles for intersection design and to ensure the safe passage of movements.

Though IRC-SP: 41-1994 give the monogram for warrants for the different types of at-grade or grade separated intersections, these warrants are based upon the traffic volumes on each of the two intersecting roads. The type of intersection to be provided shall be based on these

IRC guidelines. Similarly warrants given in the "Type Designs for Intersections on National Highways" published by the MORT&H has also been taken into consideration for the design of intersections. However, looking at the very high level of traffic the at-grade intersections have been categorized in two types:

- Intersections within the sub-links
- Intersections of sub-links with the main link.

4.13.1 Type of intersections

The following types of junctions have been identified:

- 3-Arm Junctions
- 4-Arm Junctions
- Rotary intersection

4.13.2 Classification of intersections

The following features have been included in the junctions:

- Initially, all junctions shall be of non - signalized type. Later, they can be converted to signalized junctions in due course as traffic volumes grow without any major changes in the layout of the curves and islands.
- Pedestrian crossing (Zebra Crossing) will be marked.
- Turning arrows will be marked.
- Centre lines and lane lines will be demarcated.
- Traffic safety aids such as studs (cluster of red reflectors) shall be provided at nose of islands and rotary islands.
- Traffic signs shall be installed.
- For all junctions the turning radius is kept as 15 m.

4.13.3 Design of rotary intersection

The proposed rotary has been designed as per clause 5.1 to 9.2 of IRC 65-1976.

The basic design parameters are given below:

Table 10: Rotary Design Parameters

Sl no.	Details	Value
1	Radius of central Island	1.33 time of radius of entry
2	Radius of the inscribed circle	Radius of central island +Weaving width
3	Rotary design speed (minimum)	30 kmph
4	Suggested value for Radius at entry	15-25 m
5	Width of entry	7.0 to 10.5 m
6	Width of exit	7.0 to 10.5 m

Sl no.	Details	Value
7	Minimum Width of Non weaving section (circulation width)	7.0m
8	Width of weaving section	One traffic lane wider than entry width
9	Minimum Length of weaving section	30 m (for 30 kmph design speed)
10	Capacity of rotary	<3,000 nos. per hour Justifying the provision of rotary as per Clause 3.3 (c) of IRC:65-1976

Source: Clause 5.1 to 9.2 of IRC 65-1976

A typical drawing for rotary is attached below. The drawings two proposed rotary of Internal Road with SH-51 is also attached.

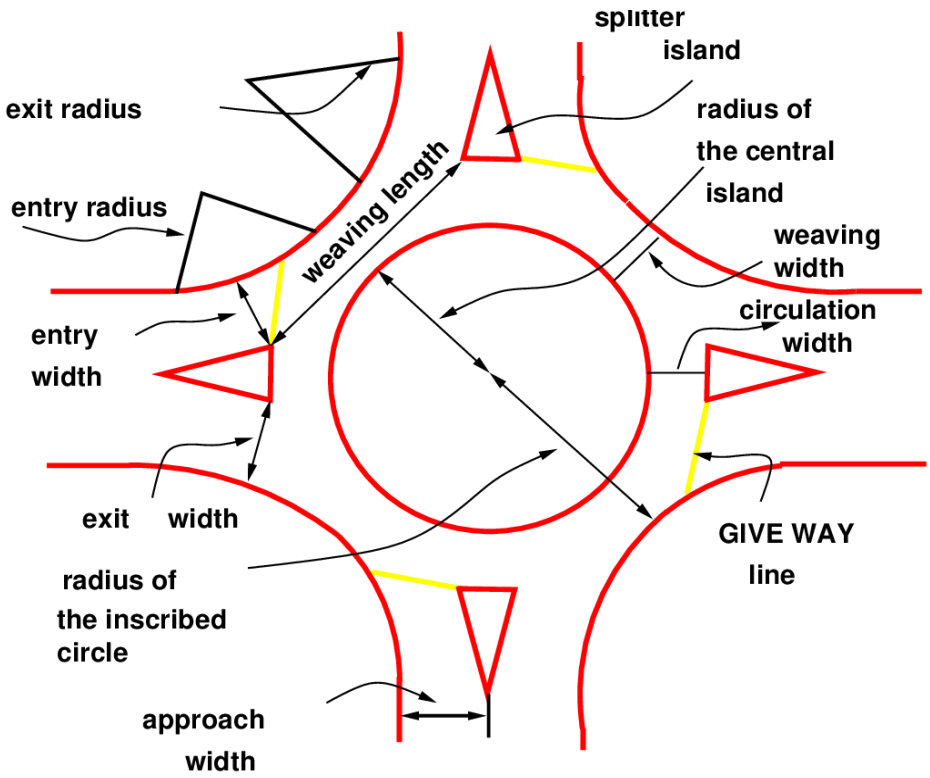


Figure 10: Typical Drawing for Rotary

Source: IRC 65-1976

4.14 Sight Distance

Sight distance is required for the safe movement of traffic on road and at intersections. The driver's ability to judge the hazard of entering intersection is very much enhanced as the visibility is increased by removal of obstructions falling in the line of sight.

Improvements to sight distance have been imparted by making the corners of the property lines circular parallel to the radius of the outer line of the carriageway or by giving green strip between carriage way and plot lines.

Chapter 5: Potable Water Supply System

5.1 Potable Water Supply System

This section summarizes the detailed design for the proposed potable water supply system, designed to supply adequate quantity and quality of water at desired locations, in an economical and sustainable manner.

The potable water shall be supplied to each plot by pumping from Semi Underground Tank. The pumping system is considered because it rejects the need of regular proper maintenance of Overhead Tank and running cost. The following are the various tasks carried out while preparing the Detailed Project Report of the Potable water supply system.

- Water demand calculation
- Planning, zoning and Network
- Design parameters
- Hydraulic Design criteria
- Detailed Designs

5.2 Water Demand Calculation

Based on available guidelines and process demand requirements, potable water demand has been estimated.

The water demand is estimated based on proposed land use, built-up area and the population proposed. These demands have been derived from the CPHEEO Manual and NBC Guidelines. Provision for assured water supply is vital for achieving sustainability in site.

Table 11: Water Demand Calculation

S. No.	Land Use	Working / Residing Population	Floating population	Total Population	Potable (KLD)	Flushing (KLD)	Total Domestic Water (KLD)
	Plotted Development						
1	25-50 sqm	795	80	875	71.95	36.57	108.52
3	51 - 150 sqm	4780	478	5258	432.59	219.88	652.47
4	151 - 300 sqm	10480	1048	11528	948.44	482.08	1430.52
5	301 - 400 sqm	2440	244	2684	220.82	112.24	333.06
6	401 - 500 sqm	2875	288	3163	260.19	132.25	392.44
7	501-600 sqm	625	63	688	56.56	28.75	85.31
		21995	**2200**	**24195**	**1990.55**	**1011.77**	**3002.32**

S. No.	Land Use	Working / Residing Population	Floating population	Total Population	Potable (KLD)	Flushing (KLD)	Total Domestic Water (KLD)
	Group Housing						
GH-1	Group Housing	1414	141	1556	127.99	65.06	193.05
GH-2	Group Housing	2310	231	2541	209.05	106.26	315.31
GH-3	Group Housing	556	56	612	50.32	25.58	75.89
GH-4	Group Housing	1262	126	1388	114.23	58.06	172.29
GH-5	Group Housing	1449	145	1594	131.13	66.65	197.78
GH-6	Group Housing	1451	145	1596	131.31	66.74	198.05
GH-7	Group Housing	1045	104	1149	94.53	48.05	142.57
GH-8	Group Housing	629	63	692	56.90	28.92	85.82
GH-9	Group Housing	664	66	730	60.09	30.54	90.64
GH-10	Group Housing	358	36	394	32.44	16.49	48.93
GH-11	Group Housing	561	56	618	50.81	25.83	76.64
GH-12	Group Housing LIG	565	57	622	51.17	26.01	77.18
GH-13	Group Housing LIG	1678	168	1846	151.89	77.21	229.10
GH-14	Group Housing LIG	654	65	719	59.14	30.06	89.20
GH-15	Group Housing LIG	785	79	864	71.06	36.12	107.18
GH-16	Group Housing EWS	1353	135	1488	122.45	62.24	184.68
GH-17	Group Housing EWS	1280	128	1408	115.82	58.87	174.69
GH-18	Group Housing EWS	2000	200	2200	180.97	91.99	272.96
		20014	**2001**	**22016**	**1811.30**	**920.66**	**2731.96**
	Total Residential						
	Commercial				1442.51	594.77	2037.28
C-1	Kiyasath Booth	13	132	146	0.99	1.59	2.58
C-2	Sector Shopping	15	150	165	1.13	1.80	2.93
C-3	Sector Shopping	25	253	278	1.90	3.03	4.93
C-4	Sector Shopping	34	342	377	2.57	4.11	6.67
C-5	Sector Shopping	30	298	328	2.23	3.57	5.81

S. No.	Land Use	Working / Residing Population	Floating population	Total Population	Potable (KLD)	Flushing (KLD)	Total Domestic Water (KLD)
C-6	Retail	57	568	625	4.26	6.82	11.08
C-7	Shopping mall & hotel	109	1093	1202	8.20	13.12	21.32
C-7 A	Petrol pump	4	88	92	0.55	0.97	1.52
C-8	Retail	33	332	365	2.49	3.98	6.47
C-9	Retail	28	279	307	2.09	3.34	5.43
C-10	Retail	45	450	495	3.38	5.40	8.78
C-11	Bank & ATM	11	108	119	0.81	1.30	2.11
C-12	Retail	35	350	385	2.62	4.20	6.82
C-13	Retail	38	375	413	2.81	4.50	7.31
C-14	Retail	35	348	383	2.61	4.18	6.79
C-15	Retail	30	295	325	2.21	3.54	5.75
C-16	Retail	37	371	408	2.78	4.45	7.23
C-17	Retail	37	371	408	2.78	4.45	7.23
C-18	Retail	37	366	402	2.74	4.39	7.13
C-19 a	Retail/ Hotel	101	1012	1114	7.59	12.15	19.74
C-19 b	Retail/ Hotel	153	1526	1678	11.44	18.31	29.75
C-20 a	Retail/ Hotel	76	759	835	5.70	9.11	14.81
C-20 b	Retail/ Hotel	109	1090	1199	8.17	13.08	21.25
C-21	Sector Shopping	14	138	151	1.03	1.65	2.68
C-22	Retail/ShoppingMall/ Showroom/ 4/5 Star Hotel	150	1497	1646	11.23	17.96	29.19
C-23	Retail/ShoppingMall/ Showroom/ 4/5 Star Hotel	141	1408	1549	10.56	16.90	27.46
C-24	Retail/ShoppingMall/ Showroom/ 4/5 Star Hotel	150	1504	1654	11.28	18.04	29.32
C-25	Retail/ShoppingMall/ Showroom/ 4/5 Star Hotel	96	957	1053	7.18	11.48	18.66
C-26	Retail/ShoppingMall/ Showroom/ 4/5 Star Hotel	69	686	755	5.14	8.23	13.38
C-27	Retail/ShoppingMall/ Showroom/ 4/5 Star Hotel	93	928	1021	6.96	11.14	18.10
C-28	Retail/ShoppingMall/ Showroom/ 4/5 Star Hotel	113	1125	1238	8.44	13.50	21.94
C-29	Retail/ShoppingMall/ Showroom/ 4/5 Star Hotel	83	827	910	6.20	9.93	16.13
C-30	Retail/ShoppingMall/ Showroom/ 4/5 Star Hotel	99	989	1088	7.42	11.86	19.28
C-31 a	Retail/ Showroom	29	290	319	2.18	3.48	5.66

S. No.	Land Use	Working / Residing Population	Floating population	Total Population	Potable (KLD)	Flushing (KLD)	Total Domestic Water (KLD)
C-31 b	Retail/ Showroom	23	230	253	1.73	2.77	4.49
C-31 c	Retail/ Showroom	13	128	141	0.96	1.54	2.50
C-32	Retail/ShoppingMall/ Showroom/ **4/5 Star Hotel**	100	1003	1103	123.34	61.67	185.01
C-33	Retail/ShoppingMall/ Showroom/ 4/5 Star Hotel	151	1507	1658	395.71	93.46	489.17
C-34	Retail/ShoppingMall/ Showroom/ **4/5 Star Hotel**	92	924	1016	242.46	57.27	299.72
C-35	Retail/ShoppingMall/ Showroom/ **4/5 Star Hotel**	93	929	1022	243.92	57.61	301.53
C-36	Retail/ShoppingMall/ Showroom/ **4/5 Star Hotel**	105	1047	1151	274.71	64.88	339.60
	Total (Commercial)	***2703***	***27073***	***29776***	***1442.51***	***594.77***	***2037.28***
	Public Semi Public				637.46	2719.58	3357.04
PSP-1	1 Anganwadi 1 Nursery School 1 Health centre	34	674	708	4.21	7.42	11.63
PSP-2	1 Jr. high school integrated	51	1024	1075	6.40	11.27	17.67
PSP-3	1 Marriage community centre 1 club 3 e suvidha centre	39	394	433	2.95	4.72	7.68
PSP-4	1 Marriage community centre 1 club 1 sub post office 10 GCC	39	390	429	2.93	4.68	7.61
PSP-5	ESS 5-GCC	4	2	6	0.11	0.10	0.22
PSP-6	1 Inter College (integrated)	75	1503	1578	9.39	16.53	25.92
PSP-7	1 Jr. high school integrated	64	1272	1336	7.95	14.00	21.95

S. No.	Land Use	Working / Residing Population	Floating population	Total Population	Potable (KLD)	Flushing (KLD)	Total Domestic Water (KLD)
	1 Anganwadi 5 GCC						
PSP-8	1 Jr. high school integrated	26	521	547	3.26	5.73	8.99
PSP-9	1 Sub post office 1 E suvidha centre 1 Child care and Maternity home 2 Anganwadi 10 GCC	425	43	468	10.85	8.93	19.78
PSP-10	ADA office building	595	60	655	15.18	12.50	27.68
PSP-11	Inter College Integrated	77	1536	1613	9.60	16.90	26.50
PSP-12	1 Jr. high school integrated 1 Anganwadi 1 Nursery School	50	1007	1057	6.29	11.08	17.37
PSP-13	1 Gas/ LPG Godown	3	34	38	0.28	0.40	0.67
PSP-14	1 Police chowki with residential facility 1 Sub post office 15 GCC	352	35	387	37.08	16.17	53.25
PSP-15	Inter College Integrated	76	1511	1587	9.44	16.62	26.06
PSP-16	Inter College Integrated	80	1605	1686	10.03	17.66	27.69
PSP-17	ESS 9-GCC	4	2	6	0.11	0.10	0.22
PSP-18	1 Religious Plot	7	133	140		0.70	1.40
PSP-19	1 Anganwadi 1 Nursery School 1 Sub Post Office 10 GCC	28	559	587	3.49	6.15	9.64
PSP-20	1-Fire station	30	3	33	0.77	0.63	1.40
PSP-21	1 Police chowki with residential facility 5 GCC	231	23	254	24.39	10.63	35.02
PSP-22	1 Anganwadi 2 Nursery School	31	624	656	3.90	6.87	10.77

S. No.	Land Use	Working / Residing Population	Floating population	Total Population	Potable (KLD)	Flushing (KLD)	Total Domestic Water (KLD)
	1 Health centre 4 GCC						
PSP-23	1 Jr. high school integrated	36	720	756	4.50	7.92	12.41
PSP-24	1 Jr. high school integrated 2 Nursery School 1 Police chowki with residential facility 5 GCC	57	1144	1201	7.15	12.59	19.74
PSP-25	1 Religious Plot	8	166	174	0.87	1.74	2.61
PSP-26	Nursing home/ ClinicalLab/ Health club/	36	362	398	2.72	4.35	7.06
PSP-27	Nursing home/ ClinicalLab/ Health club/ Junior high school	50	499	549	3.74	5.99	9.73
PSP-28	Nursing home/ ClinicalLab/ Health club/ Junior high school	61	610	671	4.58	7.32	11.90
PSP-29	Guest house/ hostel	26	263	290	3.69	3.82	7.51
PSP-30	Nursing home/ Clinical Lab/ Health club/ Gymnasium	38	379	417	2.84	4.55	7.39
PSP-31	Community centre/ Cultural centre/ music Drama & Dance Taaining centre/ Art centre	715	14293	15007	75.04	150.07	225.11
PSP-32	Guest house/ hostel	17	166	183	2.32	2.41	4.73
PSP-33	Guest house/ hostel	19	190	209	2.66	2.75	5.41
PSP-34	Banquet hall/ conference hall/ Meeting hall	530	10608	11139	55.69	111.39	167.08
PSP-35	Community centre/ Cultural centre/ music Drama & Dance Taaining centre/ Art centre	788	15768	16556	82.78	165.56	248.34
PSP-36	Guest house/ hostel	32	323	355	4.52	4.68	9.20
PSP-37	Guest house/ hostel	25	254	280	3.56	3.69	7.25

S. No.	Land Use	Working / Residing Population	Floating population	Total Population	Potable (KLD)	Flushing (KLD)	Total Domestic Water (KLD)
PSP-38	Guest house/ hostel	29	286	314	4.00	4.14	8.14
PSP-39	Guest house/ hostel	21	212	233	2.97	3.08	6.05
PSP-40	Guest house/ hostel	21	213	234	2.98	3.08	6.06
PSP-41	Nursing home/ Clinical Lab/ Health club/ Gymnasium	32	316	348	2.37	3.79	6.16
PSP-42	Nursing home/ Clinical Lab/ Health club/ Gymnasium	31	308	338	2.31	3.69	6.00
PSP-43	Nursing home/ Clinical Lab/ Health club/ Gymnasium	32	321	353	2.41	3.85	6.26
PSP-44	Yoga/ Meditation/ Satsang Bhawan/ Spritual and Religious Discourse Centre	675	13494	14169	70.85	141.69	212.54
PSP-45	Theatre/ Auditorium/ Natyashala	917	18336	19253	96.27	192.53	288.80
PSP-46	Guest house/ hostel	32	320	352	4.47	4.63	9.11
PSP-47	Higher secondary school/ Inter college / Hospital / R&D Centre/ Research centre	188	3769	3957	23.55	41.45	65.01
PSP-48	Politechnic/ Engineering/ Medical / Dental college/ Management Institutes/ Specilised Educational Institutes	260	5195	5455	32.47	57.14	89.61
PSP-49	Politechnic/ Engineering/ Medical / Dental college/ Management Institutes/ Specilised Educational Institutes	125	2492	2616	15.57	27.41	42.98
PSP-50	Hospital / R&D Centre/ Research centre	173	3461	3634	21.63	38.07	59.70
PSP-51	Politechnic/ Engineering/ Medical / Dental college/ Management Institutes/ Specilised Educational Institutes	657	13139	13796	82.12	144.53	226.65

S. No.	Land Use	Working / Residing Population	Floating population	Total Population	Potable (KLD)	Flushing (KLD)	Total Domestic Water (KLD)
PSP-52	Politechnic/ Engineering/ Medical / Dental college/ Management Institutes/ Specilised Educational Institutes	294	5878	6172	36.74	64.66	101.39
PSP-53	Auditorium/ Convention Centre/ Exhibition Place/ Art Gallery	3665	73309	76974	384.87	769.74	1154.61
PSP-54	Higher secondary school/ Inter college	122	2445	2567	15.28	26.89	42.17
PSP-55	Higher secondary school/ Inter college	127	2547	2674	15.92	28.01	43.93
PSP-56	Auditorium/ Convention Centre/ Exhibition Place/ Art Gallery	2108	42151	44259	221.29	442.59	663.88
PSP-57	Higher secondary school/ Inter college / Hospital / R&D Centre/ Research centre	182	3635	3817	22.72	39.99	62.71
	Total Public Semi Public	***14452***	***250526***	***264978***	***637.46***	***2719.58***	***4206.35***
	Utilities				4.53		
	UT-1	81	3	84	2.44	1.25	3.69
	UT-2	59	2	61	1.78	0.91	2.69
	UT-3	10	2	12	0.31	0.17	0.47
	Total Utilities	***150***	***8***	***157***	***4.53***	***2.32***	***6.86***
	Transportation						
	Parks & Open Spaces						
	Green & Open Spaces						
	G-1						
	G-2						
	G-3						
	G-4						
	G-5						
	G-6						
	G-7						
	G-8						
	G-9						
	G-10						
	G-11						
	G-12						
	G-13						
	G-14						

S. No.	Land Use	Working / Residing Population	Floating population	Total Population	Potable (KLD)	Flushing (KLD)	Total Domestic Water (KLD)
	G-15						
	G-16						
	G-17						
	G-18						
	G-19						
	G-20						
	G-21						
	G-22						
	G-23						
	G-24						
	G-25						
	G-26						
	G-27						
	G-28						
	G-29						
	G-30						
	G-31						
	G-32						
	G-33						
	G-34						
	G-35						
	G-70						
	G-71						
	G-72						
	G-73						
	G-74						
	G-75						
	G-36						
	G-37						
	G-38						
	G-39						
	G-40						
	G-41						
	G-42						
	G-43						
	G-44						
	G-45						
	G-46						
	G-47						
	G-48						
	G-49						
	G-50						

S. No.	Land Use	Working / Residing Population	Floating population	Total Population	Potable (KLD)	Flushing (KLD)	Total Domestic Water (KLD)
	G-51						
	G-52						
	G-53						
	G-54						
	G-55						
	G-56						
	G-57						
	G-58						
	G-59						
	G-60						
	G-61						
	G-62						
	G-63						
	G-64						
	G-65						
	G-66						
	G-67						
	G-68						
	G-69						
	Total Other Green/ Open Areas						
	Grand Total	**59314**	**281808**	**341122**	**5886.35**	**5249.11**	**11984.76**

The non-potable demand comprising of horticulture demand, domestic flushing will be met from the recycled water. The water demand has been calculated separately due to variation in standards and requirements.

The horticulture demand and non-potable domestic demand will be fed through recycled water from proposed Sewage Treatment Plant (STP) and additional quantity of water, if any shall be drawn from existing source.

Total Daily potable water demand is estimated as about 6.77 MLD Potable use.

Table 12: Water Balance Table

Description	Demand (MLD)
Potable Water Demand	6.77
Flushing Water Demand	6.04
Fire Water Demand	2.12
Waste Water Generated	11.45
STP	12.60
Recycle Water Generated	9.16

Description	Demand (MLD)
AC Cooling Demand	2.61
Washing & Cleaning	0.20
Horticulture Demand	2.09
Treated Waste Water to Waterbodies	4.26
Make-up Water required	
Total Water Demand	**6.77**
Capacity of WTP/ Water Work(s)	**7.45**

Distribution and transmission system has been efficiently managed, making non-revenue water (NRW) or the unaccounted-for Water (UFW) and other water losses included.

5.3 Water Quality Standards

The Water Quality Standards after treatment of the raw water from the existing source shall be as per the Bureau of Indian Standards IS: 10500-1991. The following standards may suitably be adopted for the present project.

Table 13: Water Quality Standards

SN	Substance or Characteristic	Requirement (Desirable Limit)	Permissible Limit in the absence of Alternate source
Essential Characteristics			
1.	Color (Hazen units Max)	5	25
2.	Odour	Unobjectionable	Unobjectionable
3.	Taste	Agreeable	Agreeable
4.	Turbidity (NTU,Max)	5	10
5.	pH Value	6.5 to 8.5	No relaxation
6.	Total Hardness(as CaCo3) mg/lit.,Max	300	600
7.	Iron (as Fe) mg/lit.,Max	0.3	1.0
8.	Chlorides (as Fe) mg/lit.,Max	250	1000
9.	Residual, free chlorine, mg/lit.,Max	0.2	--
Desirable Characteristics			
10.	Dissolved Solids mg/lit.,Max	500	2000
11.	Calcium (as Ca) mg/lit.,Max	75	200
12.	Copper (as Cu) mg/lit.,Max	0.05	1.5

SN	Substance or Characteristic	Requirement (Desirable Limit)	Permissible Limit in the absence of Alternate source
13.	Manganese (as As) mg/lit.,Max	0.10	0.3
14.	Sulfate (as So4) mg/lit.,Max	200	400
15.	Nitrate (as No3) mg/lit.,Max	45	100
16.	Fluoride (as F) mg/lit.,Max	1.9	1.5
17.	Phenolic Compounds (as C6H5OH) mg/lit.,Max	0.001	
18.	Mercury (as Hg) mg/lit.,Max	0.001	No relaxation
19.	Cadmium (as Cd) mg/lit.,Max	0.01	No relaxation
20.	Selenium (as Se) mg/lit.,Max	0.01	No relaxation
21.	Arsenic (as As) mg/lit.,Max	0.05	No relaxation
22.	Cyanide (as Cn) mg/lit.,Max	0.05	No relaxation
23.	Lead (as Pb) mg/lit.,Max	0.05	No relaxation
24.	Zinc (as Zn) mg/lit.,Max	5	15
52.	Anionic detergents (as MBAS) mg/lit.,Max	0.2	1.0
26.	Chromium (as Cr6+) mg/lit.,Max	0.05	No relaxation
27.	Polynuclear aromatic hydro carbons (as PAH) g/lit.,Max	--	--
28.	Mineral Oil mg/lit.,Max	0.01	0.03
29.	Pesticides mg/lit.,Max	Absent	0.001
30.	Radioactive Materials		
	i. Alpha emitters Bq/l,Max	--	0.1
	ii. Beta emitters pci/l,Max	--	1.0
31.	Alkalinity mg/lit.,Max	200	600
32.	Aluminum (as Al) mg/lit.,Max	0.03	0.2
33.	Boran mg/lit.,Max	1	5

Source : IS code 10500

5.4 Framework for Potable Water Supply Design

The design of potable water supply will be based on CPHEEO manual. Following design parameters will be considered for design.

5.4.1 Pumping mains

Hazen - Williams's formula is used for the design of pumping mains. Most economical size of pumping main will be based on proper analysis of following factors:

a) Different pipe sizes
b) Duty, capacity and installed cost of the pump sets required against the corresponding pipe sizes considered
c) The recurring cost on energy charges, cost of repairs and renewables, cost of miscellaneous consumable stores, etc.,

5.4.1.1 Design formula

The Hazen – Williams's formula is expressed as

$Q = 1.292 * 10^{-5} * C * d^{2.63} S^{0.54}$

Where,

Q = discharge in cubic meter per hour

d = diameter of pipe in mm

C= Hazen Williams coefficient

S = Slope of Hydraulic grade line

5.4.1.2 Minimum pipe size

As per CPHEEO Manual on water supply, minimum pipe size of 90 mm is considered

5.4.1.3 Velocity

For pumping mains, minimum velocity of 0.6 m/s and maximum velocity of 2.5 m/s is considered.

5.4.1.4 Pipe Material

The selection of pipe material depends on various technical factors such as internal pressures, coefficient of roughness, hydraulic and operating conditions, maximum permissible diameter, internal and external corrosion problem, laying and jointing, type of soil, special conditions etc.,

HDPE PE-100 PN-10 upto 200mm and DI, K9 pipes above 200mm are considered.

5.4.2 Distribution System

5.4.2.1 Peak factor

Peak factor as per the CPHEEO's guidelines is as follows:

Table 14: Peak factor

SN	Contributory population	Peak factor
1	Less than 50,000	3.0

2	50,000 to 200,000	2.5
3	Above 200,000	2.0

Peak Factor of 2.0 shall be considered for design.

5.4.2.2 Residual Pressure

Generally, distribution system is designed for minimum residual pressure at ferrule point. The minimum residual pressures at ferrule point as per CPHEEO are documented as below.

Table 15: Residual Pressure

SN	Type of building	Minimum Residual pressure at ferrule
1	Single Storey building	7m
2	Double Storied building	12m
3	Three Storied building	17m
4	Multi Storied building	Boosters to be provided for high pressures

Minimum Residual Pressure of 12m bar is considered for design. In case of high-rise buildings, where their pressure requirement is more than 12m, own booster pumping systems are proposed.

5.4.2.3 Hazen Williams Coefficient

The following values are adopted as per CPHEEO Manual on water supply.

HDPE - 145

DI - 140

5.4.3 Appurtenances

5.4.3.1 Sluice Valve

Generally, sluice valves shall be located on at least three sides of every T-junction for Flow Control and also on the main line.

For Atal Puram Township project, DI. D/F Sluice Valves located on the mail line.

5.4.3.2 Butterfly Valves

Generally, Butterfly valves shall be located on at least three sides of every T-junction for Flow Control and also on the main line.

For Atal Puram Township project, DI. D/F Butterfly Valves located on at least three sides of every T-junction for controlling of flow.

5.4.3.3 Air Valve

Air valves are fitted to release the air automatically when a pipeline is being filled and also to permit air to enter the pipeline when it is being emptied. The air valves also release any entrained air which might accumulate at high points in pipeline during normal operations. The valves are mainly available in two forms, either single chamber or double chamber. The single chamber air valves are suitable for emptying and filling of pipelines and later for venting and releasing air in pipeline as well as for releasing air during operation. Double Chamber air valves are proposed in the design.

For Atal Puram Township project, 50mm & 80mm diameter double acting Air Valves confirming to IS 14845.

5.4.3.4 Scour Valve

In pressure pipes, blow off or scour valves are provided at low points in the line such that each section of the line can be emptied and drained completely. They discharge into nature drainage channels or into a sump from where the water can be pumped to waste or drain. Frequency of operation depends upon the quality and quantity of water carried.

5.4.3.5 Anchorage

Anchorages are required for one or more of the following reasons:

- To resist the tendency of pipe to pull apart at bends and other points when unbalanced pressure occurs this exceeds the resistance of their joints to their longitudinal stresses.
- When the resistance of the joints to longitudinal stresses are inadequate and the pipes have the tendency to pull apart when pipe is laid on steep ground.

These are provided at bends, tees, and crosses to protect the pipe from unbalanced forces.

5.4.3.6 Service Connection and Metering

The project is aimed at providing water supply through meters. The consumption of water will be metered so that the consumption of water will be regulated and recorded. The off-take branch of ½ inches for house connection and upto 40 mm size from the main line is proposed for big size plot with valve connection to provide connection. Size is totally dependent on the local authorities norms.

Structural appurtenances such as air, washout and gate valve chambers will be considered as per requirement.

Smart metering technology to be used. A typical drawing to depict the house connection is presented in the drawings

5.4.4 Fire demand

Based on CPHEEO Manual,

Fire demand in Kilo litres per day = **100** $\sqrt{P}$

Where, p = population in thousands.

Chapter 6: Recycled Water Supply System

6.1 Recycled Water Supply System

The recycled water shall be supplied to each plot by pumping from Semi Underground Tank. The pumping system is considered because it rejects the need of regular proper maintenance of Overhead Tank and running cost. The following are the various tasks carried out while preparing the Detailed Project Report of the Potable water supply system.

- Water demand calculation
- Planning, zoning and Network
- Design parameters
- Hydraulic Design criteria
- Detailed Designs

6.2 Recycled Water Demand Calculation

The water demand is estimated based on proposed land use, built-up area and the population proposed. These demands have been derived from the CPHEEO Manual and NBC Guidelines. Provision for assured water supply is vital for achieving sustainability in site.

Table 16: Water Demand Calculation

S. No.	Land Use	Flushing (KLD)	Washing/ Cleaning	AC Cooling	Horticulture	Total Recycled Water (KLD)
	Plotted Development					
1	25-50 sqm	36.57				36.57
3	51 - 150 sqm	219.88				219.88
4	151 - 300 sqm	482.08				482.08
5	301 - 400 sqm	112.24				112.24
6	401 - 500 sqm	132.25				132.25
7	501-600 sqm	28.75				28.75
		1011.77				**1011.77**
	Group Housing					
GH-1	Group Housing	65.06			2.06	67.11
GH-2	Group Housing	106.26			3.36	109.62
GH-3	Group Housing	25.58			0.81	26.38
GH-4	Group Housing	58.06			1.84	59.90
GH-5	Group Housing	66.65			2.11	68.76
GH-6	Group Housing	66.74			2.11	68.85
GH-7	Group Housing	48.05			2.01	50.05
GH-8	Group Housing	28.92			1.21	30.13
GH-9	Group Housing	30.54			0.97	31.51
GH-10	Group Housing	16.49			0.86	17.35
GH-11	Group Housing	25.83			1.08	26.91
GH-12	Group Housing LIG	26.01			0.54	26.55
GH-13	Group Housing LIG	77.21			1.61	78.82
GH-14	Group Housing LIG	30.06			0.63	30.69
GH-15	Group Housing LIG	36.12			0.58	36.70

S. No.	Land Use	Flushing (KLD)	Washing/ Cleaning	AC Cooling	Horticulture	Total Recycled Water (KLD)
GH-16	Group Housing EWS	62.24			1.00	63.24
GH-17	Group Housing EWS	58.87			0.95	59.81
GH-18	Group Housing EWS	91.99			1.48	93.46
		920.66			**25.18**	**945.84**
	Total Residential					
	Commercial	594.77		1023.65	24.38	
C-1	Kiyasath Booth	1.59				1.59
C-2	Sector Shopping	1.80		7.63	0.12	9.55
C-3	Sector Shopping	3.03		5.22	0.20	8.46
C-4	Sector Shopping	4.11		8.78	0.28	13.17
C-5	Sector Shopping	3.57		11.89	0.24	15.70
C-6	Retail	6.82		10.34	0.46	17.62
C-7	Shopping mall & hotel	13.12		19.73	0.89	33.74
C-7 A	Petrol pump	0.97				0.97
C-8	Retail	3.98		5.06	0.27	9.31
C-9	Retail	3.34		11.51	0.23	15.08
C-10	Retail	5.40		9.68	0.36	15.44
C-11	Bank & ATM	1.30		15.63	0.15	17.07
C-12	Retail	4.20		6.24	0.28	10.72
C-13	Retail	4.50		12.14	0.30	16.95
C-14	Retail	4.18		13.03	0.28	17.49
C-15	Retail	3.54		12.10	0.24	15.88
C-16	Retail	4.45		10.25	0.30	15.00
C-17	Retail	4.45		12.87	0.30	17.62
C-18	Retail	4.39		12.87	0.30	17.55
C-19 a	Retail/ Hotel	12.15		12.70	0.82	25.67
C-19 b	Retail/ Hotel	18.31		35.16	1.24	54.70
C-20 a	Retail/ Hotel	9.11		52.99	0.62	62.72
C-20 b	Retail/ Hotel	13.08		26.37	0.88	40.33
C-21	Sector Shopping	1.65		37.85	0.11	39.61
C-22	Retail/ShoppingMall/ Showroom/ 4/5 Star Hotel	17.96		4.78	1.06	23.80
C-23	Retail/ShoppingMall/ Showroom/ 4/5 Star Hotel	16.90		51.98	1.00	69.87
C-24	Retail/ShoppingMall/ Showroom/ 4/5 Star Hotel	18.04		48.91	1.07	68.02
C-25	Retail/ShoppingMall/ Showroom/ 4/5 Star Hotel	11.48		52.22	0.68	64.38
C-26	Retail/ShoppingMall/ Showroom/ 4/5 Star Hotel	8.23		33.23	0.49	41.95
C-27	Retail/ShoppingMall/ Showroom/ 4/5 Star Hotel	11.14		23.82	0.66	35.62
C-28	Retail/ShoppingMall/ Showroom/ 4/5 Star Hotel	13.50		32.24	0.80	46.54
C-29	Retail/ShoppingMall/ Showroom/ 4/5 Star Hotel	9.93		39.07	0.59	49.58
C-30	Retail/ShoppingMall/ Showroom/ 4/5 Star Hotel	11.86		28.72	0.70	41.29
C-31 a	Retail/ Showroom	3.48		34.33	0.21	38.02
C-31 b	Retail/ Showroom	2.77		10.08	0.16	13.01

S. No.	Land Use	Flushing (KLD)	Washing/ Cleaning	AC Cooling	Horticulture	Total Recycled Water (KLD)
C-31 c	Retail/ Showroom	1.54		8.00	0.09	9.63
C-32	Retail/ShoppingMall/ Showroom/ 4/5 Star Hotel	61.67		4.46	1.79	67.92
C-33	Retail/ShoppingMall/ Showroom/ 4/5 Star Hotel	93.46		87.59	1.07	182.12
C-34	Retail/ShoppingMall/ Showroom/ 4/5 Star Hotel	57.27		52.35	1.65	111.26
C-35	Retail/ShoppingMall/ Showroom/ 4/5 Star Hotel	57.61		80.68	1.66	139.94
C-36	Retail/ShoppingMall/ Showroom/ 4/5 Star Hotel	64.88		81.16	1.87	147.91
	Total (Commercial)	***594.77***		***1023.65***	***24.38***	***1642.80***
	Public Semi Public	2719.58	170.00	1249.56	72.23	
PSP-1	1 Anganwadi 1 Nursery School 1 Health centre	7.42			0.48	7.90
PSP-2	1 Jr. high school integrated	11.27			0.89	12.15
PSP-3	1 Marriage community centre 1 club 3 e suvidha centre	4.72			0.63	5.35
PSP-4	1 Marriage community centre 1 club 1 sub post office 10 GCC	4.68			0.62	5.31
PSP-5	ESS 5-GCC	0.10				0.10
PSP-6	1 Inter College (integrated)	16.53			0.96	17.49
PSP-7	1 Jr. high school integrated 1 Anganwadi 5 GCC	14.00			1.10	15.10
PSP-8	1 Jr. high school integrated	5.73			0.45	6.19
PSP-9	1 Sub post office 1 E suvidha centre 1 Child care and Maternity home 2 Anganwadi 10 GCC	8.93			0.74	9.67
PSP-10	ADA office building	12.50			0.57	13.07
PSP-11	Inter College Integrated	16.90			1.06	17.96
PSP-12	1 Jr. high school integrated 1 Anganwadi 1 Nursery School	11.08			0.87	11.95
PSP-13	1 Gas/ LPG Godown	0.40				0.40
PSP-14	1 Police chowki with residential facility 1 Sub post office 15 GCC	16.17			0.56	16.73
PSP-15	Inter College Integrated	16.62			1.05	17.67
PSP-16	Inter College Integrated	17.66			1.11	18.77
PSP-17	ESS 9-GCC	0.10				0.10
PSP-18	1 Religious Plot	0.70	2.10	0.38	1.79	4.97

S. No.	Land Use	Flushing (KLD)	Washing/ Cleaning	AC Cooling	Horticulture	Total Recycled Water (KLD)
PSP-19	1 Anganwadi 1 Nursery School 1 Sub Post Office 10 GCC	6.15			0.48	6.63
PSP-20	1-Fire station	0.63				0.63
PSP-21	1 Police chowki with residential facility 5 GCC	10.63				10.63
PSP-22	1 Anganwadi 2 Nursery School 1 Health centre 4 GCC	6.87			0.54	7.41
PSP-23	1 Jr. high school integrated	7.92			0.62	8.54
PSP-24	1 Jr. high school integrated 2 Nursery School 1 Police chowki with residential facility 5 GCC	12.59			0.92	13.50
PSP-25	1 Religious Plot	1.74	1.19	5.57	0.24	8.74
PSP-26	Nursing home/ ClinicalLab/ Health club/	4.35		34.14	1.06	39.55
PSP-27	Nursing home/ ClinicalLab/ Health club/ Junior high school	5.99		47.03	1.25	54.26
PSP-28	Nursing home/ ClinicalLab/ Health club/ Junior high school	7.32		57.52	1.53	66.36
PSP-29	Guest house/ hostel	3.82			0.44	4.26
PSP-30	Nursing home/ Clinical Lab/ Health club/ Gymnasium	4.55		35.75	0.95	41.25
PSP-31	Community centre/ Cultural centre/ music Drama & Dance Taaining centre/ Art centre	150.07		68.63	1.47	220.17
PSP-32	Guest house/ hostel	2.41			0.28	2.68
PSP-33	Guest house/ hostel	2.75			0.32	3.07
PSP-34	Banquet hall/ conference hall/ Meeting hall	111.39	10.92	50.94	1.09	174.33
PSP-35	Community centre/ Cultural centre/ music Drama & Dance Taaining centre/ Art centre	165.56		75.72	1.62	242.90
PSP-36	Guest house/ hostel	4.68			0.54	5.22
PSP-37	Guest house/ hostel	3.69			0.42	4.11
PSP-38	Guest house/ hostel	4.14			0.48	4.62
PSP-39	Guest house/ hostel	3.08			0.35	3.43
PSP-40	Guest house/ hostel	3.08			0.35	3.44
PSP-41	Nursing home/ Clinical Lab/ Health club/ Gymnasium	3.79		29.79	0.79	34.37
PSP-42	Nursing home/ Clinical Lab/ Health club/ Gymnasium	3.69		29.00	0.77	33.47
PSP-43	Nursing home/ Clinical Lab/ Health club/ Gymnasium	3.85	6.49	30.29	0.80	41.43

S. No.	Land Use	Flushing (KLD)	Washing/ Cleaning	AC Cooling	Horticulture	Total Recycled Water (KLD)
PSP-44	Yoga/ Meditation/ Satsang Bhawan/ Spritual and Religious Discourse Centre	141.69	13.89	64.80	1.39	221.76
PSP-45	Theatre/ Auditorium/ Natyashala	192.53		88.05	1.89	282.47
PSP-46	Guest house/ hostel	4.63			0.53	5.17
PSP-47	Higher secondary school/ Inter college / Hospital / R&D Centre/ Research centre	41.45			2.11	43.56
PSP-48	Politechnic/ Engineering/ Medical / Dental college/ Management Institutes/ Specilised Educational Institutes	57.14			2.91	60.05
PSP-49	Politechnic/ Engineering/ Medical / Dental college/ Management Institutes/ Specilised Educational Institutes	27.41			1.40	28.80
PSP-50	Hospital / R&D Centre/ Research centre	38.07	16.61	77.53	1.94	134.15
PSP-51	Politechnic/ Engineering/ Medical / Dental college/ Management Institutes/ Specilised Educational Institutes	144.53			7.36	151.89
PSP-52	Politechnic/ Engineering/ Medical / Dental college/ Management Institutes/ Specilised Educational Institutes	64.66			3.29	67.95
PSP-53	Auditorium/ Convention Centre/ Exhibition Place/ Art Gallery	769.74	75.43	352.02	8.80	1205.99
PSP-54	Higher secondary school/ Inter college	26.89			1.69	28.59
PSP-55	Higher secondary school/ Inter college	28.01			1.77	29.78
PSP-56	Auditorium/ Convention Centre/ Exhibition Place/ Art Gallery	442.59	43.37	202.41	5.06	693.43
PSP-57	Higher secondary school/ Inter college / Hospital / R&D Centre/ Research centre	39.99			1.89	41.88
	Total Public Semi Public	***2719.58***	***170.00***	***1249.56***	***72.23***	***4211.37***
	Utilities					
	UT-1	1.25			0.65	1.89
	UT-2	0.91			0.47	1.38
	UT-3	0.17			0.08	0.25
	Total Utilities	***2.32***			***1.20***	***3.52***
	Transportation		433.76			
	Parks & Open Spaces					
	Green & Open Spaces					
	G-1				0.74	0.74
	G-2				2.86	2.86
	G-3				0.61	0.61
	G-4				0.61	0.61

S. No.	Land Use	Flushing (KLD)	Washing/ Cleaning	AC Cooling	Horticulture	Total Recycled Water (KLD)
	G-5				0.61	0.61
	G-6				13.25	13.25
	G-7				0.66	0.66
	G-8				18.09	18.09
	G-9				0.74	0.74
	G-10				0.62	0.62
	G-11				3.39	3.39
	G-12					
	G-13				13.46	13.46
	G-14				4.21	4.21
	G-15				1.41	1.41
	G-16				0.57	0.57
	G-17				0.80	0.80
	G-18				2.64	2.64
	G-19				0.76	0.76
	G-20				3.05	3.05
	G-21				1.47	1.47
	G-22				34.77	34.77
	G-23				1.17	1.17
	G-24				19.18	19.18
	G-25				15.60	15.60
	G-26				29.64	29.64
	G-27				2.62	2.62
	G-28				12.04	12.04
	G-29				0.96	0.96
	G-30				9.01	9.01
	G-31				9.72	9.72
	G-32				34.59	34.59
	G-33				9.48	9.48
	G-34				0.66	0.66
	G-35				2.90	2.90
	G-70				11.01	11.01
	G-71				2.17	2.17
	G-72				2.46	2.46
	G-73				0.80	0.80
	G-74				0.43	0.43
	G-75				11.03	11.03
	G-36				2.48	2.48
	G-37				11.23	11.23
	G-38				1.44	1.44
	G-39				1.52	1.52
	G-40				0.86	0.86
	G-41				0.86	0.86
	G-42				3.16	3.16
	G-43				1.00	1.00
	G-44				1.67	1.67
	G-45				0.90	0.90
	G-46				3.39	3.39
	G-47				1.33	1.33
	G-48				0.74	0.74

S. No.	Land Use	Flushing (KLD)	Washing/ Cleaning	AC Cooling	Horticulture	Total Recycled Water (KLD)
	G-49				1.02	1.02
	G-50				14.89	14.89
	G-51				3.50	3.50
	G-52				3.50	3.50
	G-53				0.74	0.74
	G-54				11.59	11.59
	G-55				3.07	3.07
	G-56				11.05	11.05
	G-57				9.85	9.85
	G-58				2.86	2.86
	G-59				5.03	5.03
	G-60				3.96	3.96
	G-61				7.27	7.27
	G-62				37.94	37.94
	G-63				13.98	13.98
	G-64				2.99	2.99
	G-65				2.56	2.56
	G-66				0.72	0.72
	G-67				11.93	11.93
	G-68				35.74	35.74
	G-69				1.36	1.36
	Total Other Green/ Open Areas				***496.93***	***496.93***
	Grand Total	**5249.11**	**603.76**	**2273.21**	**619.91**	**8312.23**

The horticulture demand and non-potable domestic demand will be fed through recycled water from proposed Sewage Treatment Plant (STP) and additional quantity of water shall supplied to the proposed water bodies.

Total Daily recycled water demand is estimated about 10.94 MLD.

Distribution and transmission system has been efficiently managed, making non-revenue water (NRW) or the unaccounted-for Water (UFW) and other water losses included.

6.3 Water Quality Standards

The Water Quality Standards after treatment of the raw water from the existing source shall be as per the Bureau of Indian Standards IS: 10500-1991. The following standards may suitably be adopted for the present project.

Table 17: Treated Wastewater Quality Standards for Reuse of Landscaping and Toilet Flushing

Sl.NO	Parameter	Toilet Flushing	Landscaping	Unit
1	Turbidity	<2	<2	**NTU**
2	SS	nil	nil	**mg/l**
3	TDS	2100	2100	**mg/l**
4	pH	6.5 to 8.3	6.5 to 8.3	

SI.NO	Parameter	Toilet Flushing	Landscaping	Unit
5	Temperature C	Ambient	Ambient	
6	Oil & Grease	10	10	**mg/l**
7	Minimum Residual Chlorine	1	1	**mg/l**
8	Total Kjeldahl Nitrogen as N	10	10	**mg/l**
9	BOD	10	10	**mg/l**
10	COD	AA	AA	
11	Dissolved Phosphorous as P	1	2	**mg/l**
12	Nitrate Nitrogen as N	10	10	**mg/l**
13	Faecal Coliform in 100 ml	Nil	Nil	
14	Helminthic Eggs / Litre	AA	AA	
15	Colour	Colourless	Colourless	
16	Odour	Aseptic which means not septic and no foul odour		

6.4 Framework for Recycled Water Supply Design

The design of potable water supply will be based on CPHEEO manual. Following design parameters will be considered for design.

6.4.1 Pumping mains

Hazen - Williams's formula is used for the design of pumping mains. Most economical size of pumping main will be based on proper analysis of following factors:

d) Different pipe sizes
e) Duty, capacity and installed cost of the pump sets required against the corresponding pipe sizes considered
f) The recurring cost on energy charges, cost of repairs and renewables, cost of miscellaneous consumable stores, etc.,

6.4.1.1 **Design formula**

The Hazen – Williams's formula is expressed as

$$Q = 1.292 * 10^{-5} * C * d^{2.63} S^{0.54}$$

Where,

Q = discharge in cubic meter per hour

d = diameter of pipe in mm

C= Hazen Williams coefficient

S = Slope of Hydraulic grade line

6.4.1.2 Minimum pipe size

As per CPHEEO Manual on water supply, minimum pipe size of 90 mm is considered

6.4.1.3 Velocity

For pumping mains, minimum velocity of 0.6 m/s and maximum velocity of 2.5 m/s is considered.

6.4.1.4 Pipe Material

The selection of pipe material depends on various technical factors such as internal pressures, coefficient of roughness, hydraulic and operating conditions, maximum permissible diameter, internal and external corrosion problem, laying and jointing, type of soil, special conditions etc.,

HDPE PE-100 PN-10 upto 200mm and DI, K9 pipes above 200mm pipes are considered for pumping mains.

6.4.2 Distribution System

6.4.2.1 Peak factor

Peak factor as per the CPHEEO's guidelines is as follows:

Table 18: Peak factor

SN	Contributory population	Peak factor
1	Less than 50,000	3.0
2	50,000 to 200,000	2.5
3	Above 200,000	2.0

Peak Factor of 2.0 shall be considered for design.

6.4.2.2 Residual Pressure

Generally, distribution system is designed for minimum residual pressure at ferrule point. The minimum residual pressures at ferrule point as per CPHEEO are documented as below.

Table 19: Residual Pressure

SN	Type of building	Minimum Residual pressure at ferrule
1	Single Storey building	7m
2	Double Storied building	12m
3	Three Storied building	17m

4	Multi Storied building	Boosters to be provided for high pressures

Minimum Residual Pressure of 12m bar is considered for design. In case of high-rise buildings, where their pressure requirement is more than 12m, own booster pumping systems are proposed.

6.4.2.3 Hazen Williams Coefficient

The following values are adopted as per CPHEEO Manual on water supply.

HDPE - 145

DI - 140

6.4.3 Appurtenances

6.4.3.1 Sluice Valve

Generally, sluice valves shall be located on at least three sides of every T-junction for Flow Control and also on the main line.

For Atal Puram Township project, DI. D/F Sluice Valves located on the mail line.

6.4.3.2 Butterfly Valves

Generally, Butterfly valves shall be located on at least three sides of every T-junction for Flow Control and also on the main line.

For Atal Puram Township project, DI. D/F Butterfly Valves located on at least three sides of every T-junction for controlling of flow.

6.4.3.3 Air Valve

Air valves are fitted to release the air automatically when a pipeline is being filled and also to permit air to enter the pipeline when it is being emptied. The air valves also release any entrained air which might accumulate at high points in pipeline during normal operations. The valves are mainly available in two forms, either single chamber or double chamber. The single chamber air valves are suitable for emptying and filling of pipelines and later for venting and releasing air in pipeline as well as for releasing air during operation. Double Chamber air valves are proposed in the design.

For Atal Puram Township project, 50mm & 80mm diameter double acting Air Valves confirming to IS 14845.

6.4.3.4 Scour Valve

In pressure pipes, blow off or scour valves are provided at low points in the line such that each section of the line can be emptied and drained completely. They discharge into nature drainage channels or into a sump from where the water can be pumped to waste or drain. Frequency of operation depends upon the quality and quantity of water carried.

6.4.3.5 Anchorage

Anchorages are required for one or more of the following reasons:

- To resist the tendency of pipe to pull apart at bends and other points when unbalanced pressure occurs this exceeds the resistance of their joints to their longitudinal stresses.
- When the resistance of the joints to longitudinal stresses are inadequate and the pipes have the tendency to pull apart when pipe is laid on steep ground.

These are provided at bends, tees, and crosses to protect the pipe from unbalanced forces.

6.4.3.6 Service Connection and Metering

The project is aimed at providing water supply through meters. The consumption of water will be metered so that the consumption of water will be regulated and recorded. The off take branch of 50 mm size from the main line is proposed for each plot with valve connection to provide connection.

Structural appurtenances such as air, washout and gate valve chambers will be considered as per requirement.

Smart 40mm dia domestic multijet mechanical AMR water metering technology to be used.

Chapter 7: Sewage Piping Network

7.1 Introduction

Based on the topography of the site a comprehensive wastewater system is proposed. The wastewater generated from the plot shall be conveyed through a pipe to the main sewer line by gravity. The gravity system is mainly considered because it incurs less capital and operational costs. The total length of the wastewater network is 22.17Km.

Waste Water Generation

The quantity of wastewater generated from the market yard is calculated based on the water demand and has been estimated to be about 11.44 MLD. The wastewater generations are taken as 80% of the per capita potable water consumption & 100% of flushing water consumption.

Table 20: Wastewater Demand Calculation

S. No.	Land Use	Waste Water Generate (KLD)
	Plotted Development	
170	0-35 sqm	32.56
	36-50 sqm	89.98
1071	51 - 150 sqm	249.82
	151 - 300 sqm	2102.78
181	301 - 400 sqm	239.17
	401 - 500 sqm	177.60
	Total Plotted Development	2891.92
	Group Housing	
GH-1	Group Housing	158.19
GH-2	Group Housing	276.58
GH-3	Group Housing	85.73
GH-4	Group Housing	137.87
GH-5	Group Housing	114.35
GH-6	Group Housing	156.01
GH-7	Group Housing	103.84
GH-8	Group Housing	130.29
GH-9	Group Housing	43.18
GH-10	Group Housing	40.26
GH-11	Group Housing	36.23

S. No.	Land Use	Waste Water Generate (KLD)
GH-12	Group Housing LIG	165.19
GH-13	Group Housing EWS	89.01
GH-14	Group Housing LIG	175.92
GH-15	Group Housing EWS	165.81
GH-16	Group Housing EWS	209.68
GH-17	Group Housing	49.76
GH-18	Group Housing	50.08
	Total Group Housing	2187.97
	Commercial	1551.40
C-1	Retail / Hotel	18.89
C-2	Retail / Hotel	6.71
C-3	Retail / Hotel	18.22
C-4	Retail / Hotel	18.16
C-5	Retail / Hotel	13.85
C-6	Retail / Sector Shopping	5.69
C-7	Retail / Sector Shopping	6.25
C-8	Retail	5.84
C-9	Retail	8.92
C-10	Retail	8.92
C-11	Retail	8.92
C-12	Retail	5.39
C-13	Retail / Sector Shopping	7.31
C-14	Retail / Sector Shopping	6.38
C-15	Retail & Offices	12.21
C-15A	Petrol Pump	0.14
C-15B	Bank & ATM	2.69
C-16	Shopping Mall	20.82
C-17	Sector Shopping / convenience Store	5.33
C-18	Sector Shopping / convenience Store	4.20
C-19	Sector Shopping / convenience Store	4.44
C-20	Sector Shopping / convenience Store	3.43
C-21	Kiyasath Booth	0.15

S. No.	Land Use	Waste Water Generate (KLD)
C-22	Cinema/ Multiplex	128.04
C-23	Showroom / Mall / Hotel	17.92
C-24	Showroom / Mall / Hotel	37.58
C-25	Showroom / Mall / Hotel	30.64
C-26	Hotel	93.17
C-27	Showroom / Retail Shops	10.56
C-28	Shopping Mall with Multiplex / Hotel	48.00
C-29	Shopping Mall with Multiplex / Hotel	33.61
C-30	4/5 Star Hotel/ Resort	449.62
C-31	4/5 Star Hotel/ Resort	296.16
C-32	4/5 Star Hotel/ Resort	213.24
29.74	Total (Commercial)	1551.40
	Public Semi Public	
PSP -1	ESS - 1 9- GCC	0.20
PSP -2	1- Nursery School 3- Aanganwadi 1-Sub Post Office	17.14
PSP-3 A	ADA Office Building ICCC Office	24.05
PSP-3 B	1- Junior high school integrated 1- Nursery School 1- Sub Post office 3 - Aanganwadi	32.17
PSP -4 A	1- Inter College Integrated	48.06
PSP -4 B	1- Gas & LPG Godown	6.77
PSP -5a	1- Inter college integrated	103.35
PSP -5b	1- Police Chowki with residential facility	77.50
PSP - 6	1- Inter College integrated 1- Health Centre 1- Religious Plot	24.60
PSP 7	1- Junior high school integrated 1- Nursery School 1- Police Chowki with residential facility	46.03
PSP- 8	2 - Nursery School 1 - Junior high school integrated	34.27

S. No.	Land Use	Waste Water Generate (KLD)
PSP-9A	1- Sub Post office 1- E Suvidha centre 1- Child Care and Maternity Home 2-Anganwadi	17.32
PSP-10	1- Marriage Community Centre 1- Club 1- Sub Post office 2- E Suvidha Centre 1- ATM	14.45
PSP-11	1-Marriage Community Centre 1- Club	303.36
PSP-12	1 - Aanganwadi 1 - Health Centre	13.41
PSP- 13	1- Junior high school integrated 1- Religious Plot	24.80
PSP-14	ESS - 2	0.40
PSP-15	1- Inter College Integrated	44.96
PSP- 16	1- Junior high school integrated 1 - Aanganwadi	26.17
PSP- 17a	1- Fire Station	12.97
PSP-17	1- Police Chowki with residential facility	12.01
PSP-18	1 - Aanganwadi 1 - Health Centre 2 - Nursery School	30.40
PSP- 19 & 20	1- Junior high school integrated	27.66
PSP 21	Banquet Hall/ Conference Hall / Meeting Hall	63.38
PSP 22	Banquet Hall/ Conference Hall / Meeting Hall	64.48
PSP 23	Guest House/ Hostels	14.77
PSP 24	Banquet Hall/ Conference Hall / Meeting Hall	130.06
PSP 25	Guest House/ Hostels	14.77
PSP 26	Community Centre/ Cultural Centre/ Music, Dance & Drama Training Centre/ Art Centre	273.55
PSP 27	Nursing Home/ Clinical Laboratory/ Health Club/ Gymnasium	6.46
PSP 28	Nursing Home/ Clinical Laboratory/ Health Club/ Gymnasium/ Junior High School	6.60

S. No.	Land Use	Waste Water Generate (KLD)
PSP 29	Nursing Home/ Clinical Laboratory/ Health Club/ Gymnasium/ Junior High School	7.12
PSP 30	Theatre/ Auditorium/ Natyashala	297.88
PSP 31	Community Centre/ Cultural Centre/ Music, Dance & Drama Training Centre/ Art Centre	243.03
PSP 32	Yoga/Meditation/Satsang Bhawan/ Spiritual and Religious Discourse Centre	267.57
PSP 33	Theatre/ Auditorium/ Natyashala	284.78
PSP 35	Polytechnic / Engineering, Medical / Dental College, Management Institutes / Specialized Educational Institutes	29.41
PSP 37	Polytechnic / Engineering, Medical / Dental College, Management Institutes / Specialized Educational Institutes	113.89
PSP 38	Hospital, R&D Centre/ Research Centre	22.58
PSP 39	Polytechnic / Engineering, Medical / Dental College, Management Institutes / Specialized Educational Institutes	56.59
PSP 40	Higher Secondary/ Inter College School	39.31
PSP 41	Higher Secondary/ Inter College School/ Hospitals	70.56
PSP 42	Hospital/ R&D Centre/ Research Centre	29.77
PSP 43	Auditorium/Convention Centre/ Exhibition Place/ Art Gallery/ University	378.61
PSP 44	Higher Secondary/ Inter College School/ Hospital, R&D Centre/ Research Centre	20.46
PSP 45	Polytechnic / Engineering, Medical / Dental College, Management Institutes / Specialized Educational Institutes/ Auditorium/Convention Centre/ Exhibition Place/ Art Gallery	38.01
PSP 46	ESS	0.76
72.77	Total Public Semi Public	3416.45
	Utilities	
	UT-1 (Water Works)	3.16
	UT-2 (STP)	2.30
	UT-3	0.39
	Total Utilities	5.85
	Grand Total	10053.59

7.2 Design Brief

The gravity system is mainly considered because it gives better results and also incurs less capital and operational costs. The collection system will be designed based on CPHEEO manual and using Sewer CAD software.

7.2.1 Gravity Sewers

For design purposes, sewage flow in pipes is presumed to be steady and uniform. The sewer lines are aligned with positive slopes as much as possible and follow the gravity flow. As a design practice, the Manning's equation to be used to model flows in sewers, which are assumed to be open channel flows. Manning's equation is popular due to the ease of manipulation and because it can readily be expressed in graphic form as design charts.

7.2.2 Design formula

Manning's formula shall be adopted for the design of gravity sewers.

Were,

V = velocity in m/sec in partial flow conditions

N = Manning's roughness coefficient

R = Hydraulic radius (m)

S = Hydraulic gradient

Q = Flow rate m3/sec

A = Cross sectional area (m2)

The values of Manning's Roughness Coefficient (n) for various pipeline materials are given in the table below.

Table 21: Roughness Coefficient Considerations

Pipe Channel	Roughness Coefficient, n
Cement concrete, with collar joints, good	0.013
Cement concrete, with collar joints, fair	0.015
Concrete, spun with socket-spigot joints (RCC and PSC)	0.011
Steel, welded	0.013
Steel, riveted	0.017
Steel, slightly tuberculate	0.020
Steel, spun cement mortar lining	0.011
Cast Iron, unlined	0.013
Cast Iron, spun cement mortar lining	0.011

Pipe Channel	Roughness Coefficient, n
Plastic (PVC) smooth/ DWC Pipes	0.010

Source: CPHEEO Manual

7.2.3 Minimum Cover

The difference between the ground level and the crown of the sewer can be termed as cover. The minimum cover of 1.0m is considered in the entire network.

7.2.4 Velocity of Flow

To maintain self-cleaning velocities in the sewers, it is usual practice to maintain a minimum velocity of 0.6 m/sec at initial peak flow and 0.8 m/sec at design peak flow as recommended in paragraph 3.15.1 of the CPHEEO Manual. However, in sewers with small initial peak flows, typically the upper reaches of the system, depths will be shallow and correspondingly velocities may be less than 0.6 m/sec. In these cases, a minimum velocity of 0.3 m/sec will be allowed which is sufficient to ensure minimum self-cleansing velocity. In those cases, where a 0.3 m/sec velocity cannot be maintained and periodic sewer flushing will be required. The pipe diameter and slope shall be selected to obtain the required velocities to minimize settling problems.

7.2.5 Erosion and Maximum Velocity

To avoid scouring and erosion of sewer pipes caused by sand and other gritty material the maximum velocity in gravity sewers is recommended not to exceed 3.0 m/sec, as per section 3.15.3 of the CPHEEO Manual.

7.2.6 Depth of Flow in Sewer

As per CPHEEO Manual, sewers are to be designed to flow 0.8 full at ultimate peak flow. As suggested, the sewers will be designed for 0.5 and 0.8 for current peak flow and ultimate peak flow, respectively. Hydraulic properties of circular sections for Manning's formula are given in Table below:

Table 22: Hydraulic properties of circular sections for Manning's formula

d/D	v/V	q/Q	N0/N	v/V	q/Q
1.0	1.000	1.000	1.00	1.000	1.000
0.9	1.124	1.066	1.07	1.056	1.020
0.8	1.140	0.968	1.14	1.003	0.890
0.7	1.120	0.838	1.18	0.952	0.712
0.6	1.072	0.671	1.21	0.890	0.557
0.5	1.000	0.500	1.24	0.810	0.405

d/D	v/V	q/Q	N0/N	v/V	q/Q
0.4	0.902	0.337	1.27	0.713	0.266
0.3	0.776	0.196	1.28	0.605	0.153
0.2	0.615	0.088	1.27	0.486	0.070
0.1	0.401	0.021	1.22	0.329	0.017

Source: CPHEEO Manual

7.2.7 Groundwater Infiltration

The CPHEEO Manual on sewerage and sewage treatment specifies rates for ground water infiltration for sewers (clause 3.2.7). The groundwater infiltration rates are summarized in the table below.

Table 23: Infiltration Flow Considerations

Infiltration Condition	Units	Minimum	Maximum
Service Area	Litres/hectares	5,000	50,000
Pipe Length	Litres/ Kilometer/ day	500	5,000
Manholes	Litres/each/day	250	500

Source: CPHEEO Manual

Infiltration allowance of 500 liters/manhole/day is to be adopted during design.

7.2.8 Peak factor

Peak factors for design purposes will be in accordance with prescribed guidelines indicated in CPHEEO manual and is given below.

Table 24: Peak factor for market yard

S. No.	Contributory Population	Peak factor
1	Up to 20,000	3.00
2	20,001 to 50,000	2.50
3	50,001 to 7,50,000	2.25
4	Above 7,50,000	2.00

Source: CPHEEO Manual

The peak factor for processing area is 2.25 will be considered for design purposes.

7.2.9 Pipe Material

DWC pipes is to considered for pipe size upto 600mm diameter and RCC pipes bearing ISI mark with SRC (Sulphate Resistant Cement) lining for diameters above 600mm irrespective of the trench depth for sewer laying in the project area.

7.2.10 Bedding

The class of bedding shall be designed taking into account the required external loading conditions, geo-technical requirements such as sub soil and bearing capacity of soil encountered in respective sewer line, type, class and material of pipe used for the laying purposes as per CPHEEO manual.

7.2.11 Sewer Appurtenances and Maintenance

Sewer appurtenances such as manholes, drop manholes will be provided at appropriate locations along the sewerage network in accordance with the CPHEEO guidelines and design considerations.

7.2.12 Manholes

Manholes provide access to sewers for inspection and cleaning. They are normally provided at change in direction, change in pipe sizes, changes in gradient and at junction points. Spacing of manholes depends upon type of sewer cleaning, manually or by mechanical devices. Considering the sewers to be cleaned manually, the minimum distance between manholes of 30 m is adopted for sewer sizes up to 400 mm and larger spacing up to 100 meters for large diameter sewers. The shape and size of the manholes for different depths shall be as indicated below in table below.

Table 25: Manhole Schedule

Types of Manholes	Description	Size of manholes
Circular Manholes	For depth up to 1.65m	0.90m diameter
Circular Manholes	For depth from 1.65m to 2.29m	1.20 m diameter
Circular Manholes	For depth from 2.30m to 9.0m	1.50 m diameter
Circular Manholes	For depth above 9.0m	1.80 m diameter

Source: CPHEEO Manual

7.2.13 Manhole spacing

Considering structural advantage, circular manholes are being proposed in general. Diameter of manholes shall be as per the CPHEEO Manual. Manholes should be built at changes of alignment, gradient or diameters, and at the junction of two or more sewers. On sewers which are to be cleaned manually and cannot be entered for cleaning or inspection, the maximum distance between manholes shall be per the CPHEEO Manual.

7.2.14 Drop Manholes

When there is a difference in level exceeding 60 cm between the invert level of the incoming branch sewer and the invert level of the junction manhole, a drop is provided to the incoming sewer and the manhole is designed as a drop manhole.

7.2.15 Plot Service Connections

The basic criteria for design & installation of the service sewers are summarized below:

The minimum diameter of the service sewer shall be 160mm

The service sewer shall be laid up to the property line/Building, at slope not less than 1 percent, i.e. 1 in 100.

7.3 Design Parameters

Table 26: Recommended Design Parameters

SN	Description	Unit	Recommended parameters	Justification
A	Waste Water Generation			
1	% of WS converted in to waste water	%	80	CPHEEO manual recommended 80%
2	Rate of Infiltration	%	500 litres/manhole/day	As per the CPHEEO manual.
3	Peak Factor		2.25	As per CPHEEO manual.
B	Hydraulic Design			
1	Hydraulic Design		Manning's formula	As per CPHEEO manual.
C	Minimum Sewer Diameter in mm			
1	Minimum diameter	mm	200	The 200mm dia is preferable keeping in view of velocities in initial reaches and based on economic considerations
D	Sewer Material			
1	Material for sanitary sewer		For diameter size upto 600 mm dia DWC pipe and dia above 600mm RCC Np3 pipes	As per the best practice
2	Manning's "η"		0.01 – DWC pipes 0.013 – RCC NP3 pipes	Considering the recommended pipe materials and the fact that the pipes will carry sewage (which have sludge/solids), conservative value of 0.011 is

SN	Description	Unit	Recommended parameters	Justification
				recommended for UPVC pipes and 0.013 for RCC pipes.
E	Limiting Velocities			
1	Minimum	m/sec	0.6	It is understood that the self-cleansing Velocity may not be achieved for all the sewers, particularly in the initial reaches, due to small contributory population. In such cases self-cleaning velocity shall be ensured at least for full flow conditions of the pipe.
2	Maximum	m/sec	3.0	The waste water may carry some solids, such as grit. Therefore, it is desirable to restrict the maximum velocity to 3m/sec, to prevent the damage to the inner surface of the sewer.
F	Bedding			
1	Type of Bedding		Plain Cement Concrete Cradle Bedding	The type of bedding is finalized based on diameter of the pipe and depth.
G	Earth Cover			
1	Minimum Cover		Minimum 1m cover is recommended for sewerage designs	Based on traffic load consideration minimum 1m cover is recommended and also recommended in CPHEEO manual
H	Limiting Depth of flow to Diameter			
1	d/D ratio		0.80	As per CPHEEO manual
I	Manhole Construction			
1	Material		Brick & RCC	To ensure strong and robust construction and its ability to maintain uniform & high construction quality. The high degree of water tightness reduces the potential of infiltration. Its corrosion resistance (after suitable lining) is important in the prevailing environment.

SN	Description	Unit	Recommended parameters	Justification
				Brick manholes for depth upto 2.3m and beyond 2.30 m depth RCC manholes are recommended.
J	Spacing of Manholes – Maximum interval on straight reaches			
1	Spacing	m	The maximum distance between manholes should be 30m as per CPHEEO. Spacing of manholes shall be located at: I. change of direction II. change of slope III. change of pipe diameter IV. change of material V. beginning of each line VI. at points of branches and in straight reaches.	Considering the operational problems for sewer cleaning during maintenance, it is preferable to provide the manhole Spacing as specified. As mechanical cleaning equipment is enticement and cost of equipment is also included in the project cost, 30m spacing as specified in DPR may not be necessary. To be a safer side a spacing of 30m for all diameters may be provided.
K	Manhole sizes			
1	Circular 0.90 to 1.65m > 1.65 to 2.3m > 2.30 depth		 0.90 1.20 1.50	Circular manholes are structurally more efficient to resist earth pressure. Suggested to avoid rectangular manholes. As per IS – 4111: 1986, Circular type manholes are much stronger than rectangular & arch type manholes. The criteria is based on the CPHEEO manual.
L	Drop Across Manhole – Sewer Transition			
1	Drop Manhole		Where difference between incoming and outgoing inverts exceeds 0.60m	When a sewer connects with another sewer and the difference in levels between both lines is more than 600mm, a drop connection is to be provided incorporating a vertical drop pipe

SN	Description	Unit	Recommended parameters	Justification
				from the higher sewer to the lower one.
M	Plot Service Connections			
1	Minimum Diameter	mm	160	The minimum diameter is required to carry the heavy solids and other matter without choking, and to facilitate the effective cleaning, without damage to the pipe
2	Minimum gradient for plot service	%	1 in 100	The standard practice is to maintain the slope of 1in 100 to ensure better hydraulic conditions.

Chapter 8: Power Infrastructure

Power Supply in the proposed Atal Puram township is to make quality and reliable power available for 24/7 supply with Smart Grid & Smart Metering with energy efficient transmission and automation in distribution. The power supply system will be with underground cables.

The following aspects needs to be considered while carrying out the design & execution of the Atal Puram township-

a) Maintaining high availability and as well reliability in the system
b) More redundancy (n-1 design criteria will be followed)
c) Ensuring Personal & System Safety
d) Space optimization
e) Operational and maintenance ease
f) Control and monitoring
g) Economic
h) Obtain the fault level at each buses within permissible limits
i) Voltage drop and AT & C losses within permissible limit.
j) Ensuring Zero % theft.
k) Application of state-of-the-art technology
l) Service proven design
m) Use of interchangeable, modular components
n) Environment friendly
o) Adherence to operational performance requirements

The power distribution system will be developed based on Smart Grid concept. All 33 kV and 11 kV feeders of substations and supply point of the plot will be metered and proper energy management system will be established.

8.1 Components of Smart Power Supply

The objective of Smart Township concept is to implement an electrical grid with automation, communication and IT systems which is named as smart grid.

This will be adopted with various features such as:

- Advanced Metering Infrastructure (AMI) is an integrated system of smart meters, communication networks and data management system that enables two-way communication between utilities and customer.
- Advanced Distribution Management System (ADMS) provides contemporary customer requirements such as demand management, real time network monitoring and control, automatic restoration of power supply.

- Outage Management System that brings down outage duration and ensures reliable supply to consumers.
- Peak Load Management (PLM) is one of the smart grid initiatives through which utility can reduce the peak demand.
- Power Quality Management (PQM) is a measure of the fitness of electrical power fed into the consumer centres.
- Demand Response is used to refer to mechanisms used to encourage consumers to reduce demand.
- Smart Street Lighting with web-based application for remote monitoring and control.
- Supervisory Control and Data Acquisition (SCADA) for remote control and data acquisition.

It is prudent to introduce intelligence in all sectors of power distribution system through smart grid application which may facilitate efficient and reliable end-to-end intelligent two-way delivery system from source to consumer.

Implementation of above-mentioned technologies ensure more reliable power, smart utilization of available technology to make today's cumbersome and sophisticated activities easier and accurate. Most importantly, consumer satisfaction becomes the ultimate motto and customers shall be empowered to interact with utility. Thus, implementation of smart grid technology is inevitable for Smart City concept.

The international best practices are followed in entire township to make the township smart, energy efficient, sustainable and user friendly. The main components used to make Smart Power infrastructure are as follows-

Table 27: main components of smart power infrastructure

S.NO.	SMART POWER COMPONENT	ADVANTAGE
1	Distribution of power at high voltage (33kV & 11kV) with 3 nos. of Distribution substation	Reduce Distribution losses.
2	Smart metering & Advanced metering Infrastructure	Reduce Theft of power supply & reduce time of fault detection & diagnosis.
3	Smart Grid & Smart Energy Management	Increase Reliability & quality of power, load management in the city.
4	Ring Main Unit (RMU) for 11kV Distribution system	Increase power reliability & reduce time of fault detection & diagnosis.

	with self-healing system & compact substation (CSS)	
5	Underground cabling system using Trench/duct bank	Probability of occurrence of fault is less.
6	Power factor improvement by using APFC at the customer end	Reduce power consumption of the Customer & Utilities.
7	Smart Street Lighting & LED Light fixtures	Optimized power requirement.
8	Required arrangement by customer shall be made to adhere power quality parameters at their end	Reduce power consumption & Increase quality of power in the city.
9	Energy Efficient Motors (IE-3 motors) & VFDs	Reduce power consumption of the Utilities.

8.2 Scope of Work

This specification is intended to cover the *design, detailed Engineering, construction/ manufacture, procurement of electrical equipment's, assembly, testing at manufacturer's works, supply in properly packed condition for transport to site, transportation, Erection, site testing and commissioning,* including preliminary acceptance test, performance guarantee and post commissioning services and insurance during transit, storage, erection and commissioning till end of defect liabilities period with all accessories for efficient and ease of operation of township, Agra.

The Scope includes but not limited to Supply, Installation, testing & commissioning (SITC) of 3 nos. of 33/11kV Distribution substations including Lighting, earthing & cabling system, Ring Main units (RMUs) for power supply at each plot, RCC trench & associated manholes for underground cabling system, Compact Substation (CSS) for power supply of Street lighting & miscellaneous loads, 33kV & 11kV power cables.

The scope also include all civil works (Design, Supply, construction and handling over) required for all electrical equipments i.e. civil works for 33/11kV substation such as building, Transformer foundations and cable trench, boundary wall, fencing works, gate, internal road, drains, control room etc., foundation for RMUs (at each plot) & CSS, all civil works for RCC trench & associated manholes for underground cabling system for Atal Puram township.

The scope shall also include supply of mandatory spares and special Tools as specified.

- Cable shall be laid in groups with uniform spacing arrangement in trays to sustain the loads.
- Manhole chambers for RCC trench should have sufficient space inside for cable laying, bending (20D) and jointing as well as for future maintenance as given in drawing.

In addition to the standards provided in the Technical specification, Contractor shall also observe the latest editions of the following standards, specification or requirements. In case of any conflict, technical advice from EIC shall be obtained.

The BIDDER shall be responsible for complete satisfactory working of system with guaranteed parameters. All the major equipment shall be installed tested and commissioned under supervision of representative of original manufacturer of respective equipment in the presence of commissioning agent appointed by the employer.

The scope includes but not limited to SITC of following items-

SL No	Description	Quantity	Remarks
Power Transformers	33/ 11kV, 10MVA, Oil type, two winding, 3 Phase, Dyn11, 50Hz, ONAN/ ONAF Transformer with 8.35% impedance on 10 MVA with OLTC.	6 nos.(4 Nos in EPC Package)	2 at ESS-2 and 1 Nos at ESS-1&3
33kV Switchgears	Indoor type, GIS (Refer SLD for more detail).	3 nos.	1 at each S/S
11kV Switchgears	Indoor type, GIS (Refer SLD for more detail).	3 nos.	1 at each S/S
Distribution Transformer	11/ 0.433kV, 250kVA, Dry type, two winding, 3 phase, Dyn11, 50Hz, AN, off circuit tap changer with +/-5% in steps of 2.5% on HV side for station transformer & 4% impedance with losses as per CBIP.	6 nos.	2 at each substation
Lighting Transformer	415/415V, 50kVA, Dry type, two winding, 3 phase, Dyn11, 50Hz, off circuit tap changer +/-5% with 4% impedance.	3 nos.	1 at each substation
11kV RMUs	3 way RMUs(2 nos. incomer Load break switch & 1 nos. of outgoing VCB) with FPI (Fault passage indicator) and FRTU (Field remote terminal unit) for SCADA integration.	14 nos.	

SL No	Description	Quantity	Remarks
11kV RMUs	4 way RMUs(2 nos. incomer Load break switch & 2 nos. of outgoing VCB) with FPI (Fault passage indicator) and FRTU (Field remote terminal unit) for SCADA integration.	24 nos.	
11kV RMUs	5 way RMUs(2 nos. incomer Load break switch & 3 nos. of outgoing VCB) with FPI (Fault passage indicator) and FRTU (Field remote terminal unit) for SCADA integration.	51 nos.	
Smart Meter	3-Phase, 4wire, HT, CT Operated, TOD Smart Meter.	89 nos.	
33kV Cables	33KV(E), 3C X 300 sq.mm, armoured , XLPE insulated, stranded Aluminium conductor, screened by extruded semi-conducting compound for the conductor followed with copper tape and inner and outer extruded PVC sheath compound Type-ST2.	11.54 KM	2nos 33kV incoming line for ESS-2 and One 33kV incoming line for ESS-1 and ESS-3.
11kV Cables	11KV(E), 3C X 300 sq.mm, armoured , XLPE insulated, stranded Aluminium conductor, screened by extruded semi-conducting compound for the conductor followed with copper tape and inner and outer extruded PVC sheath compound Type-ST2.	41.52 KM	2nos 11kV Interconnected double run line for ESS-2 and 1no 11kV Interconnected double run line for ESS-1 & 3.
33kV Cable termination kits & joints	Cable Termination kits & straight joints for 33KV (E), 3C X 300 sq.mm cables.	1 Lot	
11kV Cable termination kits & joints	Cable Termination kits & straight joints for 11KV (E), 3C X 300 sq.mm cables.	1 Lot	
Compact substation (CSS)	11/ 0.433kV CSS, having 11kV, HT Panel with 2 incomers LBS and 1 outgoing self-powered VCBs with 250kVA, dry type, two winding, 3 phase, Dyn11, 50Hz, AN, Transformer, LT panel, APFC, FPI & FRTU.	3	1 at each substation

SL No	Description	Quantity	Remarks
Common service trench(CST)	Construction of RCC trench- & associated manholes for underground cabling system and laying of 33kV, 11kV, LT (Street lighting), C&I cables inside RCC trench. including excavation and backfilling with soil including warning tape over the trench, etc.	1 Lot	
Earthing & Lightning protection System	Equipment & safety earthing of all equipment's in 33/11kV substations, RMUs & CSS.	1 lot	
Lighting system	Lighting system including internal wiring & conducting, indoor & outdoor fixtures, including flood lights, emergency & exit light fixtures, switch, power sockets & plugs, Lighting mast, LDBs, PDBs etc. for 33/11kV substations.	1 lot	
Auxiliary systems for 33/11kV Substations	Electrical Auxiliaries (ACDB, DCDB, UPS, Lead Acid Plante type Batteries (1) x 100% rated battery associated with 2 x 100% float cum boost chargers for DC system, exhaust fans_corrission proof, welding sockets, Mechanical Auxiliaries (HVAC, Fire Hydrant, Fire Detection & Alarm, Overhead Crane, Nitrogen Injection fire prevention method system for power transformers etc.), Control Cables & terminations etc.	3 lot	1 at each substation
DG Sets:	Diesel Generator sets with AMF panel for Emergency power Backup for 33/11 kV Substations	3 nos.	1 at each substation
Cabling System	Cabling system including cable trench trays & supports, terminations, joints etc. for 33/11kV substations.	1 lot	
Civil works	Civil works for 33/11kV substation such as building, Transformer foundations and cable trench, boundary wall, fencing works, gate, internal road, drains, control room etc., foundation for RMUs (at each plot) & CSS.	1 lot	
SCADA & Smart Grid System	Smart grid system includes ADMS, AMI, SCADA, , Demand response, costumer portal, Automation of the substations.	1 lot	

Detailed Technical specification of each equipment's needs to be referred in respective equipment technical specifications.

8.3 Applicable Codes & Power Demand Norms

Relevant norms for calculating the power demand for different product mixes inside project boundary are being reproduced here as under which forms the basis for power demand calculations.

Table 28: Power demand norms

S. NO	CODES & STANDARDS	
1	General	UP Electricity Supply code 2018
2	General	Energy Conservation Building Code 2009
3	General	Indian Electricity Rules
4	General	National Building Code 2005
5	General	Guidelines for Determination of Connected Load DVVNL, U.P
6	General	Guideline to Design Electrical Network - NPCL
7	General	Power engineer's handbook
8	CEA	Manual on Transmission planning Criteria
9	CEA	Design Criteria/Guidelines for 765/400/220/132 kV
10	NEC – NFPA 70	Sub-Stations and Switchyard of Thermal/Hydro Sub-Stations and Switchyard of Thermal/Hydro Power Projects
11	IS 3043/IEEE-80	Power Projects
12	IS 732	Code of practice for Electrical wiring installation
13	IS 3427 / IEC-62271-	Metal Clad Switchgear
14	IS 13118/ IEC-62271-100/IEC60947	Circuit Breakers
15	IS 2705	Current transformer
16	IS 3156	Potential Transformer
17	IS 2544	Bus bar support insulators
18	IS 3231	Electrical Relays for Power System Protection
19	IS 13703	HRC Fuses

20	IS 3646	Code of Practice for interior illumination
21	IS 1944	Code of Practice for road lighting
22	IEC 62305	Protection of buildings and allied structures against Lightning code of practice
23	IS 7098	Specification for XLPE insulated PVC sheathed cables
24	IS 1554	Specification for PVC insulated cables
25	IS: 1651	For Stationary cells and batteries, with Tubular positive plates specification.
26	IS 9000	For Basic climatic & mechanical durability tests for components for electronic and electrical equipment
27	IS 6297	For Transformer and inductors (Power, Audio, Pulse & switching) for electronic equipment
28	IS 6619	For Semiconductor rectifier equipment code
29	IS 5082	For Thyristor converters
30	IS 2026/IEC 600076	Power transformers

8.4 Terminal Points

8.4.1 At 33kV Incomer-

Terminal point for 33kV incomer shall be outgoings of the UPTCL 33kV GIS switchgears placed in 132/33kV GIS substation. The 33kV cable originating from outgoing of the UPTCL 33kV GIS switchgear. 132/33kV Substation which includes- 40 MVA Power transformers, 132kV GIS, 33kV GIS 132kV cables, 132kV Transmission lines and any facility required for 132kV GIS substation shall not be in bidder's scope. Any work required for arrangement of 33kV incoming substation from UPTCL 33kV GIS substation is in bidders scope.

8.4.2 At Consumer Plot-

Terminal point for 33kV & 11kV distribution shall be up-to Smart meter placed at the outgoing of the 33kV & 11kV RMUs placed at HT consumer plots and Feeder pillar placed at LT consumer polts . Cable beyond the Smart meter at RMU and Feeder pillar shall be in consumers' (plot owner's) scope. All 33kV, 11kV, LT, control cables & its terminations & joints, RMUs, FRTUs, in-built DC system, Smart meter & all arrangement required Smart grid & SCADA communication as per specifications shall be in bidder's scope.

8.4.3 Exclusion List

i.) 132/33kV Substation Augmentation, Power Transformers & its U/G cabling for incomer.

ii.) LT Smart meters inside consumer's plot.

iii.) The following exclusions and provisions apply to the substation locations under the EPC package:

a. **Transformer Configuration:**
   i. ESS-2 will proceed with **2 nos. of power transformers** as planned.
   ii. ESS-1 and ESS-3 will each have **1x10 MVA transformer** instead of the originally planned 2x10 MVA transformers.

b. **Exclusions from EPC Scope:**
   i. One transformer at ESS-1 and ESS-3.
   ii. One 33kV incoming line each for ESS-1 and ESS-3.
   iii. One line of 33kV and 11kV interconnections between ESS-1 and ESS-3.

c. **Future Infrastructure Provision:**
   i. Adequate space for future infrastructure, such as trenches and substation expansions, must be incorporated into the design.

8.5 Codes And Standards

i.) All equipment, system and services covered under this specification shall comply with all currently applicable statutes, regulations and safety codes of the country. Nothing in this specification shall be construed to relieve the Bidder of this responsibility.

ii.) The standards not indicated in the specification are also acceptable after approval, if they are established to be equal or superior to the standards indicated in the specification.

iii.) The metric units/SI units shall be used in all data/drawings to be submitted against this package.

iv.) The Bidder shall furnish the English translations of all standards to which the equipment and systems offered are conforming to, as and when required by the Owner.

v.) The work shall be performed in conformity with these specifications standards and Codes of Practice specified or referred in the tender. In case of any conflict the stipulations under these specifications shall govern.

vi.) In addition, work shall also conform to the requirements of latest editions/ amendments of the following:

The Indian Electricity Act and Rules framed there under

a) Fire Insurance Regulations
b) Regulations laid down by the Chief Electrical Inspectorate
c) Regulations laid down by the Factory Inspectorate
d) Applicable Codes of Practice of the Bureau of Indian Standards
e) Any other regulations laid down by the Central, State or Local Authorities from time to time and during the execution of this contract.

8.6 Planning And Design Criteria

8.6.1 General Design Criteria

The design concept of electrical system is based on providing safe, reliable & stable power and efficient performance of electrical system.

a) The design standard described herein is generally in compliance with the latest Indian Standards, IEC and Code of Practices of India.
b) All electrical installations shall confirm to the latest CEA (Central Electricity Authority) guidelines 2021
c) Latest National and International Standards shall be used for each electrical equipment design in Atal Puram township.

8.6.2 Design Ambient

The electrical equipment shall be designed with due consideration to the following ambient conditions:

a) Design ambient temperature : 50°C.
b) Minimum ambient temperature : 9.8°C.
c) Maximum ambient temperature : 43.1°C.
d) Equipment design temperature range : 5°C to 45°C.
e) Max. Ambient relative humidity : 95% RH
f) Seismic Zone : Between Zone II & III

8.6.3 Voltage Levels

Following voltage levels shall be used:

a) 33 kV- Transmission from UPTCL 132/33kV GIS source substations to 33kV GIS substation of Atal Puram township.
b) 33 kV- Consumer having load more than 4 MVA as per DVNNL regulation.
c) 11kV- Consumer having load up-to 4 MVA as per DVVNL regulation.

d) 415 V/230V- LV supply for LV auxiliary loads at substations & CSS to feeder pillar, UPS & street lighting and residential loads which is less than 56KVA.
e) 24 V DC –DC voltage for RMUs & control and instrumentation.

Table 29:: Voltage levels

Item	Voltage	Neutral Earthing
33 & 11kV	33 & 11 kV ±10%, 50 Hz ±3%, 3-phase	Solidly earthed
LV Power Distribution System	415V ±10%, 50 Hz ±3%, 3Ph, 4W system 230 V ±10%, 50 Hz ±3%, 1Ph, 2W system	Solidly earthed
Uninterrupted Power Supply (UPS)	240 ±1% V safe AC, 50 Hz, 2W system.	Solidly earthed
DC System	a)110 V (+)10% to (-)15% DC b) 24 V (+)10% to (-)15% DC	Ungrounded

8.6.4 Basic Insulation Level

Unless stated otherwise in the individual equipment/system specification, the insulation levels shall be as given below:

Table 30:: Basic insulation level

Nominal System Voltage	**Highest System Voltage**	**Rated 1 min power freq. Withstand voltage (KVRMS)**	**Rated Lightning Impulse Withstand Voltage (KVPEAK)**
33 kV	36 kV	70 kVrms	170 kVpeak
11 kV	12kV	28 kVrms	75 kVpeak
415 V	1.1 kV	3 kVrms	-

8.6.5 Fault Levels

Different equipment shall be designed for the following through fault withstand capabilities fault levels as mentioned below: -

Table 31:Fault level

System	Fault Level	Duration
33 kV	26.2kA	1 second
11 kV	18.3kA	1 second
415V	50kA	1 second
110V DC	15 kA	1 second

8.7 Assessment of Power Demand for Atal Puram Township.

Power demand is arrived for various categories of consumers as detailed below as per ECBC.

Table 32: power demand for standards

Classification	Standards Watt/Sq.m (Energy conversation building code)	Diversity Factor	Connected Load (MW)
Commercial	68.9	0.75	16.22
Residential	27.5	0.50	17.21
Residential - EWS/LIG & Hostel	11.4	0.50	1.05
Roads, open space, etc.	2.7	0.50	0.53
Public / Semi Public / Services etc.	64.6	0.75	31.75
Utilities	64.6	0.75	2.12
Total			**68.88**

Table 33: Assessment of Power Demand For Atal Puram

CLASSIFICATION	TOTAL POWER DEMAND (MW)	Total Power Demand (MVA) 0.95 PF.
Commercial	12.17	12.81
Residential	8.60	9.06
Residential - EWS/LIG & Hostel	0.52	0.55

Roads, open space, etc.	0.27	0.28
Public / Semi Public / Services etc.	23.81	25.06
Utilities	1.59	1.68
Total	**46.96**	**49.43**
Ultimate Power Demand Load (MW) at 11kV level		**49.43 MVA**
Ultimate Power Demand Load (MW) after considering 0.7 overall diversity factor at 220kV or 132kV level		**34.60**

Note: Total Power Demand Load (MW) after considering 0.7 overall diversity factor and Total Power Demand Load (MVA) @ 0.95 power factor.

8.8 Power Source Identification

The power demand for the township can be broadly classified in two phases, first phase which mainly caters to the power demand for residential buildings. In the next phase power supply caters to the commercial & Public sector buildings.

8.8.1 Power Source for Construction Purpose

33kV power supply for construction purpose can be sourced from nearest 33/11kV substation or 132/33kV sub-station at Bad village which is approximately 1 km away from proposed Atal Puram township.

8.8.2 Power Source for Permanent Power

DVVNL is to provide the incoming power supply to the project area for 33 KV & below voltage levels. Based on the discussion held, source of power will be 132/33 KV GIS substation at Bad village which is approximately 1 km away from proposed Atal Puram Township. Confirmation of source from competent authority is pending. Any change in power source will impact the entire design, BOQ and cost estimates.

8.9 Power Distribution Philosophy

8.9.1 Power Distribution Philosophy for Permanent Power Requirement

DESIGN ASPECTS

The following aspects were considered while carrying out the case studies.

i. Maintaining high availability and reliability in the system
ii. Ensuring Safety in the working area

iii. Space optimization
iv. Operational and maintenance ease
v. Inventory
vi. Control and monitoring
vii. Economic
viii. To obtain the fault level at each bus within permissible limits

According to existing power supply code prescribed by UP State Electricity Regulatory Commission following are the norms adopted for the selection of the power supply voltage level.

- All installations (other than irrigation pumping and agricultural services) with a contracted load less than 5 kW: Single phase at 230 V
- Irrigation pumping and agricultural services and all installations with a contracted load of 5 kW or more and up to 50kW/56kVA: 3 Phase, 4 wire at 440 V
- Contracted load exceeding 56kVA and up to 4000 kVA: 3 Phase at 6.6 kV / 11 kV
- Contracted load exceeding 4000 kVA and up to 10000 kVA: 3 Phase at 33 kV
- Contracted load exceeding 10000 kVA: 3 Phase at 66 kV/ 110kV/ 132kV/ 220kV

Power Distribution system will consist of the following major components-

- Three (3) nos. 33/11 kV Load Block Step down Substation (LBSS)
- 33kV & 11kV Ring Main Units (RMUs)- at HT consumer plot
- 11/0.433kV Compact Substation (CSS)- for residential plots, Street, Park & Common area Lighting
- FP (Feeder Pillars)- for LV Consumer plot
- 33 kV & 11 kV Distribution system using underground cables covering entire smart township.

In general Transmission and Distribution network will be designed to cater to the load requirement of different consumers as per guidelines of UP State Electricity Regulatory Commission:

- Up to 4MVA, Consumer : at 11 kV Voltage
- Above 4 MVA, Consumer : at 33 kV Voltage

All the feeders of 33kV & 11kV will feed the consumers in ring networks for better reliability. Each ring will be formed by connecting nearby consumers. Considering all optimized distribution system design aspect like de-rating factors, current carrying capacity of cables & UP Electricity regulation maximum load on each ring shall be limited as follows-

- Up to 4.5 MVA : for 11 kV Ring with 3C, 300sqmm cable
- Up to 12.5 MVA : for 33 kV Ring with 3C, 300sqmm cable

All equipment of power transmission and distribution network, including all sub-systems shall be of proven design and meets the following design criteria: -

- High reliability and availability of Equipment and system meant for Power Distribution.
- More redundancy (n-1 design criteria will be followed).
- Voltage drop within permissible limit.
- AT & C losses are within permissible limit.
- To ensure Zero % theft.
- Application of state-of-the-art technology.
- Service proven design.
- Use of interchangeable, modular components.
- System safety.
- Environment friendly.
- Adherence to operational performance requirements

The distribution system will be developed based on Smart Grid concept. All 33 kV and 11 kV feeders of substations and supply point of the tenants will be metered, and proper energy management system will be established.

a) 33/11 kV Substations

3 nos. of 33/11 kV substations are planned for entire township distribution.

The entire distribution network is proposed at 33kV & 11kV voltage level. As per Uttar Pradesh electricity code any consumer above 4 MVA load is envisaged with 33kV supply & below that supply from 11kV needs to be considered.

All the feeders of 33kV & 11kV will feed the consumers in ring networks for better reliability. Maximum load in a 33kV ring will be restricted to 12.5MVA, while for 11kV it will be restricted to 4.5MVA.

b) 33kV & 11kV Ring Main Units (RMUs)

In the event of fault in Underground Network, appropriate measures are required for fault-location and rectification. Ring Topology of Distribution using Ring Main Unit can reduces downtime by huge factor in U/G Cable Distribution. Ring Main Units are deployed in a manner, that every Load Centre has an alternative source of supply available (Source Redundancy).

In the event of fault, the faulty section can be isolated and supply to the load-centres can be resumed.

c) 11kV/0.433kV Compact Substations(CSS)

11kV/0.433kV CSS comprising of 11kV 3 Way Gas based RMU (2 Load Break Switch + 1 VCB) + dry type distribution transformer + LT switchgear will be required to feed the LT load of Common services like Open space lighting, parks & Street Lighting etc. Further distribution from CSS to LT consumers will be through feeder pillar boards.

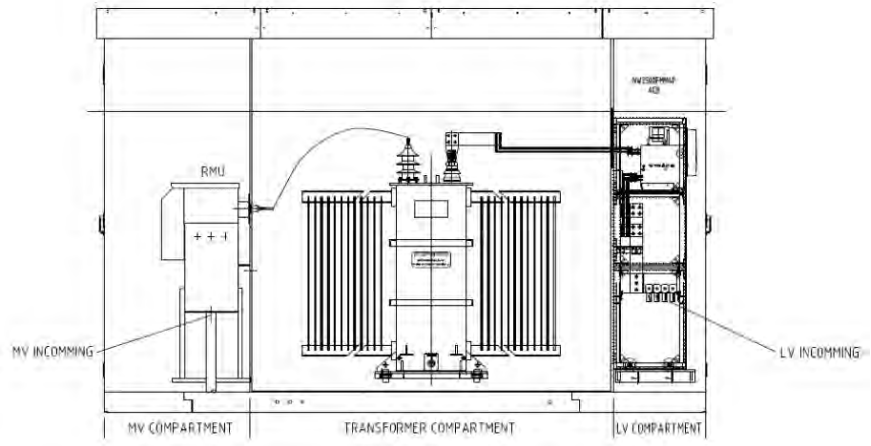


Figure 11: 11KV/0.433KV Compact Substations (CSS)

d) **Underground cable laying-**

The power distribution inside the Atal Puram township till each plot & common services will be through 11kV underground cables which will be accommodated in the R.O.W of the proposed roads in identified trench /duct bank corridors through ring main configuration originating from the near- by 33/11kV proposed 3 substations.

8.10 RCC Trench(Common Service Trench)

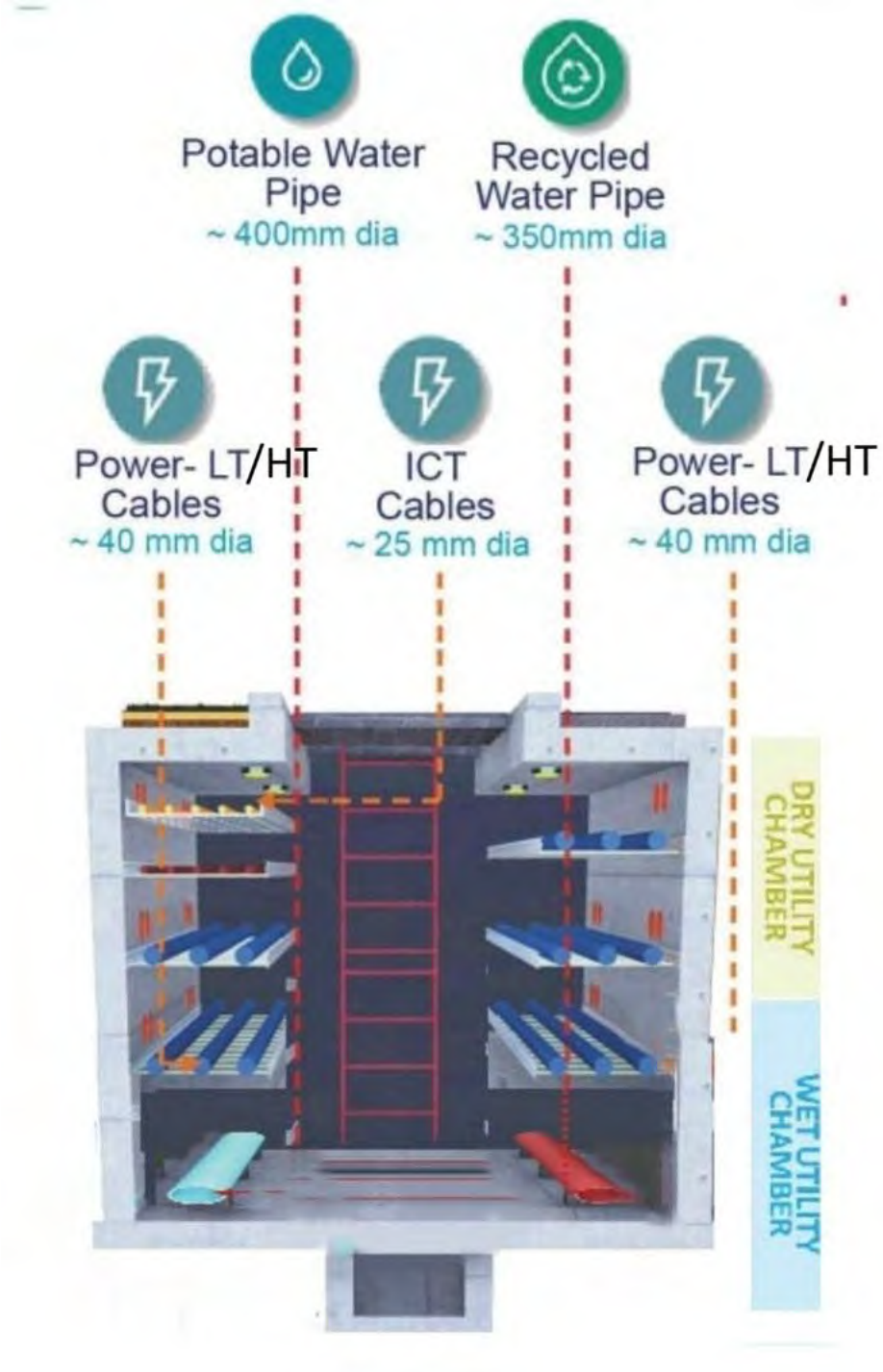
To facilitate plug and play connectivity, ease of maintenance and future access for power network cables without service disruptions to road users, it is proposed to provide standardized cable trenches & common service tunnels.

An integrated common service tunnel (CST) is proposed within the right of way under industrial sub-arterial road wherever found necessary. By providing the utilities along the road's carriageway the maintenance or upgradation of works would have minimal impact on traffic flow, with low maintenance cost. This would also help developments connect to the services without affecting the roads and traffic. The schematic design of utilities different for all the hierarchy of roads and for each type of road the placement of underground utilities is varying with respect to the requirements. The common service tunnel has been proposed in major roads to optimize the operation and maintenance of services The advantages of CST are as follows,

- Reduction of maintenance manholes,
- One-time relocation,
- Less excavation and repair compared to separate cable ducts for each service.
- Allow rapid access to all utilities without having to dig access trenches and one of the greatest advantages is public safety.
- Stacking of most services in a single corridor

All the power cables including the cables from transmission stations to further distribution stations & to the consumers is proposed to be laid underground either in

trench or in pipes/ducts according to the number of cables drawn. Underground power lines, whether in common or separate channels, prevent utility cables from blocking roads, thus speeding emergency access attire natural disasters such as earthquakes, hurricanes.



Typical (CST) Common Service trench cross section cable arrangement

8.11 Planning For Power Distribution

Space requirements of following external and Internal Electrical Infrastructure are shown in the below Table:

Table 34: Space Requirement for Power Distribution

DESCRIPTION	AREA	REMARKS
33/11kV Substation-1	0.7 Acre	
33/11kV Substation-2	0.7 Acre	
33/11kV Substation-3	0.85 Acres	Area considered is more since it is having central control room having Smart Grid & SCADA system
11kV Individual substations in the ring including DC system, FRTU	10 sqmtr. per substation	Planned in each HT Consumers plot
Compact substations for common areas, Street lighting etc.	25 sqmtr. per substation	Planned in Residential LT consumers and outdoor green area

8.12 Design Guidelines & International Best Practice Parameters For Township Area

There are following design guidelines and international best practice parameters for power infrastructure which shall be followed in entire township to make this city smart, energy efficient, sustainable and user friendly. It is proposed that every consumer coming in this Atal Puram township shall bound to follow the same:

a) All building shall meet Green building standards (Green Township / Green Factory Norms).
b) Power automation system shall be considered including substation automation system from source end to consumer end including, SCADA, advanced metering infrastructure and self-healing system, power quality improvement, Outage management system, demand response for increasing and improving power reliability.
c) Smart meters shall be considered for 100% requirement including Receiving Station, Distribution network and Consumer points.
d) Lighting load shall be considered as per ECBC-2017 which is used for energy efficient building.

e) Use of Compact substations (CSS) consisting of HT panel, Transformer & LT panels as a combined unit, which shall be placed outdoor at appropriate place, with such arrangement, there shall be a reduction in cost involved in civil building, land cost and the electrical components purchased individually.
f) Use of Automatic power factor correction (APFC) panels to improve power factor to 0.95/ 0.98. This will reduce maximum power demand for the plant and demand charges of State Electricity Board.
g) It is the responsibility of the bidder to maintain the power quality parameters within the prescribed limits.

8.13 Design & Drawings

Following studies and design calculations shall be performed as per relevant IS/IEC/IEEE:

- System Short circuit analysis.
- System Stability studies.
- Relay Coordination and relay settings for entire plant.
- Load Flow studies.
- Transformer sizing calculations.
- Earthing & lightning protection design.
- LT service Transformer sizing calculations
- Fire Detection and alarm system Design.
- All (HT /LT / DC) Cable sizing calculations.
- DC System Sizing calculation.
- UPS Sizing calculations.
- Lighting calculations.
- Preparation of General arrangement drawings, Cabling, Lighting, Earthing and lightning protection layouts for Substation.
- Interconnection schedules, Cable schedules
- Block interlock diagram for LT & HT switchgears
- Preparation of communication system layout & architecture.
- Preparation of area illumination layout
- Installation and Operation & Maintenance manual

The drawings accompanying the tender document are indicative of the nature of work and issued for tendering purpose only. The purpose of these drawings is to enable the tenderer to make an offer in line with the requirements of the owner. However the contactor shall prepare drawings for all system based on tender drawings and Bill of materials and GTP and then submit the same for Employers Representative approval. Construction shall be carried out as per approved construction drawings/ specifications issued/ approved by the Employers Representative during the course of execution of work. Detailed construction drawings on the basis of which actual execution of work is to proceed will be furnished to the Bidder progressively based on the detailed construction program evolved after the award of work and also based on construction progress achieved by the Bidder.

Prospective tenderer shall be deemed to have studied the drawings enclosed with tender or displayed for scrutiny and fully understood the nature and magnitude of the work before submitting the bids.

After each job completion, Bidder shall prepare 'As-Built' drawings. Final certified 'As- Built' drawings shall be submitted by the Bidder to owner in bound volumes with one set of reproducible original sepia plus ten sets of prints.

Bidder shall submit equipment manufacturer's drawing for supply items like pushbutton stations, lighting transformers, marshalling boxes etc. for the review of Employers Representative in five sets of prints and the approval in writing of the Employers Representative shall be obtained before commencing manufacture. However, it is to be understood that the review of drawings shall not absolve the basic responsibility of Bidder to check total compliance to specifications included in tender document. Final drawings in bound volumes with one set of reproducible original sepia plus ten sets of prints shall be submitted by Bidder along with supply of materials at site.

8.14 Statutory Clearances

Any necessary statutory clearances & approval from CEIG/ electrical inspectorate, CEA, DVNNL, UPTCL required for 33/11kV Substations, RMUs, CSS, U/G cabling system, Smart Street lighting system & any other electrical works shall be in Bidder's scope.

The supervision of power infrastructure for this work shall be conducted by DVNNL

The following exclusions and provisions apply to the substation locations under the EPC package:

1. **Transformer Configuration:**
    - ESS-2 will proceed with **2 nos. of power transformers** as planned.
    - ESS-1 and ESS-3 will each have **1x10 MVA transformer** instead of the originally planned 2x10 MVA transformers.
2. **Exclusions from EPC Scope:**
    - One Power transformer (10 MVA) at ESS-1 and ESS-3.
    - One 33kV incoming line each for ESS-1 and ESS-3.
    - 33kV and 11kV interconnections between ESS-1 and ESS-3.
3. **Future Infrastructure Provision:**
    - Adequate space for future infrastructure, such as trenches and substation expansions, must be incorporated into the design.

Bidders must account for these exclusions and provisions in their proposals.

8.15 Street Lighting

8.15.1 General

Urban areas in the entire world are dealing with increasing energy consumption and carbon emissions, a known contributor to climate change. Due to inadequate dimming control and low efficiency, current street lighting is wasteful in terms of energy spending, accounting for a major part of governmental electricity costs. Therefore, it has become desirable and of great importance to design a new smart lighting system that is more efficient and environmentally friendly.

The main aim of a new smart street lighting system is to control energy efficient LED street lights to turn on only when needed and to remain in a dim state otherwise. The system integrates technologies such as: wireless network and dimmable LEDs.

It should control the luminaires to adjust according to the requirement of the client and should perform the function of asset management for the civic authorities.

With such a system in place, it shall become a convenient platform for the civic authorities, for the facility management team as well as for the citizens of the city.

8.15.2 Scope of Work

This specification is intended to cover the *design, detailed Engineering, construction/ manufacture, procurement of electrical equipments, assembly, testing at manufacturer's works, supply in properly packed condition for transport to site, transportation, Erection, site testing and commissioning,* including preliminary acceptance test, performance guarantee and post commissioning services and insurance during transit, storage, erection and commissioning with all accessories for efficient and trouble-free operation of **Atal Puram Township, Agra.**

The smart street lighting system shall include minimum components but not limited to the following;

a) LED Street Luminaire with accessories including Dimmable Drivers
b) Hot-Dip Galvanized conical 9m Lighting pole with inbuilt Junction Box, RCC foundation, Mounting Brackets, hard wares, and other accessories
c) Connecting power Cabling laid in DWC/ HDPE pipes
d) Earthing system for pole and feeder pillars with accessories and termination
e) Smart Outdoor Main Feeder Pillars (OFP) and outdoor type external lighting feeder pillar with Smart Controller for individual light fixture Control and Monitoring System
f) Excavation of trench for laying DWC pipes and Horizontal Drilling for Existing Road crossing.
g) GPRS/Ethernet and Zigbee GPS technology connectivity for communication from Feeder Pillar

h) Cloud registration; hosting; uploading and managing all data after Mapping of Feeder Pillars and Light poles as applicable installed by BIDDER
i) All mounting and foundation supports and hardware accessories for equipment/system installations
j) All civil works associated with installations of the equipment/systems within BIDDER‟s scope including excavation, concreting, back filling of soil for preparation of equipment foundation, laying of DWC pipes either by excavating of through open excavation; embedment, chipping, punching, making holes, pipe sleeves, fire/ water proof sealing etc
k) Any other electrical equipment/ component which are not specifically listed above but are necessary to make the system complete and functional in all respect as per specification and statute.
l) Safety to personnel and equipment during both operation and maintenance.

The approximate load of Street Lighting for Atal Puram Township is estimated as 197 kW. To meet the load demand four 11/0.433kV Compact Substations are proposed, 9 nos. of Main Feeder Pillars, 43 nos. of Feeder Pillars & 1484 LED fixtures (284 Including fixtures at Junctions) are proposed to ensure redundancy in distribution. Various Smart components like – Warm White LED Luminaires, Multi-Step Dimming, Individual Street Light Control etc. are proposed for the Atal Puram Township.

All sundry fittings, assemblies, accessories, hardware items, foundation bolts, termination lugs for electrical connections as required, and all other sundry items which are useful and necessary for proper assembly and efficient working of the various components of the work shall be deemed to have been included in the tender, whether such items are specifically mentioned in the tender documents or not.

CIVIL WORK for foundation of equipment's is included in this contract unless specifically excluded in the Bill of quantities. The Scope includes but not limited to Supply, Installation, testing & commissioning (SITC) of

Item	Description	Quantity	Remarks
LV CABLES:	Supply, Laying and testing of aluminium conductor cable XLPE insulated armoured, served, sheathed 1100 volts grade upto 3m below ground level in dwc pipe/ duct bank/ground with protection. The armouring of the cable shall be properly connected with the earth conductor including fixing of palm or pin type AL cable socket (lug) / end terminations to the cable leads, insulating with tape and making connections with brass / nickle plated double compression gland, providing cable tags complete in all respect including supply of lugs and compression glands etc complete upto the satisfaction of Engineer-in-charge. 16 sq.mm 3.5 core—30.50 KM 25 sq.mm 3.5 core—7.6 KM 150 sq.mm 3.5 core—9.5 KM 300 sq.mm 3.5 core—7.5 KM	1 Lot	RCC and HDPE Conduit laying infrastructure of 150 sq.mm and 300 Sq.mm considered in Power Infrastructure
Earthing system:	Supply & burrying of **90** nos of 600mm x 600mm x 6.0mm G.I. plate, vertically for earthing with its top at least 3 meters below ground level complete with 20 mm G.I. pipe for watering funnel, 300 mm square C.I. frame with hinged cover, masonry housing, alternate layers of coke and salt at least 150 mm thick alround including excavation and back filling etc. complete in all respects. (for Feeder Pillar) Providing & fixing **450 m** of 25mm x 5mm G.I. strip on surface, in recess or in ground including connections etc. as required Providing and laying **38.1 KM** of 6 SWG dia G.I. wire on surface, in recess or in ground including conections for earthing as required along with cables.	1 Lot	
DWC/HDPE Conduit:	Supplying and laying of 63 mm dia (OD-63 mm & ID-51 mm nominal) DWC HDPE pipe ISI marked along with all accessories like socket, bend, couplers etc. conforming to IS 14930, Part II complete with fitting	35.9 KM	

Item	Description	Quantity	Remarks
	and cutting, jointing etc. in the existing trench, complete as required for cable laying including transportation and accessories required complete in all respect.		
outdoor type Main Feeder Panel (415V Switchgear, Feeder Pillar & DB)	Design, manufacture, supply, inspection, handling, assembling, affecting proper connections, testing and commissioning of 14 SWG CRCA sheet steel fabricated cubical outdoor type Main Feeder Panel , floor mounting, dust & vermin proof, front operated construction, double door enclosure class - IP 65, powder coated after proper treatment with 9 tank process with top/bottom removable gland plates, as required, double compression type cable glands, earth bus, hinged and lockable doors to achieve dust and vermin proof complete with all inter connections small wiring by min. 2.5 sq. mm. FRLS copper wires, ckt labels etc. The Aluminium Bus Bar shall be of suitable length, 600 volts, 3 phase 50 Hz TPN, electrolytic aluminium as per IS 8623 . The panel feeders shall be suitable for terminating suitable nos. 3.5 / 4 core armoured aluminium cable as required. INCOMER : 02 nos. 125 AMP FP MCCB (25 KA) BUS BAR : 250 AMP, 500 Volts, 3 phase 50 HZ TPN high conductivity electrolytic Aluminium bus bar of suitable length, insulated by heat shrinkable sleeves. The current density of bus bar shall be minimum 1.00 sq mm / amp. OUT GOINGS : 07 nos. 63 AMP FP MCCB (25 KA)	8 nos.	
outdoor type external lighting feeder pillar (Switching Point Controller)	Supply , installation testing and commissioning of outdoor type external lighting feeder pillar of suitable size made out of M.S. sheet 2mm thick (14 SWG) duly compartmentalized, double door with locking arrangement (IP-65), duly fixed on MS angle iron frame work of size 50mm x 50mm x 6mm, 90 cm long legs out of which 45 cm duly grouted in cement	37 nos.	

Item	Description	Quantity	Remarks
	concrete 1:2:4 (1 cement : 2 sand :4 stone aggrete 20mm) and having following accessories mounted inside the cubical panel i/c connection, inter connection with aluminium thimbles, earthing with two nos. earth struds duly painted with power coating and 9 tank process of approved shade complete etc. as required. Smart feeder Panel-10kVA-10kVA rated Switching point controller system (SPCS) with GPRS, Timer, Energy measurement systems and switching controllers with outgoing as required to feed 32 luminaires for individual control of luminaire.		
Street Lighting Poles:	SITC of Hot-Dip Galvanized conical 9m height Poles for Street Lighting with decorative brackets, arrangements, including suitable boards, bakelite sheet , MCBs and 20mm dia 1.5m long MS rod earthing as per IS specifications suitable to withstand the wind speed of 47 m/sec. including civil foundation , sleeves, excavation and back filling complete in all respect with all required accessories.	915 nos.	
	Supply Installation, testing and commissioning of Hot-Dip Galvanized conical 6m height Poles for Street Lighting with decorative brackets, IS 2062 for base plate with door opening arrangements, including suitable boards, bakelite sheet and MCBs as per IS specifications suitable to withstand the wind speed of 47 m/sec.	237 nos	
	Supply & fixing of 16 mtr High mast shaft of approved make with rising system hot dip glavanized inside & outside dip, heaving pole sheet thickness 3 mm. Top dia minium 150 mm, Bottom dia 360 mm base plate 32 mm thick suitable for wind velocity as per IS 875 part 3 & having no circumferential weld, with accessories for high mast such as head frame suitable for 6 to 12 luminaries & its control gear boxes 1.5 HP	3 nos	

Item	Description	Quantity	Remarks
	power tool meter, 3 point suspension system with steel wire rope 6 mm dia, double drum winch, including making suitable foundation as per manufature drawing/ site requirement along with foundation bolts nuts, washers, anchor plates etc complete in all respect		
Lighting Fixture:	Supply Installation, testing and commissioning of LED Luminaire for streetlight application with Dimmable driver and integrated SLC including connection with 3x1.5 sqmm flexible fire retardant copper connecting wire of required length complete as required for outdoor application. 150W-242 Nos 120W-344 Nos 90W-441 Nos 45W-96 Nos 35W-141 Nos 464W-24 Nos 440W-18 Nos	1 lot	
Web Application & Server:	1069 Nos of Web application charges per luminaire & on cloud hosting (annual subscription) 1 Nos SMS Alerts Charges (Yearly – for 50,000 SMS),	1 lot	

Detailed Technical specification of each equipment's needs to be referred in respective equipment technical specification.

8.15.3 Terminal Points and Interfaces

8.15.3.1 At Main Feeder Pillar (415V Switch Gear) Incomer

Terminal point for Main feeder pillar (415V switch gear) incomer shall be outgoings of the compact Substation placed in each 33/11kV GIS indoor substation. The 415V LV cable originating from outgoing of the compact substation. 11/0.415 kV compact Substation which includes- , HT Panel with 2 incomers LBS and 1 outgoing self-powered VCBs with 250kVA, dry type, two winding, 3 phase, Dyn11, 50Hz, AN, Transformer, LT panel, APFC, FPI & FRTU. Any

facility required for compact substation shall not be in this scope (covered in Power infrastructure). Any work required for arrangement of above Main Feeder Pillar (415V Switch Gear) incomer from compact substation is in bidders scope.

8.15.4 At Smart Street Pole

Terminal point for LV distribution shall be up-to MCB placed at the outgoing of the (switching point controller) placed at each Smart Street Pole. All 415V, control cables & its terminations & joints, in-built DC system & all arrangement required SCADA communication as per specifications shall be in bidder's scope.

8.15.5 Exclusion List

a) 3 nos Compact substation at each Substation for streetlighting covers in power infrastructure.
b) Cable laying infrastructure for 150 sq.mm and 300 Sq.mm LV cable is considered in Power Infrastructure.

8.15.6 Street Lighting at Intersections

The intersections street lightings are not included in the Smart Street Light Detailed Project Report. The design is to give an average value of 50 lux at the centre of the intersection. However, due to the limitation of the available luminescence, lower values are achieved, which is an average of 38 lux.

The roads are being lit to 20 lux, hence, the intersection will have better luminescence.

The light poles for the intersection are expected to be placed at the centre of the median where median are available, otherwise, at the edge of the kerb, at the curve.

8.15.7 Applicable Codes & Standards

i.) All equipment, system and services covered under this specification shall comply with all currently applicable statutes, regulations and safety codes. Nothing in this specification shall be construed to relieve the Bidder of this responsibility.
ii.) The standards not indicated in the specification are also acceptable, if they are established to be equal or superior to the standards indicated in the specification.
iii.) The metric units/SI units shall be used in all data/drawings submitted against this package.
iv.) The Bidder shall furnish the English translations of all standards to which the equipment and systems offered are conforming to, as and when required by the Owner.
v.) The work shall be performed in conformity with these specifications standards and Codes of Practice specified or referred in the tender. In case of any conflict the stipulations under these specifications shall govern.

vi.) In addition, work shall also conform to the requirements of latest editions/ amendments of the following:

The Indian Electricity Act and Rules framed there under

a) Fire Insurance Regulations
b) Regulations laid down by the Chief Electrical Inspectorate
c) Regulations laid down by the Factory Inspectorate
d) Regulations laid down by the Chief Electrical Inspectorate of Government etc.
e) Applicable Codes of Practice of the Bureau of Indian Standards
f) Any other regulations laid down by the Central, State or Local Authorities from time to time and during the execution of this contract.

Standards for Illumination of Public areas.

Illumination requirements for the Public spaces and Open areas is well established in IS standards, MOUD guidelines as well as in National Lighting Code.

IS 1944 provides lighting level requirements for different categories of roads. Bidder to design and supply lighting system along with required controls to provide illumination level as per MOUD guidelines & IS. The roads are to be categorized as per IS and the illumination level for different category is as mentioned below (as per IS 1944 & MOUD guidelines)

LEDs are changing the way we use light. They consume less energy and last much longer than most conventional light sources, do not heat illuminated surfaces or emit ultraviolet light,

Contain no toxic mercury and require little maintenance. The durable nature of LEDs makes it possible to put light where it was previously impossible or impractical.

In order to ensure the best performance over their life cycle these advanced tools i.e. LED luminaires, should conform to the various National / International standards for safety & performance. Luminaires shall conform to Performance Requirements as defined in IS 16107 Part 2/Sec 1. Manufacturer should provide test reports as per LM 79 & LM80. Luminaires should conform to the IS standards for Safety & Performance and test certificates as per IS 16107 should be provided by the manufacturer. In case of luminaires which are imported, should conform to test parameters as per UL or equivalent standards. CE marking would be acceptable.

Table 35: Classification of Roads as Per IS: 1944

Classification of lighting installation	Type of road	Uniformity ratio $E_{minimum}/E_{average}$	Transverse Uniformity $E_{minimum}/E_{maximum}$	Roads classification
Group a1	Important traffic routes carrying fast traffic	0.4	0.33	45m.36m,24m & 30m

Group a2	Other main roads carrying mixed traffic, like main city streets, arterial roads, through- ways, etc.	0.4	0.33	18m
Group bi	Secondary roads with considerable traffic like principal local traffic routes, shopping streets, etc.	0.3	0.20	12m & 9m
Group b2	Secondary roads with light traffic	0.3	0.20	7.5m,6m & 3m

REQUIREMENT OF MANDATORY LUX LEVEL TO BE MAINTAINED AS PER MOUD GUIDELINES

1. For all kind of **roads** E.avg should be minimum **30l**ux.
2. For **cycling track** E.avg should be minimum **20**lux

8.15.8 Power Distribution Philosophy

DESIGN ASPECTS

The following aspects were considered while carrying out the case studies.

- Maintaining high availability and reliability in the system
- Ensuring Safety in the working area
- Space optimization
- Operational and maintenance ease
- Inventory
- Control and monitoring
- Economic
- To obtain the fault level at each buses within permissible limits

Power Distribution system will consist of the following major components-

- Three (03) nos. 11/0.433kV Compact Substation (CSS)
- Eight (08) nos. Main Feeder Pillars (MFP)
- Thirty-eight (37) nos. Feeder Pillars (FP)

Compact Substation will supply power to the Main Feeder Pillars (MFP). Each MFP will supply power up to 5 Feeder Pillars (FP). To ensure redundancy there will be a tie connection between two nearby MFP's. Thus, MFP's will be strategically placed to ensure high reliability. Each Feeder Pillar will provide supply to 30 to 35 fixtures which will be connected in two separate circuits.

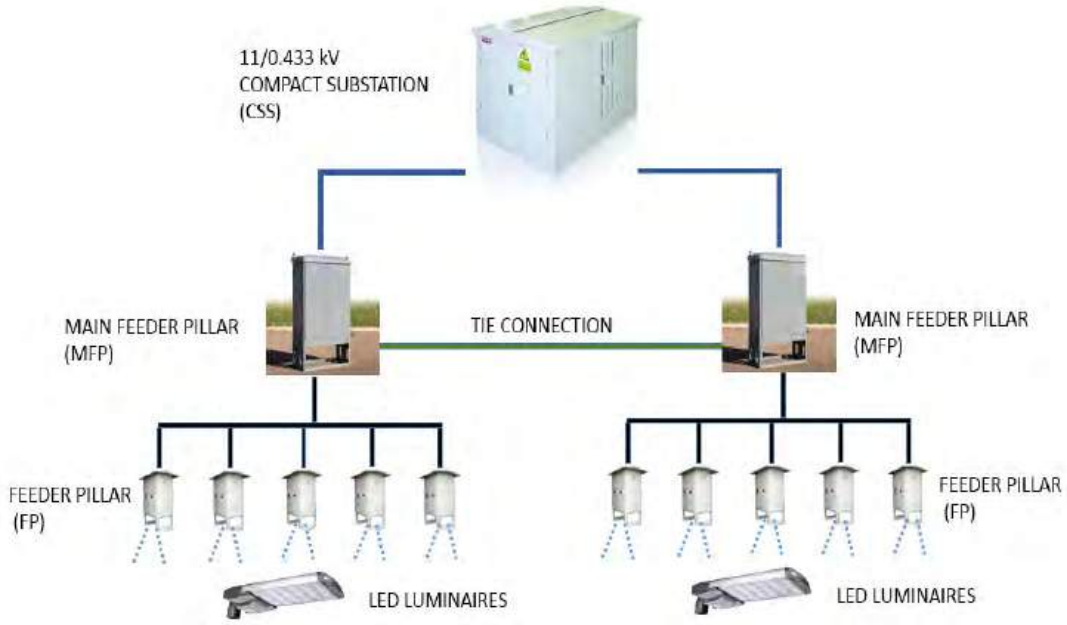


Figure 12: Smart Street Lighting System Power Distribution

The quality of luminaire / Lux level will be maintained by concessionaire during the project life (Ten years). The concessionaire has to follow all safety guidelines / directions issued by Municipal Corporation.

8.15.9 Planning And Design Criteria

8.15.9.1 General Design Criteria

The design concept of electrical system is based on providing safe, reliable & stable power and efficient performance of electrical system.

i.) The design standard described herein is generally in compliance with the latest Indian Standards, IEC and Code of Practices of India.
ii.) All electrical installations shall confirm to the latest CEA (Central Electricity Authority) guidelines 2010.
iii.) Latest National and International Standards shall be used for each electrical equipment design in Atal Puram township.
iv.) The design ambient temperature for all electrical equipment shall be considered as 45 0C.

Smart Street lighting design system will be adopted in the Atal Puram twonship from following criteria:

a) The illuminance level for road lighting in India is governed by IS 1944 (Part 1& 2): 1970 Code of Practice as well as MOUD guidelines for lighting of Atal Puram Township
b) Requirement of Mandatory lux level to be maintained as per MOUD guidelines:

- For all kind of roads E.avg should be minimum 30lux is maintained.
- For cycling track E.avg should be minimum 20lux is maintained.
- For Pedestrain crossing E.avg should be minimum 50lux is maintained.

8.15.9.2 Design Ambient

The electrical equipment shall be designed with due consideration to the following ambient conditions:

a)	Design ambient temperature	:	50 °C.
b)	Minimum ambient temperature	:	9.8°C.
c)	Maximum ambient temperature	:	43.1°C.
d)	Equipment design temperature range	:	5°C to 45°C.
e)	Max. Ambient relative humidity	:	95% RH
f)	Seismic Zone & III	:	Between Zone II

8.15.9.3 Voltage Levels

Following voltage levels shall be used:

a) 415 V/230V- LV supply for LV auxiliary loads at substations & CSS to feeder pillar, UPS & street lighting.
b) 24 V DC –DC voltage for RMUs & control and instrumentation.

VOLTAGE LEVELS

Item	Voltage	Neutral Earthing
LV Power Distribution System	415V ±10%, 50 Hz ±3%, 3Ph, 4W system 230 V ±10%, 50 Hz ±3%, 1Ph, 2W system	Solidly earthed
DC System	a)110 V (+)10% to (-)15% DC b) 24 V (+)10% to (-)15% DC	Ungrounded

8.15.9.4 Basic Insulation Level

Unless stated otherwise in the individual equipment/system specification, the insulation levels shall be as given below:

BASIC INSULATION LEVEL

Nominal System Voltage	Highest System Voltage	Rated 1 min power freq. Withstand voltage	Rated Lightning Impulse Withstand Voltage (KVPEAK)

		(KVRMS)	
415 V	1.1 kV	3 kV_{rms}	-

8.15.9.5 Fault Levels

Different equipment shall be designed for the following through fault withstand capability's fault levels as mentioned below: -

FAULT LEVEL

System	**Fault Level**	**Duration**
o 415V	o 50kA	o 1 second
o 110V DC	o 15 kA	o 1 second

Chapter 9: Concept for landscape

9.1 Design strategies

- **Improve livability**

A safe, comfortable and engaging space, where diverse activities can be experienced by all, contributing to people's physical and mental wellbeing, therefore providing a high quality of life.


Figure 13: Concept for Landscape: Improve Livability

- **Connectivity- Multimodal corridor promoting Barrier Free Movement and Pedestrian Responsive approach**

Enhances the mobility of people by providing comfortable, continuous access for walking, cycling and other modes of transport.


Figure 14: Concept for Landscape: Connectivity

Barrier-Free Movement: Seamless, unobstructed access for all individuals, including those with mobility challenges. This includes the use of ramps, wide pathways, and level surfaces to promote inclusivity and ease of movement throughout the township.

Pedestrian-Responsive Approach: Prioritize the needs of pedestrians by creating safe, comfortable, and aesthetically pleasing walking environments. Incorporate shaded walkways, seating areas, and pedestrian-friendly crossings to encourage walking and enhance the overall experience for residents and visitors

Figure 15: Concept for Landscape: Pedestrian Responsive Approach

- **Engage community in Health and Social activities**

Encourage active and social lifestyles by incorporating spaces for fitness, recreation, and community gatherings. Include features such as outdoor gyms, walking trails, playgrounds, and event spaces to promote physical health and foster social connections among residents.

Figure 8-16: Concept for Landscape: Active and Passive activities

Figure 17: Concept for Landscape: senior citizen activity corner

- **Design for All age group**

The landscape design which caters to the needs and preferences of all age groups by incorporating diverse features such as playgrounds for children, seating areas for the elderly, and multipurpose spaces

for teens and adults. This approach ensures that everyone, regardless of age, can enjoy and benefit from the outdoor environment.

Figure 18: Concept for Landscape: design for all age groups

- **Sustainable design practice**

  Implement sustainable landscape design practices by using eco-friendly materials, conserving water, promoting native plant species, and reducing energy consumption. This approach ensures long-term environmental health and resilience while minimizing the ecological footprint of the township.

9.1.1 Aim: Elevating Lifestyle Standards with Sustainable Living

The planned township at Atal Puram, Agra, is poised to set new benchmarks in lifestyle standards through sustainable living, integrating environmental awareness with modern amenities. A grand entrance, featuring a wide tree-lined avenue, welcomes residents and visitors, leading them into a thoughtfully designed space where nature and urban living coexist harmoniously.

Pedestrian-friendly walkways and dedicated bicycle tracks offer smoother, healthier transportation options. Multiple green pockets with various activities, along with a central neighborhood garden, provide ample recreational opportunities for all age groups. These spaces support both active and passive recreation, fostering community engagement, promoting a healthy lifestyle, and encouraging environmental stewardship.

9.1.2 Landscape Design Concept

9.1.2.1 **Innovative Urban Design: Merging Sustainability with Modern Amenities**

This township embodies a pioneering approach to urban development, where environmental stewardship and modern conveniences are seamlessly integrated to foster an exemplary living environment. The design philosophy sets new standards for lifestyle, merging ecological responsibility with luxurious amenities to create a harmonious and sustainable community.

Grand Entrance: A Gateway to Tranquillity and Elegance

The entrance to the township features a grand, modern gate inspired by Hindu architectural motifs, setting an elegant tone for the entire development. This gateway leads into a spacious, tree-lined avenue, which is thoughtfully landscaped to provide a sense of calm and grandeur. The avenue is flanked by Terminalia mantaly trees, known for their broad canopy that creates a serene, shaded environment. These trees serve as a natural barrier, mitigating dust and noise pollution from the surrounding areas.

The avenue's design is enhanced with a variety of ornamental plants, including Nerium oleander, Raphis excelsa, Tabernaemontana coronaria, and Strelitzia reginae. These species were selected for their vibrant colors and year-round blooming characteristics, which ensure a visually stimulating experience throughout the seasons. The combination of these plants contributes to the aesthetic richness of the entrance while promoting a tranquil transition into the residential area.

Pedestrian-Friendly Walkways and Green Multimodal Corridor: Promoting Health and Environmental Awareness

The township's design emphasizes the importance of pedestrian and cyclist-friendly infrastructure to encourage sustainable transportation methods. The network includes:

- **Pedestrian Walkways**: Designed with comfort and safety in mind, these walkways are shaded by overhead tree canopies and bordered by native vegetation. They provide a pleasant environment for walking, jogging, or leisurely strolls. Integrated seating areas with covered benches are strategically placed to offer rest and enjoyment amidst the natural surroundings.
- **Bicycle Tracks**: These are clearly marked with distinctive colours to ensure safety and ease of navigation. The tracks are constructed using high-albedo paver blocks, which reflect sunlight to reduce heat absorption, thereby maintaining a cooler surface.
- **Green Multimodal Corridor**: This corridor runs alongside the driveways and incorporates sustainable design elements such as service lanes and high-albedo materials. The extensive planting along the carriageways includes local species that provide essential shade and contribute to the overall ecological balance. The vibrant plantings enhance both the visual appeal and the functional aspects of the corridor.

Green Pockets and Community Spaces: Encouraging Active and Passive Recreation

The township is dotted with multiple green pockets, each designed to cater to diverse recreational needs:

- **Recreational Areas**: These include jogging tracks, yoga zones, and open spaces for informal sports and activities. These areas are designed to support a healthy lifestyle and provide a space for physical exercise and relaxation.
- **Children's Playgrounds**: Secure and well-maintained playgrounds are equipped with modern play equipment to ensure safety and fun for children of all ages.
- **Senior Spaces**: Quiet, shaded gazebos and garden seating offer serene spots for older residents to relax and enjoy the tranquillity of the surroundings.

- **Landscaping**: Each green pocket features a blend of manicured lawns, flowering plants, and native trees, creating vibrant, inviting spaces that enhance the quality of life for residents.

Central Neighbourhood Garden: The Heart of Community Life

At the core of the township lies the central neighbourhood garden, a meticulously landscaped area that serves as the primary venue for social and recreational activities:

- **Walking Trails**: The garden features meandering trails that encourage exploration and leisure walks through the landscaped environment.
- **Waterbody**: A large, well-designed waterbody serves as a focal point, enhancing the garden's aesthetics and providing a tranquil setting.
- **Thematic Gardens**: The garden includes various thematic areas that change with the seasons, offering diverse experiences throughout the year.
- **Community Zones**: The garden is divided into zones catering to different interests and age groups. A serene meditation zone features water elements and aromatic plants for relaxation. An open-air amphitheatre hosts community events and cultural activities, fostering social interaction. A dedicated sports court allows residents to engage in physical activities, promoting overall wellness.

Environmental Stewardship: A Commitment to Sustainable Practices

The township's landscape design reflects a strong commitment to environmental stewardship:

- **Rainwater Harvesting**: Integrated systems collect and manage rainwater, ensuring sustainable water usage and reducing dependency on external water sources.
- **Native and Drought-Resistant Plants**: The use of native and drought-resistant species minimizes water consumption and supports local biodiversity.
- **Composting**: Organic waste from garden maintenance is composted on-site to produce nutrient-rich soil, enhancing soil health and reducing waste.
- **Energy Efficiency**: Solar panels power energy-efficient lighting throughout the township, contributing to a reduced carbon footprint and promoting sustainable energy practices.

Community Engagement and Well-being: Building a Connected and Healthy Community

The design of the township goes beyond aesthetics to foster a sense of community and well-being:

- **Social Spaces**: The layout includes ample areas for social gatherings, festivals, and cultural events. The green pockets and central garden act as natural meeting points, encouraging interaction and building community bonds.
- **Healthy Lifestyle**: Facilities are designed to promote physical activity, relaxation, and social interaction, enhancing residents' overall quality of life.
- **Sense of Belonging**: The thoughtful integration of amenities and green spaces supports a vibrant community life, where residents of all ages can enjoy a high standard of living in a cohesive and supportive environment.

9.1.2.2 Sustainable Urban Planning: Conservation of Existing Trees within the Site

Preserving existing trees is a critical aspect of sustainable urban planning and contributes significantly to the ecological and aesthetic value of the township. The layout of the Atal Puram Township has been carefully designed to integrate the existing tree cover into the development plan, ensuring a harmonious balance between urban growth and environmental conservation. The following strategies have been adopted to protect and enhance the site's natural assets:

- A detailed survey was conducted to identify and map all existing trees within the site. This mapping allowed for a precise understanding of tree locations, species, and their condition.
- The master plan aligns streets, open spaces, and building footprints to avoid disturbing significant trees. Roads and pathways are designed to bypass clusters of trees wherever possible, minimizing disruption to the natural environment.
- Parks and green areas have been strategically placed to preserve large groups of trees, transforming them into focal points of community spaces.

Map 7 Existing trees within the site

9.1.2.3 Landscape Concept: Vedic Landscape in Harmony to modern lifestyle

Overview

The design of open spaces in these parks draws inspiration from Vedic architectural principles, particularly the ancient system of Vastu Shastra. The core objective of the design is to create spaces that harmonize the natural environment with human life, fostering a sense of well-being, relaxation, and a spiritual connection to nature.

Key Design Principles

- **Sacred Space in the Northeast:** In accordance with Vastu Shastra, the northeast corner of each park will be designated as a sacred space. This area will feature a water body—either a serene pond or a fountain—representing the sacredness of the northeast direction. This water feature is designed to promote tranquility, balance, and positive energy flow within the park.
- **Integration of the Panchamahabhutas (Five Elements):** The design will incorporate the five great elements of nature—Earth, Water, Fire, Air, and Space—through various landscape elements and features, ensuring that visitors experience a holistic connection to the environment.
- **Diverse Outdoor Activities:** The parks will offer a range of recreational activities that cater to all age groups. These activities will include a jogging track, a children's play area, a yoga zone, an outdoor gym, and expansive lawns, providing spaces for physical fitness, relaxation, and meditation.

Landscape and Activity Features

- **Water Body (Northeast Corner):** A pond or fountain will be placed in the northeast to symbolize the element of Water, enhancing the calming and purifying energy in the space.
- **Jogging Track:** A meandering path will encourage visitors to engage in physical activity, representing the dynamic and fluid nature of Air. This feature is designed to inspire movement and vitality.
- **Children's Play Area:** Playgrounds made with natural materials will connect children to the Earth element, grounding them in a fun, playful environment while promoting interaction with nature.
- **Yoga Zone:** A dedicated space for yoga and meditation, furnished with benches and surrounded by serene landscaping, will symbolize Space. This area is designed to foster mindfulness, peace, and a deep connection to the cosmos.
- **Outdoor Gym:** Fitness equipment will represent the transformative and energetic qualities of Fire, encouraging physical strength and empowerment.
- **Expansive Lawn:** The central lawn will be a large, open area that grounds visitors and represents the solid and nurturing energy of Earth. This space is ideal for relaxation, community gatherings, and unstructured play.

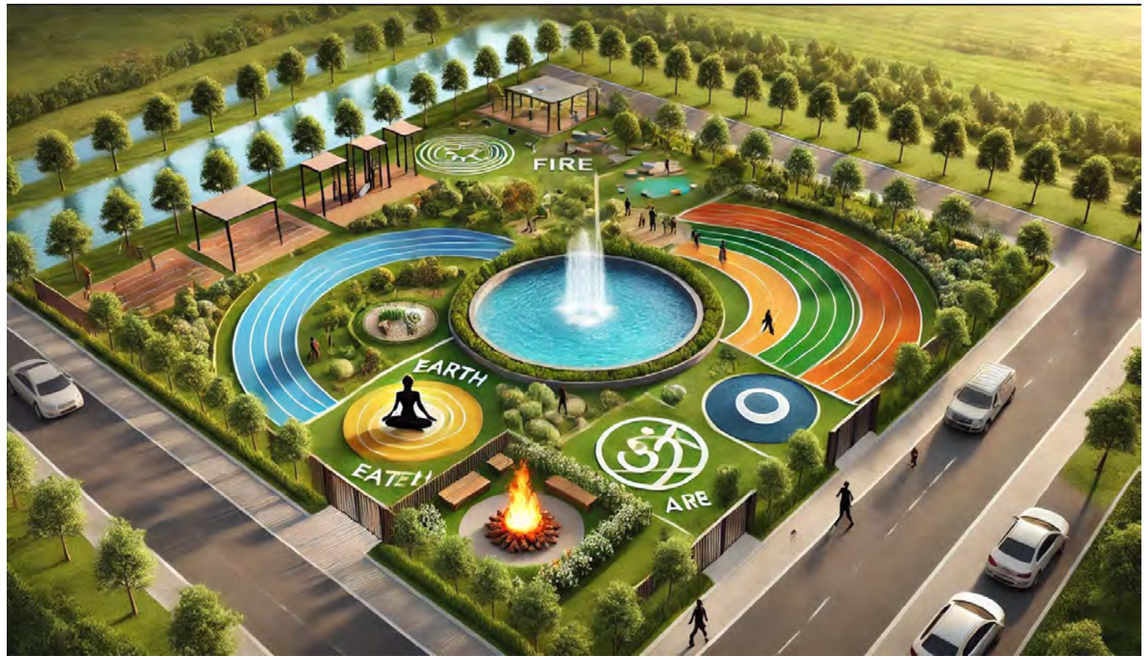


Figure 19: A park design concept inspired by Vastu Shastra with key elements representing the Panchamahabhutas (Five Great Elements_ Earth, Water, Fire, Air, and Space)

VOLUME V

TECHNICAL SPECIFICATIONS

Contents

1. GENERAL SCOPE OF WORK & SPECIFICATION

1.1 Project Background

Agra Development Authority is developing a Green Field Township Project of 140.5 Ha around the Kakua – Bhandai villages in Agra. This comprehensive initiative aims to enhance every aspect of the township, from infrastructure development to environmental sustainability.

At its core, this project will prioritize the creation of green spaces, recreational areas, and sustainable infrastructure. The development plan includes the establishment of parks, gardens, and open spaces to foster community engagement and promote a healthier lifestyle. Additionally, modern amenities such as efficient water and waste management systems, energy-efficient lighting, and smart transportation solutions will be integrated to ensure environmental sustainability.

Furthermore, the project will focus on fostering economic growth and social cohesion within the township. This entails the development of commercial and residential zones, as well as the provision of essential services such as schools, healthcare facilities, and community centers. By creating a vibrant and inclusive environment, the project aims to improve the overall quality of life for residents while also attracting investment and promoting economic development.

The Agra Development Authority intends to collaborate with various stakeholders, including local communities, government agencies, and private enterprises, to ensure the successful implementation of the project. Through extensive consultation and engagement, the authority seeks to incorporate diverse perspectives and expertise to maximize the project's impact and sustainability.

This document details out the tender specifications, to ensure that all parties involved in a project have a clear understanding of the project's requirements and expectations.

1.2 Atal Puram Layout Plan

A contiguous land parcel of approximate 140.5 Ha has been acquired by ADA for the project in the Kakua Bhandai village area. A detailed layout plan has been prepared and sanctioned by Agra Development Authority for the Atal Puram Township site.

The approach road to the site is from the Agra Gwalior Road located on the eastern side which provides optimal accessibility for through movement of traffic from Agra. The Site has direct access to the Agra bypass road from the southern side. Additionally, there is an egress point on to Agra Bypass Road which facilitates the movement towards Agra city through the proposed LVUP.

Figure1: Atal Puram Sanctioned Layout Plan

1.2.1 Development Phasing

The contractor will undertake the development of the site as per the below phasing plan. The total time for completion of the project (both phases included) will be 30 months from the start date.

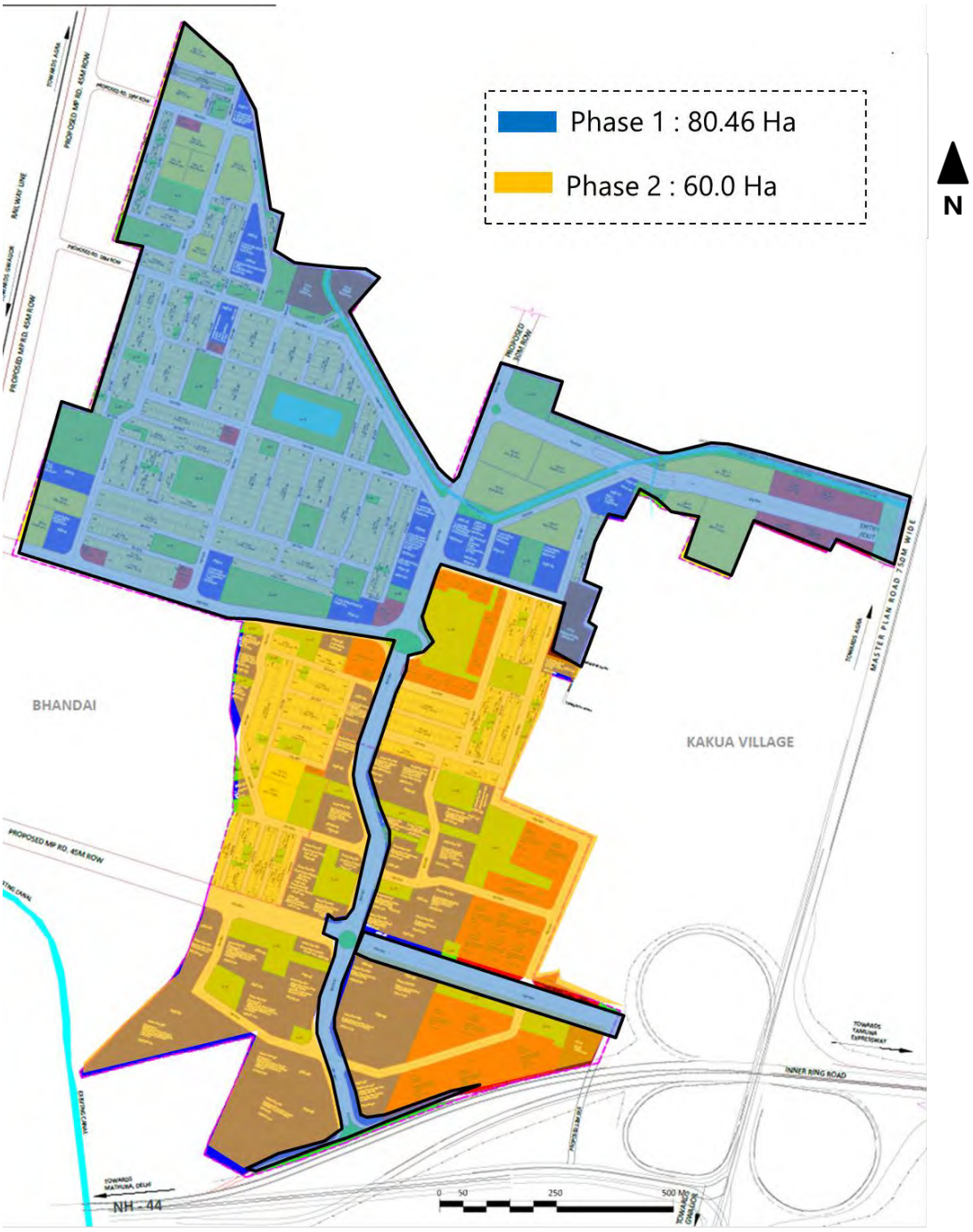


Figure2: Atal Puram Development Phasing

1.2.2 Clearances & NoCs

Agra Development Authority is in process of acquiring the Environmental Clearance for the project. ADA has also applied to MoRTH for the NoC for access to site from the Agra bypass road.

1.3 Scope of Work in Brief for the Integrated Package

The scope of work includes Survey, Investigation and Collect all primary and secondary data to undertake Detailed Engineering, Procurement, Construction, Testing and Commissioning of All Components of Atal Puram Township in Agra which include, Road, Minor Bridge, Culvert, Road Side Plantation & Arboriculture, Storm Water Drainage, Potable Water Supply & Recycle Water System, Waste Water System, Power Infrastructure, Smart Street Lighting System, Utility Ducts, Solid Waste Management, Site Grading & Levelling, Rain Water Harvesting, Security & Surveillance, landscape for parks and boundary wall in Atal Puram Township at Agra in the State of Uttar Pradesh on Design, Engineering, Procurement and Construction (EPC) basis, followed by 3 years of Defect Liability, 5 years of operation and maintenance for roads, footpath, tracks, arboriculture, street lights, ICT, Parks, plazas and gardens, networks of water, sewer, recycled water, storm drain and rain water harvesting and 10 years of operation and maintenance of WTP and STP after commissioning. The power system network and substation operation and maintenance are excluded. The total time for completion of the above mention scope shall be 30 months from the project start date.

The Contractor shall undertake the following works in conformity with the Front-End Engineering Design and other standards set forth in the contract document subject to applicable statutory bye-laws/ regulations.

1. Planning, designing and laying Flexible Pavement Roads
2. Planning, designing and construction of Minor Bridges, LVUP
3. Planning, designing, supplying and laying of pumping main pipeline for potable water supply
4. Planning, designing, supplying and laying of Pipe for sewerage
5. Planning, designing, construction & commissioning of STP
6. Planning, designing, construction & commissioning of WTP
7. Planning, designing, supply & installation / laying of underground MV & LV cables (including Testing & Commissioning)
8. Planning, designing, supply, installation, testing & commissioning of Indoor substation, Distribution Transformer substation, street lighting
9. Planning, designing, supplying & Laying of DWC and HDPE Cable Duct for Power/ ICT
10. Planning, designing and construction of RCC Utility Duct for
11. Planning, designing, supply and installation of solid waste management system
12. Planning, designing and installing SCADA system
    - Control Valves Bulk & Water flow metres
    - Level /Pressure Transmitters
    - Digital Panel Meter
    - Server with Interface switches
    - Storage & Security device
    - Switches & Routers
    - Control & Instrumentation
    - RTUs
    - PLC System with SCADA Software.
    - Web application
    - Smart Controller for Individual light fixture control & monitoring System.
    - Any other hardware, software, interface or co-ordination required to complete the SCADA system for its proper functioning shall be bidder's responsibility.

- Conduct all necessary surveys and site investigations and submit the report to the Engineer-in-charge.

- Planning and designing of all infrastructure components like water supply, system for recycling of waste water, installation of borewells, sewerage, drainage system, rainwater harvesting (including pits), roads, footpath, HT/LT Electrical works, STP/WTP and all other components mentioned in the scope as per bye-laws and norms of the local bodies including making connections with the peripheral services after getting the services design approved from the local bodies/statutory bodies. ADA's role shall be limited only to sign the application / drawings / documents for submission to the local bodies in the capacity of the owner for approval. In case of water supply, sewerage and drainage, the cost of getting the scheme approved from service provider is included in the scope of work/bid. The cost of connection of water supply lines/sewer lines from peripheral connection point/outfall sewer shall also be borne by the Contractor apart from internal and external water supply/sewerage lines to be laid to make the system of water supply and sewerage functional/complete. However, statutory charges, if levied by the service provider towards cost of laying of their peripheral services shall only be reimbursed by ADA on production of relevant documents by the Contractor to the satisfaction of Engineer-in-charge.
- The necessary arrangements are to be provided for supply of water through dual pipe system i.e. recycled water duly treated pumped through underground tanks to overhead tanks and piped to flushing in each location/utility as directed by the Engineer- in-charge.
- Planning and designing of bore wells, underground tanks, pump houses for water supply, including installing of pumps, standby pumps, rainwater harvesting pits, as per approved drawings/ specifications or as directed by Engineer-in-charge on recommendation of PMC.
- Planning and designing of 3 Electrical substations (ESS). ESS-1 and ESS-3 each with 1X10 MVA transformer and ESS-2 with 2X10 MVA transformer. (EXCLUDED from this contract: one transformer each at ESS-1 and ESS-3, one 33KV incoming line for ESS-1 and ESS-3, 33KV and 11KV interconnections between ESS-1 and ESS-3)
- Preparation & submission of Detailed design & drawings for Landscaping & Horticulture work, Main Entrance Gates, Drains, Culverts, Compound walls, External lighting arrangements, Under Ground Tanks, Signage's, etcetera complete.
- Preparation of landscaping plan including planters and other details etcetera for the horticulture works and execution of same including providing unfiltered/recycled water supply lines, construction of pump houses and installation of pumps therein etcetera complete will be responsibility of Contractor. Development of parks, if required, construction of its boundary wall, providing MS railings (including painting), wicket gates, water hydrants, the grassing, creepers and planting trees etcetera shall be completed as per the specification and drawing approved by the Engineer-in-charge.
- Planning and designing of the telecommunication and ICT network, safety and security system and connection with the Agra Smart City command and control centre.
- Vetting of design & drawings: - The contractor shall ensure vetting of designs and drawings from IIT/NITs, after approval of the design, drawings by Engineer-in-Charge.
- Setting up a Testing Laboratory at site equipped with the necessary apparatus needed for day-to-day testing of construction materials during construction period as directed by the Engineer-in-charge.
- Obtaining approval of Engineer-in-charge for all the Detailed/Preliminary Architectural, Structural & Services drawings & designs.

- Good For Construction (GFC) Drawings: - The EPC contractor shall prepare their designs & good for construction drawings based on the FEED provided in the tender document.
- The contractor shall refer the Front-End Engineering Design (FEED) for undertaking all detailed engineering works.

  The FEED provided to the contractor is to ensure a clear understanding of the design standards and other associated parameters that the Authority wishes to achieve for different components of the project. Whilst the Authority is keen to see innovation, but the required standards of design must be achieved. Contractors shall outline the means by which they will ensure design quality and the design objectives, which have influenced their scheme. This shall include details of how the Authority's objectives are to be achieved.
- Prepare and submit three-dimensional model(s) of suitable scale as and when required by the Engineer-in-charge at no extra cost.

  shall target zero incident during the entire duration of construction and defect liability.

1.4 Battery Limit:

The Battery Limit of the work is the boundary of the Atal Puram Township area. However, some of the infrastructure will have interface with existing road or trunk utilities which will have to be done beyond the boundary of the site.

1.5 Other Information:

The In addition to the standards provided in the technical specifications, Contractor shall also observe the latest editions of the standards, specification or requirements. In case of any conflict the, technical advice from Employers representative shall be obtained.

The drawings and BOQ accompanying the tender document are indicative of the nature of work and issued for tendering purpose only. The purpose of these drawings is to enable the tenderer to make an offer in line with the requirements of the owner. However, the contactor shall prepare drawings for all systems based on design approval by the ADA, drawings and Bill of quantities and then submits the same for ADA's approval. Wherever required the third-party inspection should be got done by the Bidder with due permission from the ADA the cost of which shall be borne by the Bidder.

Construction shall be carried out as per approved construction drawings/ specifications issued/ approved by the Engineer-in-charge during the course of execution of work. Detailed construction drawings on the basis of which actual execution of work is to proceed will be approved for the Bidder progressively based on the detailed construction program evolved after the award of work and also based on construction progress achieved by the Bidder.

Prospective bidder shall be deemed to have studied the drawings enclosed with tender or displayed for scrutiny and fully understood the nature and magnitude of the work before submitting the bids.

Bidder shall submit equipment manufacturer's drawing for supply items for the review of Engineer-in-charge in five sets of prints and the approval in writing from Engineer-in-charge shall be obtained before commencing manufacture/purchase. However, it is to be understood that the review of drawings shall not absolve the basic responsibility of Bidder to check total compliance to specifications included in tender document. Final drawings in bound volumes in color five sets along with editable soft copies of the same shall be submitted by Bidder.

After each job completion, Bidder shall prepare 'As-Built' drawings. Final certified 'As-Built' drawings shall be submitted by the Bidder to ADA in bound volumes with one set of reproducible original color plus five sets of prints.

1.6 Utility Clash Detection

3D modelling and clash analysis shall be done by using standard software by the contractor considering the sequence of the utility crossings like water supply, sewer line, electric cables for power supply, cables for street lighting and storm water drain. This is needed to avoid conflict in laying of utilities to be constructed.

1.7 Construction Management Action Plan

The Construction Management Plan should include the following:

1. Traffic control of the surrounding existing roads. Contractor has to maintain the flow of traffic with no hindrance to the existing traffic flow.
2. Labour management in line with the existing labour law and the practice of the industry for manpower management
3. Management plan for execution of earthwork during the monsoon for nominal time loss.
4. Solid Waste Control management plan.
5. Any other management requirement deemed fit for representation in the Management Plan.

The Construction Management Plan shall be submitted at the time of Bid Submission.

1.8 Environmental Clearance.

The Environmental Impact Assessment Report is under process. The contractor shall submit the construction environmental management plan.

The selected bidder shall operate an environmental policy in which supports the following values, to:

1. Conduct their activities with proper regard to the protection of the environment.
2. Comply with all relevant regulatory and legislative requirements and codes of practice.
3. Communicate with local communities to ensure the work causes the minimum disturbance and Disruption.
4. Ensure that staff have a good understanding of the environmental impacts of construction work and how to minimize these impacts.
5. Ensure their suppliers and sub-constructors apply similar standards to their own work.

Bidder to note that the quoted price is inclusive of the environment control at the time of Bidding. Change in price due to change in expected Environmental clearance condition will not be accepted after the Contract Price is finalized with the Bidder.

1.9 Health, Safety and Environment

A Construction Health and Safety Plan will be prepared for the works in accordance with the Construction Management Action Plan (CMAP). Risk Assessments will be developed

and agreed. Sub-constructors' detailed method statements will also be produced and safe methods of work established for each element of the works.

Site inductions will be held for all new site personnel to establish the site rules and to enforce safety procedures. All site personnel will be required to read the emergency procedures when signing in for the first time, and sign to the effect that they have read the procedures.

Bidder to submit the Health, Safety and Environment Policy of the Project and the mitigation of Pollution of the Project during construction work which includes measures to practicably mitigate those ordinary consequences from such activities and as a matter of good practice:

1.9.1 Dust

1. Demolition activities will use water as a dust suppressant;
2. Adjacent road surfaces will be frequently swept clean;
3. All loads delivered to or collected from the site will be covered where appropriate.
4. All road vehicles will be requested to comply with set emission standards;
5. Skips will be securely covered
6. The air quality within the site shall will be continually monitored Noise and Vibration
7. The constructor shall take reasonable steps to minimize any noise disruption to adjacent occupiers.
8. Where it is necessary to carry out noisy activities, identify them in advance and give notice.
9. Operatives working in noisy areas will be monitored to ensure they are wearing the necessary protective
1. alarm.
2. Material storage and waste control.
3. Fire Brigade access.
10. equipment and that they are not exceeding their permitted exposure periods.
11. Electrically operated plant will be used where practical.
12. Try to ensure all plant used on the site is effectively silenced.
13. No externally audible radios or other audio equipment will be allowed on site.

1.9.2 Fire and Emergency Procedures

Contact names and telephone numbers will be made available in case of 'out of hours' emergencies relating to the site. This information will be displayed on the hoarding. The constructor shall implement procedures to protect the site from fire. The site manager shall assess the degree of fire risk and formulate a Site Fire Safety Plan, which will be updated as necessary as the works progress and will also include the following:-

4. Hot Work Permit regime.
5. Installation of the site firefighting equipment e.g. establishing fire points and
6. Installing and maintaining fire extinguishers etc.

1.9.3 Evacuation Construction Vehicle Routing

Contractor shall take note of the fact that the site access are also ear marked for VIP movements, as such, Contractor shall take permission from the concerned Authorities for movement of construction vehicles outside the battery limit of the contract.

1.9.4 Priority Of Works

The Contractor shall undertake the following works in the order of priority for network and standalone infrastructure.

1.9.4.1 **Network Infrastructure.**

- Site Grading
- Road pavement, culverts and minor bridges
- Footpath & Tracks
- Storm water drainage
- Potable water supply
- Sewerage system
- Recycle water supply
- Rain water Harvesting
- Power
- Street Lighting
- Utility Duct

1.9.4.2 **Stand Alone Infrastructure**

The Stand-Alone activities are the works which are outside the ROW of the proposed roads. The activities are not bounded by the roads construction. The Standalone activities are as follows.

1. Water works at Plot No UT-3
2. STP in Plot No UT-1 and Recycle Pump House in Plot No. UT-1
3. Substations: ESS 1(Plot- UT-4), ESS 2 (Plot- PSP-5), ESS 3 (Plot- PSP-17),
4. Solid Waste Management – Plot No UT-2
5. Entry Gate 1) Agra Gwalior Road entry and 2) Agra Bypass Road entry
6. Boundary Wall

The standalone activities are expected to start in parallel from the zero date of the infrastructure works which are dependent of Road Construction.

2. LAND DEVELOPMENT

The land development work has mainly components like dismantling of abandoned structures, Tree cutting and transplantation of trees of different Girth, site Clearance, Excavation in Soils, filling of soil, Disposal of Surplus Earth, etc., The Drawing is attached for reference and further specific details. The quantities as provided is for reference and taken as indicative.

2.1 Scope of Work

For purposes of work to be executed in accordance with this specification, the following classification only shall apply. In case of any dispute regarding classification of materials excavated/filled, the decision of the Engineer-in-charge shall be final and binding on the Contractor.

This work shall consist of cutting, removing and disposing of all materials such as bushes, shrubs, stumps, roots, grass, weeds, top organic soil not exceeding 150 mm in thickness, rubbish etc., from the area of Works which in the opinion of the Engineer-in-charge are unsuitable for incorporation in the Works, and such other areas as may be specified on the Drawings or by the Engineer-in-charge. It shall include necessary excavation, backfilling of pits resulting from uprooting of trees and stumps to required compaction, handling, salvaging, and disposal of cleared materials. Clearing and grubbing shall be performed in advance of earthwork operations and in accordance with the requirements of these Specifications.

The scopes of works are as follows:

1. Investigation for the purpose of Engineering Design.
2. Survey of the site for the purpose of Engineering Design and Quantity.
3. Preparation and submission of all engineering drawings and design based on the Front End Engineering Design.
4. Site clearance
5. Earthwork in Excavation of all type of soils including hard and soft rocks and filling with approved quality of earth from project site after approval of design and drawing.

2.2 Indian Standards

Indian Standards to be followed are

All relevant latest Indian Standards as specified or not stated shall be applicable.

IS 1498	-	Classification and identification of soils for general Engineering purpose.
IS 3764	-	Safety code for excavation Work.
IS 4081	-	Safety code for blasting and related drilling operation.
IS 27720	-	Method of tests for soils.

2.3 Site Clearance

Prior to the start of any activity of earth-work, the area under construction shall be cleared of shrubs, vegetation, grass, brushwood, and saplings below 5 cm diameter at a height of 1 meter above ground level. All rubbish must be removed

and stacked at a distance of 50 meter outside the periphery of the area under clearance or location as decided by the Engineer-in-charge.

2.4 Site Survey & Investigation

2.4.1 Site Topographical Survey

Topographical survey for the site was conducted in the month of April 2024.

Based on the topographical survey conducted, the proposed project area is about 140.5 Ha. The proposed project area is at an elevation of 162 MSL to 169 MSL. The land is undulated with one natural stream passing the area.

Contractor is expected to conduct his own survey for the purpose of road and other utility design.

Table 2-1: Bench Mark of the Proposed Project area

Sr. No.	Point Id	Easting	Northing	Elevation
1	TBM-1	796232.587	2998608.13	164.26
2	TBM-2	796133.523	2998631.472	162.51
3	TBM-3	795990.268	2998677.788	162.94
4	TBM-4	795990.007	2998677.872	162.91
5	TBM-5	795989.038	2998673.212	162.95
6	TBM-6	795988.728	2998673.307	162.95
7	TBM-7	795924.024	2998512.099	163.00
8	TBM-9	795840.935	2998475.122	163.75
9	TBM-10	795794.503	2998496.002	163.76
10	TBM-11	795661.316	2998664.872	162.39
11	TBM-12	795586.714	2998634.443	162.49
12	TBM-14	795451.882	2998580.344	162.52
13	TBM-16	795430.335	2998816.869	162.98
14	TBM-17	795435.253	2998846.129	162.84
15	TBM-18	794835.218	2999532.361	162.67
16	TBM-19	794789.75	2999394.639	163.34
17	TBM-20	794724.652	2999179.306	164.64
18	TBM-21	794757.057	2999079.848	164.30
19	TBM-22	794889.552	2998963.33	163.15
20	TBM-23	794692.1	2998890.614	164.34
21	TBM-24	794623.925	2998784.666	164.43
22	TBM-25	794537.181	2998489.906	163.17
23	TBM-26	794778.703	2998416.784	164.01
24	TBM-27	795230.056	2998333.238	163.34
25	TBM-28	795140.061	2998094.645	163.89
26	TBM-29	795122.411	2998060.502	163.91
27	TBM-30	795066.323	2998081.574	163.64
28	TBM-31	795078.951	2997807.301	166.77
29	TBM-32	794887.269	2997707.588	166.79
30	TBM-33	794975.189	2997572.649	167.36
31	TBM-34	794865.814	2997306.165	167.27
32	TBM-35	795199.251	2997380.646	167.01
33	TBM-36	795271.379	2997514.004	167.48
34	TBM-37	795639.047	2997518.296	166.97
35	TBM-38	795580.12	2997713.088	168.07
36	TBM-39	795424.084	2997933.309	167.31
37	TBM-40	795383.386	2997794.698	167.67
38	TBM-42	795518.324	2998249.737	165.18

2.5 Setting Out

The contractor shall design and prepare detailed setting out drawings based on the approved layout drawings and those shall be submitted to the Engineer-in-charge prior to commencement of work. Bench Marks and Reference Lines shall be established, by the contractor with approval of the Engineer-in-charge.

The contractor shall erect timber profiles, masonry pillars, etc. for his use. All markings shall be maintained for the entire duration of the project. Setting out shall be approved by the Engineer-in-charge before the commencement of any work.

2.6 Excavation in Soils

The work shall be done as per C.P.W.D specifications with upto date correction slips and Indian Standard Codes of practice shall be applicable unless specified otherwise. In all cases the latest revisions of the codes shall be referred to.

2.7 Filling

Filling shall be done in layers not exceeding 20 cm in depth. Earth used shall be free from roots; grass and rubbish and all lumps and clods exceeding 8 cm in any direction shall be broken down. Each layer shall be watered with optimum moisture content to achieve 90% consolidation. Consolidation shall be done by mechanical rammers and/or roller of minimum half-ton weight. Where the roller cannot work, wooden or steel rammers of seven to ten kg weight with base of 20 sq. cm or 20-cm dia should be used. Labour for ramming shall be at least 1 for every 6 diggers. In embankment or banking, every third layer of earth shall be rolled and consolidated with power roller of minimum eight-ton weight.

2.8 Preservation of Property/Amenities

Trees, shrubs, any other plants, pole lines, fences, signs, monuments, buildings, pipelines, sewers and all facilities within or adjacent to the site which are not to be disturbed shall be protected from injury or damage. The Contractor shall provide and install at his own expense, suitable safeguards approved by the Engineer-in- charge for this purpose.

During clearing and grubbing, the Contractor shall take all adequate precautions against soil erosion, water pollution, etc., and where required, undertake additional Works to that effect. Before start of operations, the Contractor shall submit to the Engineer-in-charge for approval, his work plan including the procedure to be followed for disposal of waste materials, etc., and the schedules for carrying out temporary and permanent erosion control Works as stipulated in this RFP.

2.9 Methods, Tools and Equipment

Only such methods, tools and equipment as are approved by the Engineer-in-charge and which will not affect the property to be preserved shall be adopted for the Work. If the area has thick vegetation / roots, a crawler or pneumatic tyred dozer of adequate capacity may be used for clearance purposes. All vegetation such as roots, under-growths, grass and other deleterious matter unsuitable for incorporation in the Work shall be removed between fill lines to the satisfaction of the Engineer-in-charge.

All branches of trees extending above the roadway shall be trimmed as directed by the Engineer-in-charge.

All excavations below the general ground level arising out of the removal of stumps, etc., shall be filled with suitable material and compacted thoroughly so as to make the surface as these points conform to the surrounding area.

2.10 Disposal of Materials

All materials arising from clearing and grubbing operations shall be the property of Employer and shall be disposed of by the Contractor as hereinafter provided or directed by the Engineer-in-charge.

Boulders, stones and other materials usable in construction shall be neatly stacked as directed by the Engineer-in-charge. Stacking stumps, boulders, stones etc., shall be done at specified spots with all lifts and up to a lead of 1000 m.

All products of clearing and grubbing which, in the opinion of the Engineer-in-charge, cannot be used or auctioned shall be cleared away from the site in a manner as directed by the Engineer-in-charge. Care shall be taken to see that unsuitable waste materials are disposed off in such a manner that there is no likelihood of these getting mixed up with the materials meant for construction.

2.11 Soil

This shall include all types of soils which can be excavated by pick axes spades or earth moving equipment such as shovels, draglines, etc., and which are not classified under rock.

It shall not include, vegetable or organic matter, turf, mud, shingle, loam, peat, bricks, mica-schists, tar/bitumen, surfaces, lime concrete, stone/brick masonry, embedded rocks, boulders etc.

2.12 Excavation in Soil

Sides and bottom of excavation shall be cut sharp and true to line and level. Undercutting shall not be permitted.

The Contractor shall ascertain for himself the nature of materials to be excavated and the difficulties, if any, likely to be encountered in executing this work. Sheeting, shoring, bracing, maintaining suitable slopes, draining etc. shall be provided and installed by the Contractor, to the satisfaction of the Engineer-in-charge.

For deep and huge excavations and in other excavations, if required by the Engineer-in-charge, the Contractor shall submit for Engineer-in-charge's approval and "Excavation Scheme" showing the methodology to be adopted for excavation in order to maintain the stability of side slopes, means for ensuring safety of existing facilities nearby, dewatering. However, the Contractor shall be fully responsible for the scheme irrespective of any approvals granted. Benching shall be provided for deeper excavation wherever required.

When excavation requires bracing, sheeting or shoring etc. the Contractor shall submit drawings to the Engineer-in-charge, showing arrangements and details of proposed installation. The Contractor shall also furnish all supporting calculations as called for and shall not proceed until he has received written approval from the Engineer-in-charge. However, the responsibility for adequacy of such bracing, sheeting, shoring etc. will rest with the Contractor, irrespective of any approval of the Engineer-in-charge.

The Contractor shall have to constantly pump out any water collected in pits and other areas due to rain water, springs etc. and maintain dry working conditions at all times until the work is completed. The Contractor shall remove all slush/muck from the excavated areas to keep the work area dry. Sludge pumps, if required, shall be employed by the Contractor for this purpose.

The Contractor shall remove all materials arising from excavations from the vicinity of the work either for direct filling, stacking and subsequent filling or for ultimate disposal as directed by the Engineer-in-charge. In no case shall the excavated soil be stacked within a distance of 1.5 m from the edge of excavation or one-third the depth of excavation whichever is more. Material to be used for filling shall be kept separately.

Masonry pillars shall be erected at suitable points in the area which is visible from the largest area to serve as bench marks for the execution of the work. These bench marks shall be constructed as required and connected with standard B.M. as approved by the Engineer-in-charge. Necessary profiles with pegs, bamboos and strings shall be made to show the correct formation levels before the work is started. These shall be maintained during the excavation.

The ground levels shall be taken at 2 to 5 metres intervals (as directed by the Engineer-in-charge) in uniformly sloping ground and at closer intervals where local mounds, pits or undulations are met with. The ground levels shall be recorded in field books and plotted on plans. The plans shall be drawn after the building plans being superimposed with correct dimensions and orientation and to a scale of 4 metres to one cm or any other suitable scale decided by the Engineer-in-charge, north direction line and position of B.M. shall be shown on the plans. These plans shall be signed by the Contractor and submitted to the Engineer-in-charge for his record purposes, before the earthwork is started. The surveyor & labour required for taking levels, shall be supplied by the Contractor at no additional cost.

2.13 Cutting

In firm soils and in rocks, the sides of the excavated areas shall be kept vertical upto a depth of 2 metres from the bottom. For a greater depth, the excavation profiles shall be widened by allowing steps of 50 cm after every 2 metres from the bottom. Alternatively, the excavation can be done so as to give slopes of 1:4. Where the soil is soft, loose or slushy, the width of steps shall be suitably increased or side sloped or the soil shored up as directed by Engineer-in-charge. It shall be the responsibility of the Contractor to obtain complete instructions in writing from the Engineer-in- charge regarding the stepping, sloping or shoring to be done for the excavation deeper than 2 metres.

2.14 Excavation below Ground Water Table

The Contractor have to conduct investigation, collect all primary and secondary data to undertake land development work.

Wherever ground water table is met with during excavation, the Contractor shall immediately report this fact to the Engineer-in-charge before start of dewatering operation. The decision of the Engineer-in-charge regarding sub-soil water level shall be final and non-payable provided the Contractor has made arrangement for its dewatering. Ground water table for the purpose of this clause shall be taken as the level of standing water observed during the process of excavation. Capillary action of water in the surrounding soil mass shall also be considered for the above purpose.

The Contractor shall dewater and maintain dry working conditions by maintaining the water table below the bottom of the excavation level by well-point dewatering or deep well dewatering or any other method approved by the Engineer-in-charge. The Contractor shall continue doing so till excavation and all other operations included in the scope of work, which require dry condition in the area are completed.

Lift

The Contractor is required to excavate upto any depth as shown on the drawings or as directed by the Engineer-in-charge. Lifting of excavated materials shall be done either by manual or mechanical or both means if called for by the Engineer-in- charge.

2.15 Carriage of Excavated Materials Beyond the Initial Lead of 50 M

The disposal/stacking areas for excavated materials shall be indicated by the Engineer-in-charge. The carriage of excavated materials beyond a lead of 50m shall be done by the methods mentioned below:

- The excavated materials shall be carried beyond the initial lead of 50 m but upto 500 m manually or by mechanical means. If directed by the Engineer-in-charge this material shall be used directly for filling purposes or sorted and stacked for other users.
- For leads exceeding 500 m the Contractor shall transport the excavated materials by mechanical means only and as directed by the Engineer-in-charge. The Contractor shall arrange for movements on Kaccha and/or Pacca roads etc. within the site Providing and maintaining of the Kaccha and/or Pacca roads shall be the responsibility of the Contractor. The transported material shall be neatly stacked as directed by the Engineer-in-charge.

2.16 Filling

Filling shall be done where required with approved quality of earth. It may be from excavation and, where possible, cutting and filling shall be done simultaneously to avoid double handling.

Filling shall be done in layers not exceeding 20 cm in depth. Earth used shall be free from roots; grass and rubbish and all lumps and clods exceeding 8 cm in any direction shall be broken down. Each layer shall be watered with optimum moisture content to achieve 90% consolidation. Consolidation shall be done by mechanical rammers or roller of minimum half-ton weight. Where the roller cannot work, wooden or steel rammers of seven to ten kg weight with base of 20 sq. cm or 20-cm dia should be used. Labour for ramming shall be at least 1 for every 6 diggers. In embankment or banking, every third layer of earth shall be rolled and consolidated with power roller of minimum eight-ton weight.

2.17 Compaction

Required quantity of water corresponding to OMC be added depending upon the requirement i.e production of filling. Suitable allowance for loss of water due to evaporation etc. shall be accounted for. The thickness of loose fill layer be limited to about 200 mm. The number of passes shall be such so as to meet density requirement, determined earlier for that batch of fill material. Before placing second layer of fill material, the top surface of the earlier layer be scrapped using manual scraper, if felt necessary by the Engineer-in-charge.

Compaction to be done in layers not exceeding 200 mm loose and Modified Dry Density should be 95% and OMC ± 2% or relative density not less than 70%. Compaction be carried out by 8 to 10 t vibratory rollers.

2.18 Quality Control

The following programme be followed for detailed tests as also mentioned below

2.18.1 Earth

2.18.1.1 Laboratory Test

i. Gradation including determination of Clay content ii. Atterberg limits iii. Modified Proctor iv. Sulphate content, chloride content	As per relevant IS Code of practice or as directed by the Engineer-in-charge	For test no. (i) to (iii) one in every 5000 m3 of material. For test no. (iv) one in every 10000 m^3 of material.

2.18.1.2 Field Test

Field Dry Density — At minimum of 2 places as identified by the Engineer-in-charge In-charge.

i) Area upto 25 sqm in the case of small excavations
ii) Areas upto 100 sqm in the case of large excavations
iii) Quantity laid in a day whichever is less

For each additional 100 sq.m. one more test will be carried out.

2.18.1.3 Other necessary tests

The following tests be carried out in every 5000 cum fill material:

- Grain size analysis including hydrometer Analysis for evaluating clay content if any
- Atterberg limits (liquid limit and plastic limit)
- Compaction characteristics

For every 10,000 cum of fill material, shear parameters and compression index corresponding to 95% of modified Dry Density Compaction level or 70% relative density be evaluated.

Plate load tests (using 1.5 size RCC blocks) be carried out at 5 locations, as per the instruction of the consultant.

2.18.1.4 Routine Programme

The following programme be followed for quality control tests for every batch of 500 to 600 cum of loose material:

- Moisture content of loose material
- Modified Proctor test for evaluating maximum dry density and optimum moisture content or relative density.

Density be checked for compacted backfill material at minimum of 2 places as identified by the Engineer-in-charge:

- Areas upto 25 sqm in the case of small excavations.
- Areas upto 100 sqm in the case of large excavations
- Quantity laid in a day whichever is less

For each additional 100 sqm one more test will be carried out.

2.19 Disposal of Surplus Earth

Surplus earth shall be used to the maximum extent in backfilling. Earth useful for filling shall be separately stacked as directed by the Engineer-in-charge from time to time. Approved quality earth shall be used in the filling. It shall be consolidated as detailed and approved by the Engineer-in-charge.

All surplus and unusable earth shall be disposed off outside the site or as directed by the Engineer-in-charge.

3. TRANSPORT AND CIRCULATION

3.1 Scope of Work

The scopes of works are as follows:

1. Investigation for the purpose of Engineering Design.
2. Survey of the site for the purpose of Engineering Design and Quantity.
3. Preparation and submission of all engineering drawings and design based on the approved layout plan of the township.
4. Construction of the road network after approval of design and drawing.
5. The Network of urban roads as follows:
   - 45m ROW Road - Arterial Road Type 1
   - 36m ROW Road - Arterial Road Type 2
   - 30m ROW Road – Sub- arterial Road
   - 18m ROW Road - Collector Road
   - 12m ROW Road - Local Road
   - 9m ROW Road - Other Road Type 1
   - 7.0m ROW Road - Entry Road from South
6. Each roads are as marked in the Layout Plan.
7. Each typical cross section for each type of ROW are shown in this document, shall be followed for the typical cross section.
8. L-sections attached along in this document shall be followed in general. Deviation of the L section shall be notified to the Employer.
9. Road markings and road studs. Delineator as prescribed by the codes.
10. Tactile Detailing at footpath and Cycle track as per the requirement of the regulation.
11. Road signs and Signage.
12. Overhead signs at strategic location. Actual locations are to be given by employer at the time of construction.

3.2 Road Network

Refer the tender drawings.

3.3 Site Survey & Investigation

3.3.1 Site Topographical Survey

Topographical survey for the site was conducted in the month of April 2024.

Based on the topographical survey conducted, the proposed project area is about 225.2 acres. The proposed project area is at an elevation of 162 MSL to 169 MSL. The land is undulated with one natural streams passing the area.

Contractor is expected to conduct his own survey for the purpose of road and other utility design.

Table 3-1: Bench Mark of the Proposed Project area

Sr. No.	Point Id	Easting	Northing	Elevation
1	TBM-1	796232.587	2998608.13	164.26
2	TBM-2	796133.523	2998631.472	162.51
3	TBM-3	795990.268	2998677.788	162.94
4	TBM-4	795990.007	2998677.872	162.91
5	TBM-5	795989.038	2998673.212	162.95

Sr. No.	Point Id	Easting	Northing	Elevation
6	TBM-6	795988.728	2998673.307	162.95
7	TBM-7	795924.024	2998512.099	163.00
8	TBM-9	795840.935	2998475.122	163.75
9	TBM-10	795794.503	2998496.002	163.76
10	TBM-11	795661.316	2998664.872	162.39
11	TBM-12	795586.714	2998634.443	162.49
12	TBM-14	795451.882	2998580.344	162.52
13	TBM-16	795430.335	2998816.869	162.98
14	TBM-17	795435.253	2998846.129	162.84
15	TBM-18	794835.218	2999532.361	162.67
16	TBM-19	794789.75	2999394.639	163.34
17	TBM-20	794724.652	2999179.306	164.64
18	TBM-21	794757.057	2999079.848	164.30
19	TBM-22	794889.552	2998963.33	163.15
20	TBM-23	794692.1	2998890.614	164.34
21	TBM-24	794623.925	2998784.666	164.43
22	TBM-25	794537.181	2998489.906	163.17
23	TBM-26	794778.703	2998416.784	164.01
24	TBM-27	795230.056	2998333.238	163.34
25	TBM-28	795140.061	2998094.645	163.89
26	TBM-29	795122.411	2998060.502	163.91
27	TBM-30	795066.323	2998081.574	163.64
28	TBM-31	795078.951	2997807.301	166.77
29	TBM-32	794887.269	2997707.588	166.79
30	TBM-33	794975.189	2997572.649	167.36
31	TBM-34	794865.814	2997306.165	167.27
32	TBM-35	795199.251	2997380.646	167.01
33	TBM-36	795271.379	2997514.004	167.48
34	TBM-37	795639.047	2997518.296	166.97
35	TBM-38	795580.12	2997713.088	168.07
36	TBM-39	795424.084	2997933.309	167.31
37	TBM-40	795383.386	2997794.698	167.67
38	TBM-42	795518.324	2998249.737	165.18

The Detailed Project Report coordinates are based on the UTM Coordinates.

3.3.2 Site Geotechnical Investigation

The test report is attached for reference The Contractor have to test the CBR of each location as recommended by the Indian Road Congress for the purpose of design.

3.3.3 Material Survey

The site is located outside of the main city area. Material survey has to be conducted before construction.

The material carriages considered for the project during project estimate are as follows:

- Coarse Aggregates – Khaira Thakur 70 Km
- Coars Sand – Kalpi 300 Km
- Bricks – Itawa – 100 Km
- Cement /Steel – local 25 km

3.4 Planning And Design

3.4.1 Design Speed

The Ministry of Urban development issued guidelines for Urban Roads "Code of Practice Part – 1". Based on this Code, the following are categorized:

Table 3-2: Recommended Lane width for Roads in Urban area

Road Type	Right of Way – ROW (m)	Design Speed (kmph)
Arterial Road Type 1	30-50	50
Arterial Road Type 2	30-50	50
Sub arterial Road	30-50	50
Collector Road	12-30	30
Local Road	12-30	30
Other Road Type 1	6-15	15
Other Road Type 2	6-15	15
Entry Road from South	6-15	15

Based on the ROWs of the roads, the design speed followed will be:

Table 3-3: Adopted Design speed

Right of Way – ROW (m)	Design Speed (kmph)
45.O M ROW	50
36.O M ROW	50
30.O M ROW	50
18.O M ROW	30
12.O M ROW	30
9.O M ROW	15
7.0 M ROW	15

3.4.2 Sight Distances

Sight distances of the roads are to be designed on the recommended values as mentioned in the Guideline laid down by the Ministry of Urban Development.

3.4.3 Vertical Profile

The design of vertical profile are under three parts:

1. Grade of the vertical alignment
2. Summit Curve
3. Valley Curve

As per the guideline of the Vertical alignment design from "Code of Practice – Part – 1: Cross Sections" by Ministry of Urban Development, the Summit curves should be provided with adequate sight distances. The Safe Sight Distances should be provided at all sections of the road system. The design criteria for profile are based on the following:

Table 3-4: Guideline for MINIMUM K Value

Speed	50 kmph		30 kmph		15 kmph	
	Crest	Sag	Crest	Sag	Crest	Sag
Minimum K for Stopping Sight Distance	7		2		1	
Minimum K for	30		17		17	

Speed	50 kmph		30 kmph		15 kmph	
	Crest	Sag	Crest	Sag	Crest	Sag
Passing Sight Distance						
Minimum K for Headlight Sight Distance		13		6		3

3.4.4 Horizontal Alignment

The centerline coordinate of the road is as follow:

S.No	Road no	ROW	From	To	Length
1	R-45-01	45	0	512.49	512.49
2	R-45-02	45	0	255.3	255.30
3	R-36-01	36	0	342.58	342.58
4	R-36-02	36	0	348.03	348.03
5	R-36-03	36	0	439.457	439.46
6	R-36-04	36	0	801.609	801.61
7	R-30-01	30	0	732.36	732.36
8	R-30-02	30	0	70.86	70.86
9	R-18-01	18	0	445.79	445.79
10	R-18-02	18	0	468.49	468.49
11	R-18-03	18	0	909.89	909.89
12	R-18-04	18	0	371.78	371.78
13	R-18-05	18	0	270.12	270.12
14	R-18-06	18	0	265.9	265.90
15	R-18-07	18	0	347.85	347.85
16	R-18-08	18	0	176.97	176.97
17	R-18-09	18	0	335.92	335.92
18	R-18-10	18	0	632.06	632.06
19	R-18-11	18	0	301.09	301.09
20	R-18-12	18	0	597.75	597.75
21	R-18-13	18	0	576.62	576.62
22	R-18-14	18	0	370.21	370.21
23	R-18-15	18	0	210.7	210.70
24	R-18-16	18	0	193.8	193.80
25	R-18-17	18	0	321.75	321.75
26	R-12-01	12	0	273.05	273.05
27	R-12-02	12	0	247.81	247.81
28	R-12-03	12	0	172.5	172.50
29	R-12-04	12	0	291.12	291.12
30	R-12-05	12	0	317.55	317.55
31	R-12-06	12	0	238.41	238.41
32	R-12-07	12	0	109.74	109.74
33	R-12-08	12	0	344.48	344.48
34	R-12-09	12	0	220.13	220.13

S.No	Road no	ROW	From	To	Length
35	R-12-10	12	0	216.92	216.92
36	R-09-1	9	0	178.25	178.25
37	R-09-2	9	0	187.71	187.71
38	R-09-3	9	0	178.08	178.08
39	R-09-4	9	0	271.12	271.12
40	R-09-5	9	0	114.72	114.72
41	R-09-6	9	0	116.13	116.13
42	R-09-7	9	0	302.76	302.76
43	R-09-8	9	0	52.11	52.11
44	R-09-9	9	0	189.66	189.66
45	R-09-10	9	0	188.55	188.55
46	R-09-11	9	0	187.53	187.53
47	R-09-12	9	0	187.02	187.02
48	R-09-13	9	0	185.5	185.50
49	R-09-14	9	0	322.26	322.26
50	R-09-15	9	0	116.32	116.32
51	R-09-16	9	0	153.09	153.09
52	R-09-17	9	0	261.2	261.20
53	R-09-18	9	0	238.05	238.05
54	R-09-19	9	0	238.22	238.22
55	R-09-20	9	0	98.61	98.61
56	R-09-21	9	0	99.46	99.46
57	R-09-22	9	0	240.58	240.58
58	R-09-23	9	0	213.93	213.93
59	R-09-24	9	0	212.94	212.94
60	R-09-25	9	0	114.24	114.24
61	R-09-26	9	0	114.23	114.23
62	R-09-27	9	0	109.74	109.74
63	R-09-28	9	0	109.74	109.74
64	R-09-29	9	0	172.48	172.48
65	R-09-30	9	0	44.76	44.76
66	R-09-31	9	0	186.77	186.77
67	R-09-32	9	0	82.7	82.70
68	R-09-33	9	0	138.2	138.20
69	R-09-34	9	0	318.94	318.94
70	R-09-35	9	0	115.71	115.71
71	R-09-36	9	0	344.09	344.09
72	R-09-37	9	0	106.73	106.73
73	R-09-38	9	0	156.22	156.22
74	R-09-39	9	0	56.94	56.94
75	R-24-1	24	0	261.770	261.77
76	R-24-1_1	24	0	521.35	521.35

S.No	Road no	ROW	From	To	Length
77	Entry Road from South (S/R or slip)				500.00
78	NH Bypass (App. Of LVUP) 2*100*2				400.00

3.4.5 Intersections

The traffic lights are to be installed under this scope of work.

The traffic lights shall be selected by the Contractor in consultation with the Employer.

3.4.6 Utilities

The utilities are shown in the typical sections of the roads. The actual utility placement and design are to be based on the requirement of the location, as specified under various utilities section of this Tender. The water supply (Potable & Recycled) & power cables should be placed inside the Utility Duct, and gravity flow like sewer and/or storm water drains must be proposed outside of the Utility Dust.

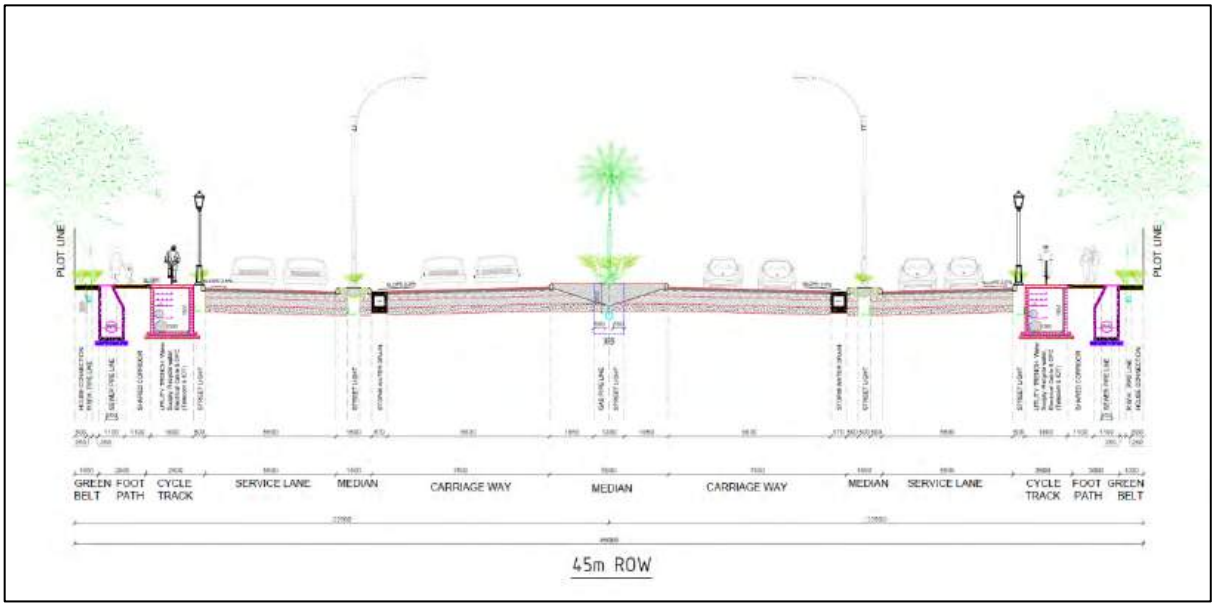
3.4.7 Road Signage

Road signage shall be provided by the Contractor as specified by “Code of Practices – Part IV” as issued by Ministry of Urban Development 2012.

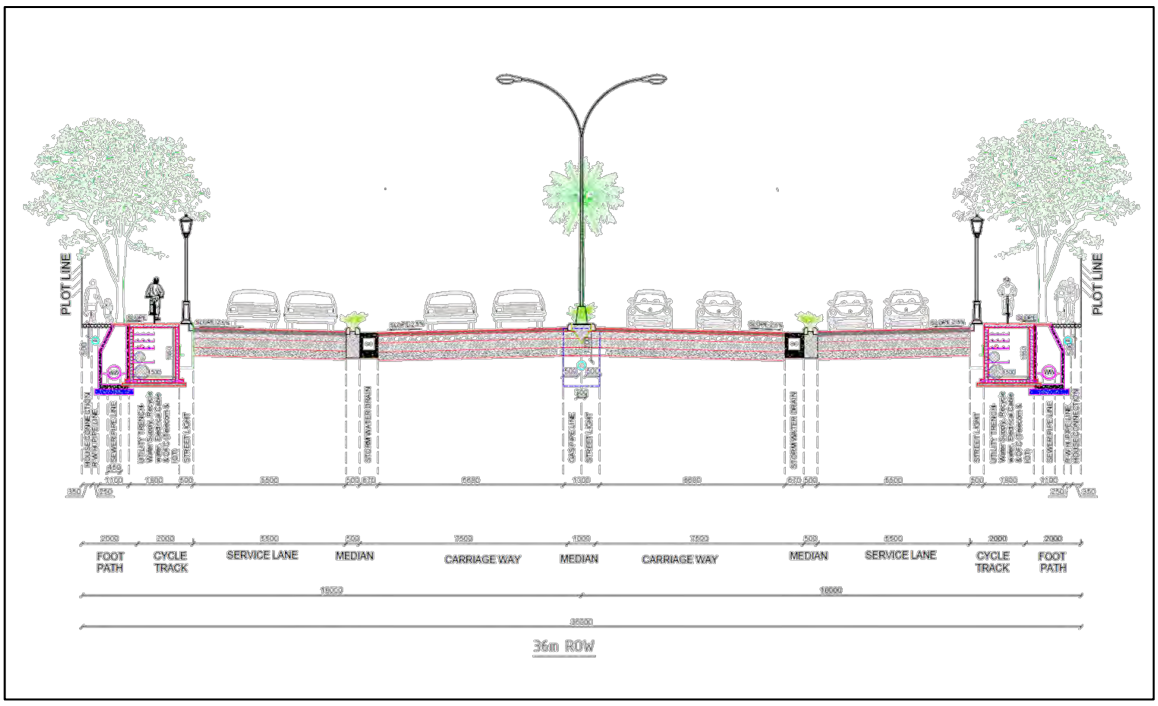
All drawings and plans related to the signage shall be approved by the Employerbefore issuing purchase for the same.

3.5 Typical Cross Sections

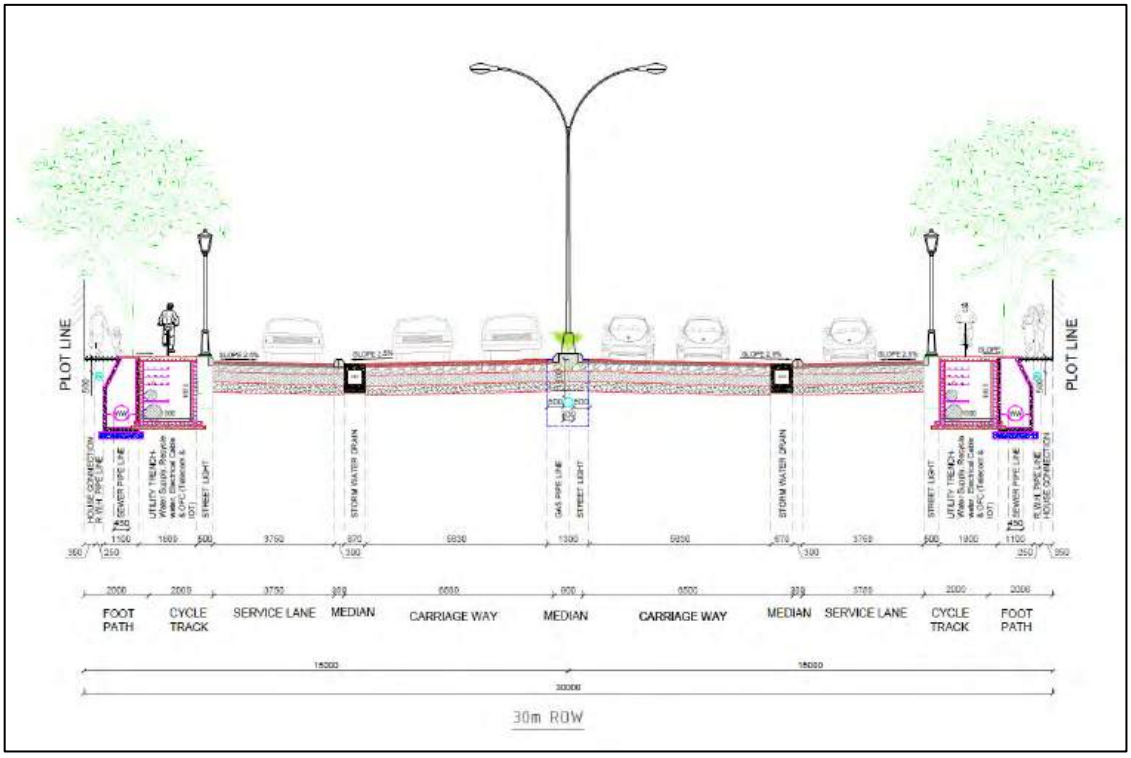
3.5.1 45m ROW Road - Arterial Road Type 1



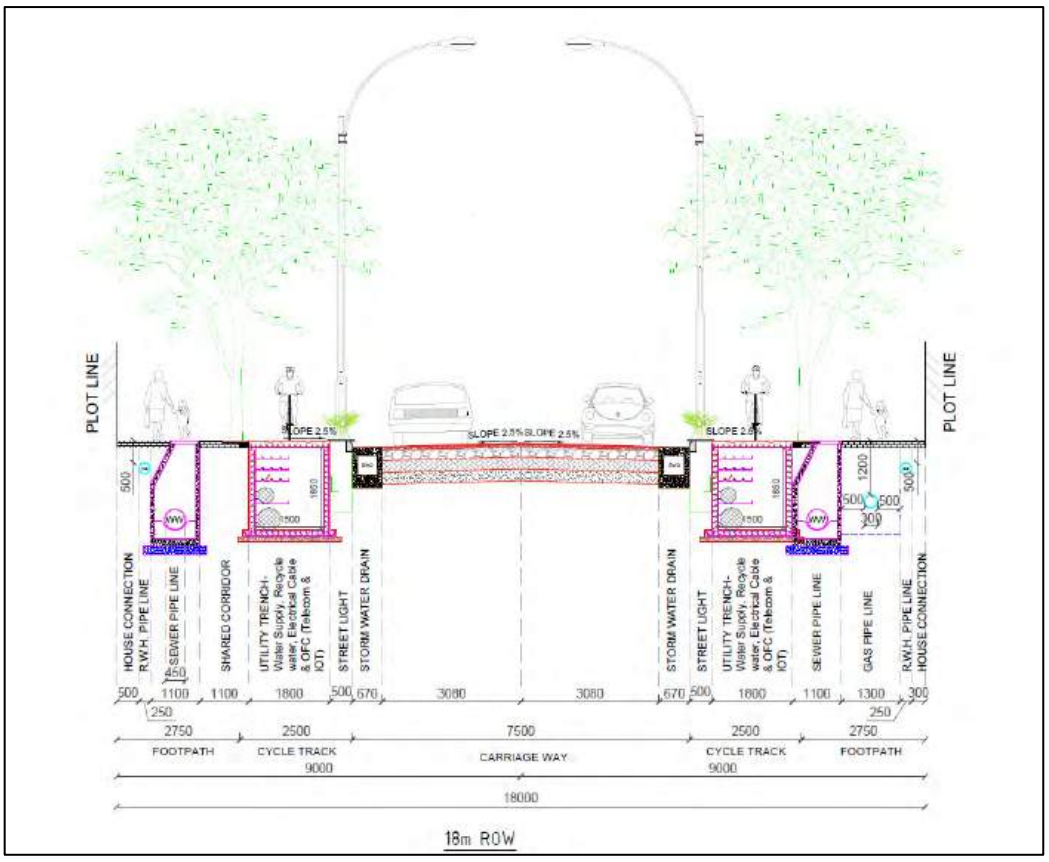
3.5.2 36m ROW Road - Arterial Road Type 2



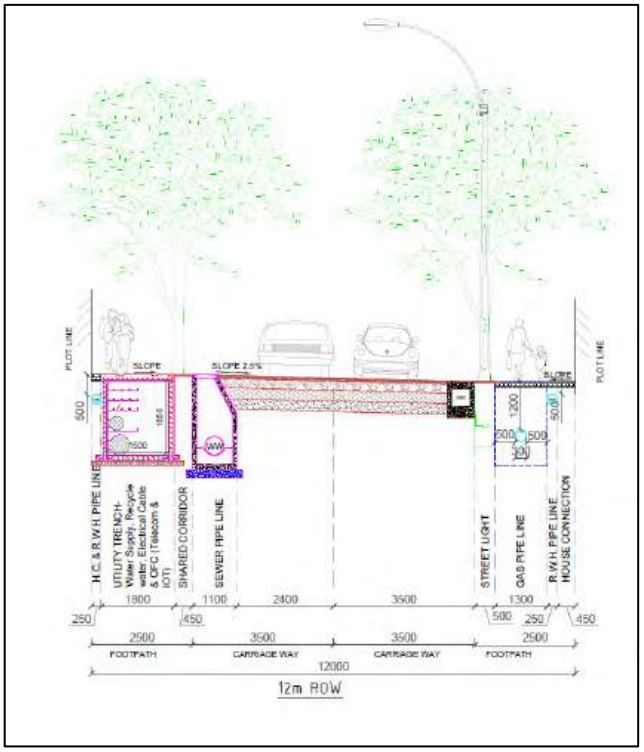
3.5.3 30m ROW Road – Sub- arterial Road



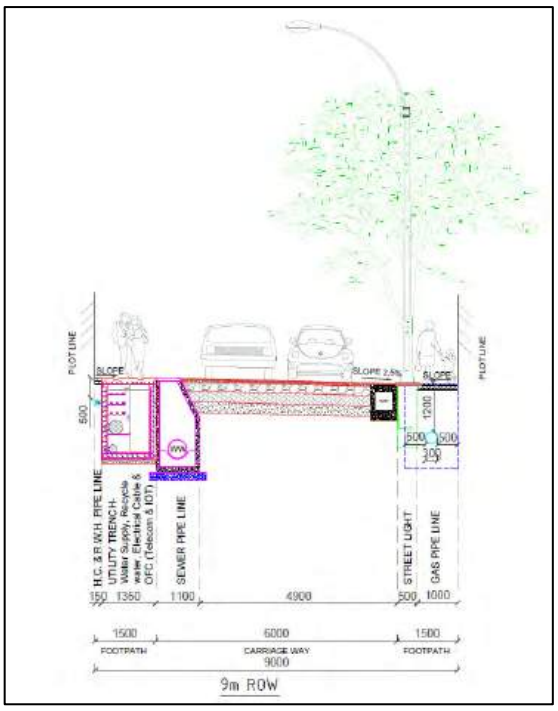
3.5.4 18m ROW Road - Collector Road



3.5.5 12m ROW Road - Local Road



3.5.6 Other Roads



3.6 Pavement design

Pavement design for these roads are based on the recommendation of Indian Road Congress IRC 37-2012 “Guideline for Design of Flexible Pavement”.

The design parameters considered for pavement design are as follows:

1. Design life of pavement is taken as 20 years.
2. Annual growth rate of commercial vehicle taken as 5.0%
3. Vehicle Damaging Factor is taken from table 4.2 of IRC 37-2012
4. Lane distribution factor taken from Section 4.5 of IRC 37-2012
5. Design life for the bottom non bituminous layers (base and sub-base) considered is 20 years and for the bituminous layers considered is also 20 years.

The relation for calculation of the traffic loads shall be as follow:

$$N = \frac{365\lfloor(1 + \mathrm{r})\mathrm{n} - 1\rfloor}{r} x\mathrm{AxDxF}$$

Where,

N = Cumulative number of Standard Axles to be catered for in the design in terms of msa

r = Annual vehicle growth rate of commercial vehicle in decimal.

n = Design life in years

A = Initial traffic in year of completion of construction in terms of the number of commercial vehicles per day (CVPD)

D = Lane distribution factor

F = Vehicle Damaging Factor

3.6.1 Soil Stabilisation recommendation

The soil improvement is proposed as the following:

The sub grade of 500mm thick shall be removed and replaced with material which is not less than 10% CBR value. Considering the value of 10% CBR of borrow material and with the recommendation of IRC 37 – 2012, it is taken that the effective value of design CBR is taken as 7% CBR.

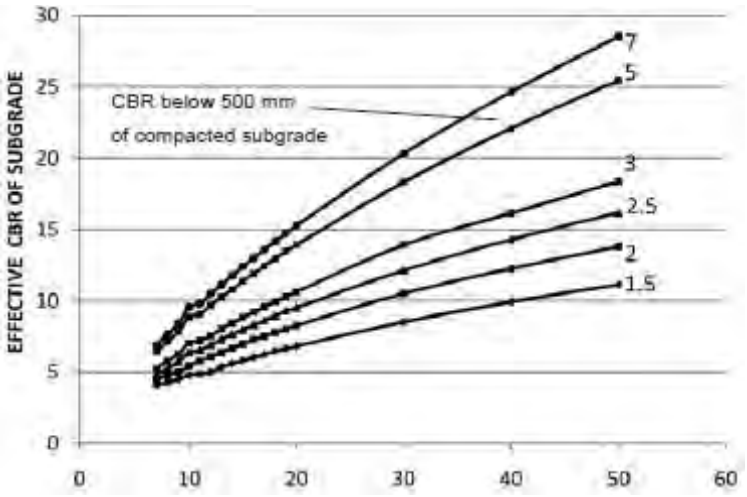


Figure 3-1: CBR of Compacted Borrow Material 500mm thick

The figure above is the recommendation of the IRC 37-2012.

The actual CBR value of the replacement material and original subgrade shall be tested and recalculated.

3.6.2 Pavement design recommendation

For reference, design crust thickness is taken from the design plate based on the assumption of 5% CBR value has been taken and shown as follows:

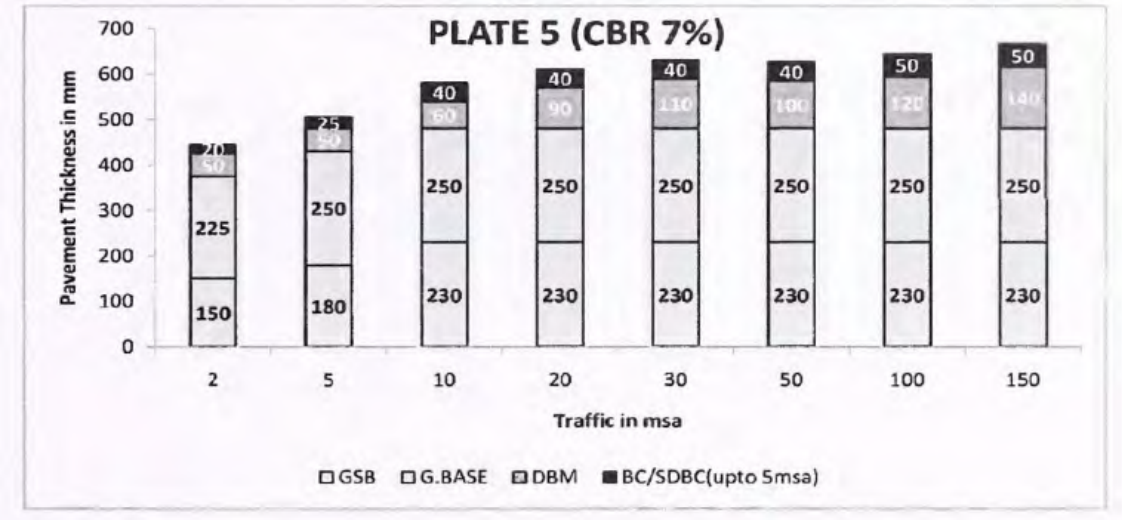


Figure 3-2: Plate no 5 of IRC 37 – 2012

3.6.3 Super elevation

Roads shall be designed for a maximum super elevation of 4% which is a recommendation for urban roads.

3.6.4 Traffic Lights

The traffic lights are projected to be used in junctions for controlling of traffic.

3.7 Retaining Walls and control of ROW

The roads which are level different from the natural grade shall be supported with retaining structure as below:

- No retaining structure till the height of 1.5 m embankment from the natural ground level.
- From 1.5m to 3.0m high, the retaining structure shall be of RCC cantilever wall. Vent hole shall be provided at a distance of 1m centre to centre throughout the wall at different levels.
- For height above 3.0m, MSE wall shall be introduced for retaining the bund.

The ROW as specified by the Master Plan should be followed for designing of the road space. To maximise the plot area and minimal interference from the infrastructure, retaining structure shall be designed to have vertical or almost vertical to minimise the loss of the adjacent plots.

3.7.1 Earth embankment Wall

The earth embankment wall shall be sloped and stabilised by rolling. The embankment shall be without lateral support. Turfing may be introduced to stabilise the slope for the first few years.

3.7.2 Design of RCC Retaining Wall

RCC Retaining wall has been selected for a height from 1.5m to 3.0m high embankment walls at the fill up area to retain bund structure.

Cantilever wall for retaining wall shall be designed for the embankment higher than 3m. The wall shall be designed for RCC with base slab.

The edge of the ROWs for road embankments which are protected with retaining walls shall be provided with road fencing. The road fencing detail shall be placed by the contractor in the drawing section.

3.8 Material Specification

3.8.1 General

The Technical Specification for the Road works shall be in accordance with the latest publication of “Specification for Roads and Bridge Works” issued by Ministry of Road, Transport and Highway, Government of India.

While submitting the design drawing, each specification shall be approved by the Employer, which form a part of the design submission.

All roads shall be designed for flexible pavement as shown in the pavement section of the Specification.

3.9 Structures

3.9.1 Light vehicular Underpass (LVUP)

Two No's LVUP (Light vehicular Underpass) with minimum lateral width 12m and minimum vertical clearance 4.5 m have to be proposed for the tertiary exit.

Table 3-5: Proposed LVUP

Sl. No	Design Chainage (km)	Road no	Type of Structure
1	0+105	R12-01	LVUP
2	0+140	R12-01	LVUP

4. STORMWATER DRAINS

4.1 Existing Water Channel

One existing Water Channel (nala) flows from East to West along the northern part of the site. There are 2 (two) locations, where nala crosses the proposed roads. Existing top level of Water channel elevation ranges from 164.2830 to 162.3400.

All the storm water drainage network of field goes in nala directly which finally flows into the river Yamuna.

4.2 Storm water Network

The storm water drainage system is integrated to cater both the surface run off of plots and roads. The integrated storm water drain runs along the road alignment at both sides throughout the road network. The storm water outfalls are located at the proposed central detention pond and existing Water Channel at the culvert locations.

The drainage network to be designed in such a manner that looking from south to north, the left side of the central 36.0 m ROW will first drain and collect into the proposed central detention pond, and when the pond reaches it's capacity, it will overflow into the natural water channel. The right side of the central 36.0m ROW will drain directly into the natural drainage channel flowing through the site.

At each plot, the surface runoff exit at the plot access. The storm water drainage network is to be placed throughout the road network.

The storm water calculation shall be established from rainfall data available with the Indian Meteorological Department. The storm drain calculated in the Project Cost is based on the one hour maximum rainfall of 282 mm.

The storm water drain network is designed as follows:

1. The surface run off should be designed to be directed towards the lowest section of road.
2. The storm water drain shall be RCC box sections capable of Class AA load as per latest IRC 6. The minimum dimension adopted in 0.45 x 0.45m. The drain may be designed to have higher depth by restricting the width of the cross section.
3. The storm drain covers should be designed to drain the surface runoff through grills placed at 10m centre to centre.
4. Plots to have rain water harvesting, the paved area of the plot is expected to discharge 50% of the runoff to the storm water and 50% of the runoff to the rain water recharge pits. Open area may be taken as 100% discharge to the Storm water network.
5. The storm water network is linked to the culvert for discharge of each network.
6. The discharge calculation for the entire Project area shall be calculated based on the Land Use Pattern. Consultation with the employer during the design stage is necessary before proceeding for the design.

4.3 List of Structure in Cross Drain

4.3.1 Minor Bridges (MNB)

Wherever Existing and/or Proposed Water Channel Crossings will require, minor bridges have to be proposed. Around three (3) locations Minor Bridges need to be proposed.

Table 4-1: Proposed Minor Bridges

Sl. No	Design Chainage (km)	Road no	Type of Structure
1	0+300	R36-04	Minor Bridge
2	0+256	R18-13	Minor Bridge
3	0+291	R36-03	Minor Bridge

4.3.2 Culverts

There are culverts to be constructed at cross drainage and near outlet points. Drawings are attached in the BID document for reference.

5. POTABLE WATER SUPPLY AND TREATED WATER SYSTEM

5.1 Scope

The Scope of Work shall include:

1. Detailed Design, plans, preparation of L section and construction drawings of pressurized water supply system of the zone
2. Submission of hydraulic design calculations, plans and drawings for approval to the client
3. Construction of Pressurized Water Supply Network as per approved design and plans
4. Supply, Installation, Testing, Commission, and O&M of the Water Supply System

The contractor shall Design and construct the pressurized water supply system on continuous running basis, along with installation of valves, scour valves, air release valves, thrust blocks etc. as required. The Contractor shall furnish all required tools, plant, instruments, materials including water, electricity, labor, consumables, etc., any and everything necessary for construction of the works, whether such items are specifically stated elsewhere in this bid. All valves shall be electrically actuated expect scour and air release valve.

The concept of design has been shown in the Technical Specification and attached drawing at the relevant section. The Contractor is open to propose the design which is better than the proposed in this Bid Document.

In general, this work shall include designing, providing, laying, jointing and testing of all pipes and specials / fittings, Valves, etc.

The specification specifies the requirements of new Ductile Iron (DI) pipes and fittings equipped along with fittings, intended for transportation of water supply to various land uses.

5.2 Terminal Points

The Terminal points of the scope are as follows:

1. The boreholes/ inlet pipe of feeder main of UP Jal Nigam located at Plot number UT-3.
2. Each plots connection point shall be placed within the ROW of each road for plot connection with Reinforced Cement Concrete Valve Chamber.

5.3 Exclusion and Interfaces

5.3.1 Exclusion

- Nil

5.3.2 Interfaces

- The inlet pipe of feeder main of UP Jal Nigam located at Plot number UT-3.

5.4 References and Standards

Except where otherwise specified the works under this project shall comply with the requirements of relevant Indian Standards (IS), CPWD specifications and manufacturer's instruction manual. If required reference is not available, for any of the work(s) mentioned in the specifications and tender, in IS code(s) then relevant clauses of either British Standards (BS) or ISO Standards shall be followed. The following standards and the amendments made thereto till date and any other IS code provisions found to be applicable to this work shall be binding on the bidders (bidding and executing the work). All standards are subject to revision and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions and amendments of the standards indicated below, but not limited to these only:

Comparison of Indian and Overseas Standards for Iron Casting	3896
Centrifugally Cast (Spun) Ductile Iron Pressure Pipe for Water,	8329
Gas and Sewage	9523
Ductile Iron Fittings for Pressure Pipes for Water, Gas and	14846
Sewage	12288
Sluice Valve for Water Works Purposes (50 to 1200mm Size)	5382

The bidders are therefore advised to refer and follow all relevant IS codes and amendments along with relevant ISO codes till date regarding supplying, testing, commissioning of DI and HDPE pipes and fittings, their testing, dimensions and measurement, composition of raw material, physical properties, mechanical characteristics, laying, jointing and their performance requirements, sampling and conformity criteria, marking and certification, etc.

If there are varying or conflicting provisions made in any one document forming part of the contract, the Accepting Authority shall be the deciding authority with regard to the intention of the document and his decision shall be final and binding on the contractor

5.4.1 Action where no Specifications are specified

In the case of any class of work for which there is no such specification, such work shall be carried out in accordance with the Bureau of Indian Standards Specifications. In case there is no such specification in Bureau of India Standards, the work shall be carried out as per manufacturer's specifications. In case there are no such specifications as required above, the work shall be carried out in all respects in accordance with the instructions and requirements of the Engineer-in-charge.

All materials and workmanship not fully specified herein or not covered by an approved relevant standard shall be of such kind as is used in first class work and suitable to the climate in the Proposed Atal Puram Township project area.

5.5 Water Supply for Proposed Atal Puram Township Project Area

Provision of Safe and adequate water is to be provided for the Proposed Atal Puram Township project Area through piped water supply scheme. The concept of potable and non-potable water demand is to be kept in mind while designing the piped water supply scheme. Potable water includes water required for drinking, cooking, bathing, washing etc. and non-potable water includes water required for flushing, horticulture, washing, cooling etc. Both `the water will be supplied to each of the plot of the Proposed Atal Puram Township project Area through dual piping system.

On the basis of the water demand calculation, requirement of treated water, transmission main system, distribution system, storage requirements including elevated service reservoirs, underground reservoir and pumping station capacities shall be assessed by the bidder.

While estimating the water demand CPHEEO manual, NBC 2016 and Civil Engineers Hand book shall be referred.

Main highlights of water supply system in proposed project area includes,

a. Smart meters for automated billing
b. Flow meter and sensors for better monitoring and control
c. Water quality analysers
d. Water loss reduction by DMA based approach
e. Water conservation and recycle system
f. Dual Piping system

5.6 Water Demand

Water demand has been estimated as per unit water demand requirement based on type of development as per master plan. Potable and Non- Potable water demand has been computed for both potable and non-potable uses separately for various types of users such as domestic, commercial and public semi-public areas as depicted in following calculations.

5.6.1 Peak Factor

As far as the design of distribution system is concerned, it is the hourly variation in consumption that matters. The fluctuations in consumption are accounted for, by considering the peak rate of consumption as rate of flow in the design of distribution system. As per Clause 10.3.1 of CPHEEO manual on water supply & treatment, the following peak factors are recommended for various population figures.

For Population	Peak Factor
< 50,000	3.0
50,000 – 2,00,000	2.5
> 2,00,000	2.0

The projected total population of the township is more than 2 Lakhs including residential, floating, commercial and other working people, a Peak factor of 2.0 is considered for distribution system design as per the CPHEEO manual and peak factor of 2.0 is considered for non-potable water network.

5.6.2 Fire Demand

The contractor will have to determine the Water requirements for firefighting which depends on various factors like type of construction, nature of occupancy, type and quantity of material handled and stored etc. Hence, Fire demand will be computed as per formula given in CPHEEO manual ($100\sqrt{P}$) where, P is population in thousands.

As this water is used only as a potable usage, the fire demands will be met with the potable water pipeline to be designed.

5.6.3 Other Demands

Recycled water (Non-Potable) shall be utilized to meet the other demands such as road washing, flushing of sewers, horticulture, etc. From this Non-Potable irrigation for Road Site plantation and Plantation in different parks will be met up. Flushing in toilet block in different parks will also be met up with this non-potable water.

5.6.4 Estimated Water Demand

The total estimated Population is 298702 Person. The Water Demand per day has been calculated as per the guidelines of National Building Code and is calculated to be about 13.34 MLD. The total Raw Water requirement is calculated to be about 13.897 MLD.

Total daily water demand	=	13.341 MLD
Total Raw Water Requirement	=	13.897 MLD
Potable water requirement	=	7.568 MLD
Non-Potable water requirement	=	5.773 MLD

Table 5-1: Water Requirement of various Land use

Sl. No.	Head	Land use	Area in Sqm	Total Population	Total Demand in lpcd	Total water requirement in KLD
1	Plotted Development	Residential	2,77,745.36	26868	150	3834.11
2	Group Housing (EWS, LIG, MIG, HIG)		106101.10	20327	150	2900.82
3	Retail / Sector Shopping	Commercial	86778.35	22678	60	462.42
4	Cinema/ Multiplex		4262.89	9146	30	157.76
5	Hotel upto 3 Star		4154.42	641	225	123.63
6	4/5 Star Hotel/ Resort		25139.63	3878	365	1315.75
7	Public Semi Public	Public Semi Public	186788.81	69089	60	1605.50
8	Gas & LPG Godown		4092.00	416	60	8.48
9	Police Chowki with residential facility		3576.00	1145	165	118.94
10	Guest House/ Hostels		9120.00	1264	150	3766.25
11	Banquet Hall, Community Centre like Mass Gathering Centers		90915.07	143096	30	2468.39
12	Utilities	Utilities	14988.48	150	60	7.75

Potable Water Demand including 15% NRW (As per CPHEEO vide Art.2.2.8.3 (a), P-11)	=	7.568 MLD
Flushing Water Demand including 15% NRW (As per CPHEEO vide Art.2.2.8.3 (a), P-11)	=	5.773 MLD
Fire Water Demand including 15% NRW (As per CPHEEO vide Art.2.2.8.3 (a), P-11)	=	1.988 MLD
Horticulture Demand including 15% NRW (As per CPHEEO vide Art.2.2.8.3 (a), P-11)	=	0.145 MLD
Total Daily Water Demand Requirement including NRW (As per	=	13.341 MLD

CPHEEO vide Art.2.2.8.3 (a), P-11)		
Total Raw Water Requirement (As per CPHEEO vide Art.2.2.8.3 (a), P-11)	=	13.897 MLD

The Horticulture and Flushing Water Demand shall be feed from the treated waste water generated at STP. The additional treated waste water generated at STP shall be disposed to the Proposed Water Bodies.

5.7 Water Quality for Potable Supply

The water quality data of ground water source is very crucial for designing and implementing the water supply systems. Thus, the quality data has to be collected from approved sources so as to design the treatment system which will cater to all quality fluctuations.

The Bureau of Indian Standards (BIS) prescribes the tests for assessing water quality and standards that must be met for making the water potable in IS 10500:2012 and subsequent amendments and IS 3025: 2019 - Methods of Sampling and Test (Physical and Chemical) for Water and Wastewater.

IS 10500:2012 - Drinking Water - Specification has the following categories of water quality parameters for which limits (standards) are provided:

a) Organoleptic and physical parameters
b) General parameters concerning substances undesirable in excessive amounts (chemical parameters)
c) Parameters concerning toxic substances (chemical parameters)
d) Pesticide residues (chemical parameters)
e) Parameters concerning radiological substances
f) Microbiological parameters namely indicator bacteria, viruses, protozoa and helminths
g) Biological parameters namely algae, zooplankton, flagellates

5.8 Planning Of Water Supply System

During Initial years Ground water to be extracted for supply of water to end users. The Bidder is to develop f tube well in accordance with IS: 2800 (part I) and IS: 11189, to measuring maximum rate of usable water yield without sand content by "V" notch method or any other approved method, measuring static level & draw down etc. by step draw down method, collecting water samples & getting tested in approved laboratory, The ground water to be pumped to the Raw Water UGR. The Raw Water to be treated for potable water supply use as per provision of IS: 10500. The treated ground water to be pumped after treatment to UGR-1.

The treated water supplied by the UP Jal Nigam will be conveyed by pumping to the proposed Water Works at plot no. UT-1. The Bidder is to make provision for necessary arrangement for inlet of this water to Clear Water UGR -1 (with two equal compartments). Clear water reservoir (CWR-1) or the UGR - 1 of 2.5 ML capacity with attached pump house for two sets of working Pumping arrangement will be located inside service area (Water Work Site). The monitoring and control of water supply system will be done by central control room (SCADA), ASCL.

Total Storage inside project area works out to be about 1 day.

Potable water from CWR (UGR-1) will be supplied to the proposed plots through pumping station attached to CWR-1. The entire area will be covered by distribution network as per minimum residual pressure requirements should be (12 mtr at furthest end) irrespective of topography of the area.

For Non-Potable water, the treated sewage after treatment will be collected through necessary lined channel or closed conduit up to the RWR (UGR-2 (with two equal compartments in plot no-52)) of 4 ML capacity. From UGR-2 water will be pumped through two sets of Pump in the Pump House attached to UGR- 2 to supply it two plots maintaining the same minimum residual pressure of 12.0 mtr at furthest end point.

Separate Potable and non-potable water supply pipelines are proposed all along the road up to the plot boundary as per the specific requirements of the plot area (as mentioned in the drawings). Pipelines (non-potable or potable) will be provided to all the plots where its requirements are felt based on the estimated demand. The requirements of extension of pipelines for future phases if any, will be planned and detailed out as per the requirement after necessary consultation with the authority.

5.9 Design Criteria

5.9.1 Bore Well

Water works shall have two bore wells where one will be operating and other on standby. Development of borewell(s) should be as per IS: 2800-1 (19991). Before design the borewell(s), the Bidder to measure maximum rate of usable water yield without sand content by "V" notch method or any other approved method, measuring static level & draw down etc. by step draw down method, collecting water samples & getting tested in approved laboratory.

5.9.2 Raw Water Transmission System

Raw water transmission system from the raw water pumping station near the raw Water Reservoir (RWR) will be designed with 20 hours/day pumping for ultimate demand up to CWR-1. A minimum residual pressure of 2.0m will be considered over the full supply level of the CWR-1 Minimum design velocity is 0.60m/s and maximum velocity of 2.5m/s will be maintained.

5.9.3 Clear Water Transmission & Distribution System

Clear water transmission system from the clear water pumping station near the Clear Water Reservoir (CWR) will be designed with 23 hours/day pumping for ultimate demand up to individual plots. A minimum residual pressure of 12.0m will be considered over the full supply level. Minimum design velocity is 0.60m/s and maximum velocity of 2.5m/s will be maintained.

Distribution network from UGR-1 will be designed as a looped network on the road layout. The system has to be planned to supply water from the UGR-1 to the individual plots by pumping on 24 x 7 basis.

The capacity of the CWR-1 is planned with 23 hours storage for potable and 16 hour storage for non-potable water requirements of the project area.

5.9.3.1 Pipe Diameter

Minimum pipe diameter in distribution system should not be less than 100mm.

5.9.3.2 Excavation Depth

All water supply pipes will be generally laid **inside Utility Duct**.

5.9.3.3 Residual Pressure

The system has to be designed for a minimum residual pressure of 12m (for double storied building) as per CPHEEO Manual, Section- 2.2.8.3 (e) above ferrule point (for potable and non-potable supply) at the nodes of distribution system (at the individual land parcel point).

5.9.3.4 'C' Value

This will be purely on the basis of the pipe material selected. The C value should be taken as per the guidelines in CPHEEO Manual on Water Supply and Treatment Clause 6.3.1.

5.9.3.5 Frictional Loss Formula

It is proposed to use Hazen William's equation for the network analysis.

5.9.3.5.1 Pumping System Design

The pumps for potable water supply are to be designed for 23 hours of pump operation. The pump machinery selection will be with 50% standby arrangement. Capacity of pumps will be as per the water demand. Space for Additional pumps shall have to be provided as per the increase in demand in future.

5.9.3.5.2 Losses

15% of the losses (As per CPHEEO vide Art.2.2.8.3 (a), P-11) are considered in the overall system.

5.9.3.5.3 Bulk meters

Bulk water meters will have to be installed at service reservoirs inlet, pumping stations and for all consumers' connections. All consumer connection shall be metered and billing needs to be generated on monthly basis. AMR type water meters will be used to facilitate automated water meter reading.

5.9.3.5.4 UFW monitoring and reduction

Unaccounted for Water (UFW) is the difference between the total amounts of water entering the distribution system and the total amount consumed by end user. DMA (District Metering Areas) based approach has been adopted for controlling UFW. Each DMA area will have a well-defined boundary with DMA meters (bulk flow meters) along with the individual consumer meters at the consumer point; valves will be provided on both upstream and downstream of the DMA meter for easy maintenance. Losses will be evaluated from comparing the flow measurements taken at DMA and metered consumption in that DMA. This process of identifying the leak and plugging the leaks shall be carried out as a routine operation until the desired UFW level is achieved (i.e. Less than 15%).

5.9.3.5.5 Valves

For operation and maintenance of transmission and distribution system adequate numbers of valves shall be provided. The transmission and distribution mains shall be provided with the following appurtenances and specials as per the following criteria.

The water supply pipelines shall be provided with sluice valves for isolation of different loop networks. All the valves shall be installed in valve chambers with cover. At bends and gaps, suitable specials shall be provided. Pressure reducing valves will be provided to reduce the pressure in pipeline. Concrete thrust block will be provided at the bend of the pipes and at the locations to avoid movement of pipe line as per the requirements. Air valves shall be provided at the summit location and at every 500m interval on the rising main/feeder mains as per requirement.

5.9.4 Pipe Material

The selection of pipe material depends on various technical factors as mentioned in CPHEEO Manual clause 6.3.1 such as internal pressures, coefficient of roughness, hydraulic and operating conditions, maximum permissible diameter, internal and external corrosion problem, laying and jointing, type of soil, special conditions etc.

Based upon the application and requirements, four pipe materials can be used for the present system. The pipe material shall be Ductile Iron (DI), High Density Polyethylene (HDPE), Pre-stressed Concrete (PSC) and Mild Steel (MS). The selected pipe material shall be easily available in market and extensively used in water industry for similar application.

HDPE pipes is to adopted for diameter upto 200mm
DI (K-9) Pipe is to be adopted for diameter above 200mm

5.9.4.1 HDPE

HDPE pipe, short for High-Density Polyethylene pipe, is a type of flexible plastic pipe widely used for fluid transfer. It's known for its durability, chemical resistance, and versatility, making it a popular choice for various applications. HDPE pipes are highly resistant to environmental factors like corrosion, abrasion, and weathering. They can withstand harsh conditions and have a long lifespan, often exceeding 50 years. They are flexible, allowing them to bend and curve without the need for numerous fittings. This makes installation easier and more cost-effective. Compared to traditional pipe materials like steel or concrete, HDPE is lightweight, making it easier to handle, transport, and install. The combination of durability, ease of installation, and low maintenance requirements makes HDPE a cost-effective solution for many piping projects.

HDPE pipe sizes are typically referred to by their nominal diameter (ND), which is the outside diameter of the pipe in millimeters (mm). Common ND sizes range from 20mm to over 1600mm.

5.9.4.2 Ductile Iron (DI)

Ductile Iron, while being technically satisfactory for the duties involved (robust and versatile), it will be much more expensive than mild steel for the diameter considered. Furthermore, if a pipe diameter of more than 1000 mm is required, getting competitive quotations would be difficult as they are supplied by limited manufacturers only.

Ductile Iron pipes are however suitable for local distribution lines downstream of reservoirs or smaller diameter tapings from trunk mains as they are readily available in sizes of 80 mm to 600 mm diameter. Ductile Iron has superior mechanical properties and greater tensile strength. It has high impact strength due to its ductility and toughness to stand up unscathed to rough handling and heavy traffic loads. The pipes are factory lined with cement mortar for smooth surface and externally coated with bit mastic paint

for protection against corrosion. Ductile Iron pipes are now extensively used in India for water distribution networks.

5.10 Water Demand

As per the Master Plan of the project area, water demand estimations have been carried out based on the unit water demand norms provided in the earlier sections.

The summary of water demand and reuse are provided in the following table.

Table 5-2: Summary of Water Demand

Sl. No.	Particulars	Demand	Unit
1	Gross Water demand	13.341	MLD
2	Potable water demand	7.568	MLD
3	Non-Potable water demand	5.918	MLD
4	Sewage generation including 10% Infiltration	12.860	MLD
5	Treated water available from STP (considering 20% loss)	10.288	MLD

5.11 Feeder Main

Raw Water from Bore Well will have to be pumped to Raw Water Reservoir. After treatment of Raw Water, the treated water for potable use will be supplied to UGR-1 in the proposed water works plot.

5.12 Clear (Potable) Water Distribution System

The potable water distribution network is to be designed by pumping from UGR-1. The water supply from UGR-1 should be designed on 24X7 basis. The water will be supplied to each plot area and storage in UGR-1. Water Distribution network should be designed by using Water Gems software. Water will be supplied up to boundary of each individual plot with isolation valve. The further connection with metering inside plot boundary will be done by respective plot owners.

Summary of Potable water distribution system

1. Pipe Diameter: Minimum Diameter 100 mm and Maximum Diameter 500 mm.
2. For the potable water distribution system 27.1 km of pipeline has been envisaged to be lay in the Proposed Atal Puram Township project Area. **The potable and recycled water supply pipelines are to be lay inside the proposed Utility Duct.**

5.13 Recycle (Non-Potable) Water Distribution System

The network should be designed under direct pumping system from the non-potable water reservoir. The network will be laid along road network. Water Distribution network has been designed by using Water Gems software. Water will be supplied up to boundary of each individual plot with isolation valve. The further connection with metering inside plot boundary will be done by respective plot owners.

Summary of Recycled water distribution system

1. Minimum Residual pressure at connection point: 12m
2. Pipe Material: HDPE, DI (K-9)

3. Pipe Diameter: Minimum Diameter 100 mm and Maximum Diameter 350 mm.
4. For the reycled water distribution system 27.6 km of pipeline has been envisaged to be layed in the Proposed Atal Puram Township project Area.

5.13.1 Pumping Stations

Three pumping stations have been proposed for raw, potable and non-potable water supply in Proposed Atal Puram Township project Area.

First pumping station will be located at UT-1 Plot for supplying raw water to water treatment plant.

Second pumping station will be located at clear water reservoir for supplying potable water to individual plots.

Third pumping station will be located near non-potable water reservoir at STP area.

Table 5-3: The pumping station details are given in following table (APPROX)

Sl. No.	Pump House	Pumping Area	Number of Pumps	Type of Pumps
1	Raw water (Potable) Pump House	Up to WTP	3 Nos. (2W+1S)	HSC Pumps
2	Clear water (Potable) Pump House	Up to End Users	3 Nos. (2W+1S)	HSC Pumps
3	Recycle (Non-Potable) water Pump House	Up to all plots	3 Nos. (2W+1S)	HSC Pumps

The capacity of pumps and size of pump houses shall be finalized based on detail engineering and approval.

5.13.2 Flow Meters

Flow meters will be provided at each inlet, outlet location and strategic points to measure the quantity of water supplied. Flow meters are proposed to be provided at inlet and outlet of reservoirs, service reservoirs, pumping station. Additionally flow meters are also provided in network to measure and evaluate the losses in the network. Ultrasonic flow meters are proposed to be installed in open channel and magnetic flow meters in pipes including transmitters and power backup.

Flow meter will be installed with suitable (easy accessible and workable) chamber by the Bidder.

5.13.3 Service Connection

Each plot shall have a service connation separately for potable and non-potable water. The tapping will be provided during the laying of pipeline to avoid road cutting and excavation during later stage. Each connection will have valve chamber and isolation valve for efficient and easy connection to each plot.

The details of service connections are proposed for potable water network and that of the recycled water system is provided in following;

About 1537 numbers of Service connection will be required for the potable water distribution network and 1559 numbers of Service connection for non-potable water supply distribution network.

5.13.4 Valves

Valves are installed in distribution for operation and maintenance, isolation, scouring and air removal in transmission and distribution system. In supply system, every branch should have a valve to enable isolation of line in stretches. All the valves are enclosed in valve chambers with manhole cover.

The transmission and distribution mains will be provided with valve per the following criteria.

- The mains are provided with sluice valves for isolation of different loop networks. The size of the valve is same as pipe diameter.
- Scour valve for draining water.
- Pressure reducing valves will be provided to reduce the pressure difference between the locations of the same zones to maximum of 3-5m.
- Air valves will be suggested at the summit location and at every 500m interval on the rising main / feeder mains -as per direction of authority.
- About 35 numbers of isolation valves, 17 numbers of scour valves and 10 number of Air valve will be required for the potable water distribution network and 37 numbers of isolation valve, 8 numbers of scour valves, 10 numbers of Air valves for non-potable water supply distribution network. These will be required in different dia of pipes throughout the Proposed Atal Puram Township project Area.
  The number of valves is for reference only. The exact number of valves will be finalized as per approved design & drawing showing valve details.

5.13.5 Electrical Design Criteria

1. The design concept of electrical system is based on providing safe, reliable & stable power and efficient performance of electrical system.
2. The design standard described herein is generally in compliance with the latest Indian Standards, IEC and Code of Practices of India.
3. All electrical installations shall confirm to the latest CEA (Central Electricity Authority) guidelines 2010.
4. Latest National and International Standards shall be used for each electrical equipment design in Proposed Atal Puram Township project Area.
5. The design ambient temperature for all electrical equipment shall be considered as 45 0 C.
6. The design ambient, Voltage levels, basic insulation levels and fault levels all are as specified under Annexure I-(G) Power Infrastructure section 5 Planning and design criteria should be followed.

The Technical specifications of compact substation, Earthing & Lighting Protection, Power Cables and 415V Switchgear, MCC, APFC PANEL & DB as specified under Power Infrastructure section.

5.13.6 Electrical System Automation

In utilities like pumping station, Common areas, etc. the electrical equipment envisaged are 11kV Switchgear and 415V Switchgear. Complete Electrical system till 415V is intended to be controlled from remote CCC.

Following operations will be achieved from remote CCC.

1. Control of all 11kV and 415V Switchgears.

2. Status Monitoring, alarm and annunciation of at 11kV and 415V Switchgears
3. Measurement (Metering) of all 11kV and 415V parameters including harmonics metering & provision for smart metering.
4. To achieve above mentioned remote control, following automation is proposed in all utility areas.

Providing 415V Intelligent MCCs (IMCC) for 415V loads. These IMCC will have built in controllers for each motor with control, metering and communication capability. Controllers will be looped in a ring formation and connected to respective PLC/SCADA available in respective utility stations. As communication is already envisaged between utility PLC/SCADA system and master SCADA at CCC, control, monitoring and metering of utility electrical system of 415V will be possible from CCC.

For 11kV Switchgear, each feeder IEDs (Numerical Relays) will be looped to PLC/SCADA available in respective utility stations thereby control, monitoring and metering of 11kV Switchgear is done from remote CCC.

Separate SCADA/PLC is not envisaged for electrical system of utility as all IEDS and IMCCs will be connected to respective utility SCADA/PLC as stated above.

5.13.7 Methodology for Control and Protection

5.13.7.1 Circuit-Breaker Operating Mechanism:

The circuit-breaker operating mechanism shall be power operated. Operation will normally be from a remote or supervisory position but facilities shall be provided for operation locally by electrical release and by direct manual release from stored energy devices. It shall be possible to lock each local control function when circuit breaker is in the open position. Operation counters of non-resetting type shall be fitted to all circuit-breaker mechanisms. The mechanism and its control scheme shall be such that, in the event of an electrical tripping pulse being applied to the circuit-breaker during the closing stroke, or of the mechanism failing to latch in the closed position, the circuit-breaker shall open fully and in such a manner as to be capable of interrupting its rated breaking current. The mechanism and its control scheme shall be such that the mechanism shall not make repeated attempts to close the circuit- breaker when the control switch is held in the CLOSE position in the event of failure to latch on the first closing attempt or in the event of a trip signal being given to the circuit-breaker.

The electrical closing and tripping devices, including direct acting solenoid coils and solenoid operated valves, shall be capable of operation over the ambient temperature range when the voltage at their terminals is any value within the specified auxiliary voltage range.

The circuit breaker shall be driven by a single mechanism coupled to the three phases and suitable for rated operating sequence O-0.3Sec-CO-3min-CO. Spring operated mechanisms shall have the following additional features.

If the circuit breaker is opened and the springs charged, the circuit breaker can be closed and then tripped.

If the circuit breaker is closed and the springs charged, there shall be sufficient energy to trip, close and then trip the circuit breaker.

Mechanical indication shall be provided to indicate the state of the spring.

This indication shall be clearly visible from the front of the breaker. In addition, suitable contacts shall be provided which may be used for remote indication.

Motor charged mechanisms shall be provided with means for charging the springs by hand, and also a shrouded push- button for mechanical tripping initiation.

Under normal operation, motor recharging of the operating spring shall commence immediately and automatically upon completion of each circuit breaker closing operation. The time required for spring recharging shall not exceed 30 seconds.

It shall not be possible to close a circuit breaker, fitted with a motor charged closing mechanism, whilst the spring is being charged. It shall be necessary for the spring to be fully charged and the associated charging mechanism fully prepared for closing before it can be released to close the circuit-breaker. All operating coils for use on the DC. Supply shall be connected so that failure of insulation to earth does not cause the coil to become energized.

Tripping and closing circuits shall be provided with MCBs on each unit and shall be independent of each other and all other circuits. The MCBs shall be equipped with auxiliary contacts for remote / SCADA signalling. Auxiliary switches shall be provided in circuit-breaker tripping circuits to interrupt the tripping supply as soon as the circuit-breaker has completed the tripping operation, and to interrupt the closing supply as soon as the circuit breaker has completed the closing operation.

Approved mechanically operated indicating devices shall be provided to indicate whether a circuit-breaker is in the open or closed, isolated or earthed position. Locking facilities with padlocks shall be provided so that the circuit breaker can be prevented from being closed when it is open. These facilities shall not require the fitting of any loose components prior to the insertion of the single padlock required. It shall not be possible to lock mechanically the trip mechanism so as to render inoperative the electrical tripping. Where earthing through the circuit breaker is adopted the method of earth position selection shall be arranged to disconnect the trip supply in the earth position.

5.13.7.2 Local Control:

Each circuit-breaker shall be provided with local control facilities including local control switches and a mimic diagram for the operation and status indication of the circuit-breaker and all associated disconnectors and earth switches together with selector switches to prevent local, remote/supervisory controls being in operation simultaneously Local manual release facilities shall be provided for closing and tripping the circuit breaker. The operation of both releases shall be subject to lockout if insufficient stored energy is available. Local manual releases shall be provided with locking off facilities.

5.13.7.3 Disconnecting and Earthing Switches:

Disconnectors and earth switches shall have valid type test report as per IEC 62271-102

Conducted on an independent test lab or witnessed by independent observers. Evidence of type tests as per IEC 62271-102 shall be submitted along with tender. Disconnecting and earthing switches shall be arranged to permit safe maintenance of any section of the equipment when the remainder is live.

Disconnecting switches shall be arranged for operation while the equipment is live, but will not be required to break current other than the charging currents of bus bars and connections. Switch mechanisms shall be so designed that the disconnector cannot be

opened by forces due to currents passing through it and shall be self-locking in both the "open" and "closed" positions.

The mechanism shall open and close all three phases simultaneously. Bus bar disconnectors shall have the capability of loop current breaking during on load bus transfer. Local mechanical position indicators shall be provided on all switches and shall be visible from the front side of the panel for safe isolation and earthing of the bus bars and feeders, high speed fault-making spring driven disconnector/earth switches shall be provided.

The contacts shall have the same fault making capability as that of the circuit breaker. As an alternative to the fault making earthing switches, circuit breakers may be used for the earthing, of the outgoing feeders and bus bars. In such case adequate interlocking facilities shall be provided, subject to approval of FEWA. The earth switches and disconnector shall employ motor operation mechanism. In addition, emergency hand operation shall be provided.

5.13.7.4 Interlocking:

An interlocking scheme shall be provided which takes into account the following basic requirements. All interlocking shall be approved before starting the schematic diagram.

To safeguard maintenance personnel who may be working on one section of the equipment with other sections live.

To prevent incorrect switching sequences, this could lead to a hazardous situation to plant, equipment and personnel.

To prevent earthing of live circuit.

The interlocking scheme shall be electrical for all operational interlocks and preferably of the mechanical/key type for maintenance safety interlocks but shall be effective when the equipment is being controlled locally, under emergency hand operation or from a remote position. All mechanical interlocks shall be applied at the point at which hand power is used so that stress cannot be applied to parts remote from that point. All electrical interlocks shall so function as to interrupt the operating supply and a system of interlocks shall be provided which shall cover the emergency hand operation of apparatus which is normally power operated. Failure of supply or connections to any electrical interlock shall not produce or permit faulty operation.

Electrical bolt interlocks shall be energized only when the operating handle of the mechanism is brought to the working position. Visible indication shall be provided to show whether the mechanism is locked or free. Means, normally padlocking, shall be provided whereby the bolt can be operated in the emergency of a failure of interlock supplies. Where key interlocking is employed tripping of the circuit breaker shall not occur if any attempt is made to remove the trapped key from the mechanism. Any local emergency-tripping device shall be kept separate and distinct from the key interlocking.

Auxiliary switches shall be provided on all circuit breakers disconnectors and earthing switches for local, remote & SCADA indication, control and interlocking. With each circuit-breaker, disconnecting device, and earthing device, there shall be supplied all necessary auxiliary switches, contactors and mechanisms for indication, protection, metering, control, interlocking, supervisory and other services. All such auxiliary switches shall be enclosed in dust free housing. Not less than four spare auxiliary switch ways shall be provided with each circuit breaker, disconnectors and earthing switches.

All auxiliary switches shall be wired up to a terminal board on the L.V panel of the switchgear whether they are in use or not in the first instance and shall be arranged in the same sequence on all equipment. Switches shall be provided to interrupt the supply of current to the tripping mechanisms of the circuit breakers directly, once the operation of the latter has been completed.

All such switches and mechanisms shall be mounted in approved accessible positions clear of the operating mechanism and shall be adequately protected. The contacts of all auxiliary switches shall be strong and shall have a positive wiping action when closing. Direct acting auxiliary switch contacts shall be used in conjunction with bus bar protection schemes in case of duplicate bus bars.

If sufficient aux. Contacts are not available, the contacts shall be multiplied by using suitable latching relays (bistable relays) so that the failure of DC supply shall not cause a mal-operation or undefined position of circuit breakers, disconnectors or earth switches. If any discrepancy between the aux. Contacts and latching relay contacts, this shall be monitored and alarmed locally and for remote indication. All repeat relays are subject to approval.

5.13.8 SCADA, Control System & Instrumentation

5.13.8.1 SCADA Systems

Supervisory Control and Data Acquisition (SCADA) system will have to done which allows an operator to monitor and control the water supply system at every stage of its operation. SCADA system allows remote and sites to communicate with a control facility and provides the necessary data to control operate processes. It provides an economic advantage on the maintenance of the water supply system. SCADA identifies the faults or defects in the water supply system over a large foot print area and helps to diagnose and repair the system from the control centre.

Typically, there are three major elements that make up a SCADA system:

1. Master terminal unit
2. Remote terminal unit
3. Communications equipment

5.13.8.2 Control Systems

5.13.8.2.1 Objectives

The objectives of providing Instrumentation, Automation and SCADA for pumping station and the entire system network in general are as follows

1. Hydraulic parameters monitoring and control.
2. Electrical Energy monitoring.
3. Supervisory Control & Monitoring of equipment i.e. pump, motors etc.
4. Shutdown sequence and emergency tripping conditions of all the individual and complete system have to be defined.
5. Two levels of Supervisory control shall be adopted for HMI and Control room levels.
6. Emergency response for stopping pumping station.
7. Data acquisition of pump parameters and pumping system efficiency monitoring.
8. Optimization of pumping system.

9. Monitoring, measurements and control of Reservoir, Tapping points, Distribution Centres, District Outlets & Water Meter.
10. Minimization of human errors.
11. Aid to man power.
12. Logging, reporting, preventive maintenance, safety etc.

5.13.8.2.2 Purpose

The purpose of Clear Water Pump and /or Recycle Water Pump control system are as follows:

1. To ensure continuity of Clear & Recycle water flow through the system.
2. To ensure satisfactory operation during transient conditions such as during start up and shut down of the system.
3. To ensure the capacity of UGR (Underground Reservoir) is not exceeded.
4. To monitor at a central point, the operation of the complete pumping installations.
5. To allow change of system control set points from a central location.
6. To provide facilities for alarm announcement and management, and in the event of system faults, to take appropriate action to protect the faulted item and to effect where possible remedial actions (i.e., in the event of a drive fault to raise an alarm and initiate operation of a standby drive, if available).
7. In addition, the control system will permit:
8. Trending of operational variables.
9. Preparation of operational data archives.
10. Preparation of on-demand periodical operational management reports.

5.13.8.2.3 Requirements

The monitoring and control for Pumping Stations will comprise of PLC based system equipped with combination of Optical Fibre network and Ethernet network by using media converts. This system will aid the operator to monitor and control the pumping station equipment both locally and remotely from Central SCADA. PLC at pumping station will communicate to Central SCADA over both Wireless Communication and Optical Fibre Network. Network including Clear & Recycle Water Pumping Station and Water Distribution Centres are interconnected using Optical Fibre as primary communication media and wireless as secondary. Control System is designed accordingly maintaining interdependency between pumping stations Following sites are provided with PLC based control System:

1. Clear Water Pumping Station
2. Recycle Water Pumping Stations
3. Water Distribution Centres

5.13.8.3 Data Collection & Analysis In SCADA

5.13.8.3.1 Data collection

SCADA systems should be such that it will have probes/sensors which will sense and generate signals for the level, pressure and flow in a given unit and transmit the signals for storage and analysis in the computer. The signals are transmitted by radio, by Telephone, microwave satellite or fibre-optic transmission systems. The signals transmitted are stored as data, analysed and presented as information. SCADA systems can include the network diagrams of the distribution system of which detailed sketches of a particular area can be viewed by the operator if necessary to observe the current operating data such as flow, pressure, level, residual chlorine, pH Analyser as per IUPAC

(International Union for Pure & Applied Chemistry) and/ or Turbidity Anayser as per ISO 7027.

SCADA systems in Water distribution shall be programmed for collection and processing of following information.

- To monitor levels in Service reservoirs, pressures and flows in a distribution system
- To monitor and store data on levels in SRs, or flows/quantity of delivered into a SR or pressures of distribution system and generate alarms for threshold values of levels, flows and pressures to initiate operation of valves and pumps
- To monitor and store data on operation of pumps such as Voltage, amperes, energy consumed, operating times and down times of pumps
- To measure and record residual chlorine, pH Analyser as per IUPAC (International Union for Pure & Applied Chemistry) and/ or Turbidity Anayser as per ISO 7027 and generate alarms at thresh hold values of residual chlorine in the distribution systems.
- To monitor and store data on operation of valves.

5.13.8.3.2 Analysis of Data

SCADA systems must be designed to analyse the data and provide daily, weekly, monthly and annual reports or schedules. It shall help in monitoring the inventories on spare parts and plan requirement of spares. Responses for different scenarios such as seasonal changes or any emergencies can be programmed into SCADA. The information stored in the SCADA can be easily retrieved and analysed. Typical information that could be generated in the system include: Consumption patterns linked to the weather conditions, plots on pressures against flows, electrical energy consumption linked to consumer demands, record on system leaks, record on pump failures, areas with less chlorine residuals etc.

5.13.8.3.3 System Architecture

Overall system depicts complete system flow right from Clear and Recycle pumping station to consumer level. It displays complete data of all pumping station and Distribution network in the centre. Network including Clear & Recycle water Pumping Station and Water Distribution Centre are interconnected using Optical Fibre as primary communication media while wireless communication shall be secondary.

5.14 Appendix (Water Supply & Recycle Water System)

5.14.1 Energy Efficient Induction Motors

5.14.1.1 General

This specification is intended to cover the [design, engineering, manufacture, assembly, testing at manufacturer's works, supply in properly packed condition for transport to site, Erection, site testing and commissioning] of low voltage (415 V) energy efficient squirrel cage Induction motors (up-to 160kW) along with all associated equipment/accessories for efficient and trouble-free operation as per standards.

5.14.1.2 Applicable codes and standards

All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) / IEC as given below except where modified and/or supplemented by this specification.

IS : 325	Specification for three phase induction motor.
IS : 900	Code of Practice for installation and maintenance of induction motors

IS : 996	Single phase AC motors
IS : 1231	Dimensions of three-phase foot-mounted induction motors
IS : 1271	Thermal evaluation and classification of electrical insulation.
IS : 2223	Dimensions of flange mounted ac induction motors.
IS : 2254	Dimensions of vertical shaft motors for pumps
IS : 3177	Crane duty motors
IS : 4029	Guide for testing three phase induction motors.
IS : 4691	Degree of protection for enclosures of rotating electrical machinery.
IS : 4722	Specification for rotating electrical machinery.
IS : 4728	Terminal marking and direction of rotation for rotating electrical machinery.
IS : 4889	Methods of determination of efficiency of rotating electrical machines.
IS : 5571	Guide for selection of electrical equipment for hazardous areas.
IS : 6362 IS : 8223	Designation of Method of Cooling of Rotating electrical machines. Dimensions and output ratings for foot mounted rotating electrical machines with frame numbers 355 to 1000.
IS : 8789	Values of performance characteristics for three phase induction motors.
IS : 12065	Noise level of motors.
IS : 12075	Measurement and evaluation of vibration of rotating electrical machines.
IS : 12615	Induction motors - Energy efficient, three-phase, squirrel cage - Specification
IS : 12802	Temperature rise measurement of rotating electrical machines
IS : 12824	Type of duty and classes of rating assigned.
IS : 14222	Requirements and method of Impulse withstand test
CEA	CEA Regulations
CEA	Standard Technical Specifications For Main Plant Package
IEC: 60034	Rotating electrical machines.
NEMA, MG-1	Motors and Generators
ISO : 1940-1	Mechanical vibration – Determination of permissible residual unbalance

Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

The electrical installation shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

5.14.1.3 Design Criteria

a) All motors shall be suitable for an ambient temperature of 45°C and relative humidity of 87%. The motors shall be suitable for operation in a highly polluted environment.
b) AC Motors shall be of constant speed, squirrel cage, three/ single phase, induction type. Motors shall be rated for [continuous duty/intermittent duty]. They shall also be suitable for long period of inactivity.
c) All AC motors shall be suited for the following range of frequency and voltage variations:

Voltage	415V, 3 Phase, 50Hz
Voltage Variation	+/-10%
Frequency Variation	50Hz (+)3% to (-)5%
Combined Variation of Voltage & Frequency	10% (absolute sum)

d) The motor characteristics shall match the requirements of the driven equipment so that adequate starting, accelerating, pull up, break down and full load torques are available for the intended service.

e) Moreover, motors shall be so designed that maximum inrush currents, locked rotor, and pull-out torque developed by them at extreme voltage and frequency variations do not endanger the motor and driven equipment.
f) Motors shall be capable of developing the rated full load torque even if the supply drops to 70% of the rated voltage.
g) Maximum continuous motor ratings shall be at least [10%] above the maximum load demand of the driven equipment under entire operating range including voltage and frequency variations.
h) Accelerating torque at any speed with the lowest permissible starting voltage shall be at least [10%] motor full load torque. Pull out torque at rated voltage shall not be less than 205% of full load torque. It shall be 275% for crane duty motors.
i) If motors are connected to an automatic bus transfer system, they may be subjected to 150% of the nominal voltage during changeover of buses due to the phase difference between the incoming voltage and motor residual voltage. In such cases, motors shall be capable of restarting under full load after momentary loss of voltage.
j) Motors shall be of energy efficient of type Eff-3 as per IS: 12615/equivalent IEC/ International Standards.
k) Motor shall be designed to keep torsional and rotational natural frequencies of vibration of the motor and driven equipment at least 25% above the motor operating speed range.

i. System Grounding

(a)	415 V	Solidly Grounded

ii. Fault Level

(a)	415 V	[50 kA for 1 second]

iii. Degree of Protection

(a)	Indoor Motors	[IP 54]
(b)	Outdoor Motors	[IPW 55]
(c)	Cable Box located in Indoor Area	[IP 54]
(d)	Cable Box located in Outdoor Area	[IPW 55]

iv. Winding Insulation

(a)	For 415V AC Motors	[Class – B]

v. Winding Conductor Material

(a)	For 415V AC Motors	Copper

vi. Bearing

(a)	For Drive End	[Roller]
(b)	For Non Drive End	[Roller / Ball]

i. Temperature Rise

(a)	For Air Cooled Motors	[70 ˚C] over ambient temperature [Class B]
(b)	For Water Cooled Motors	[80˚C] over inlet cooling water temperature [Class B]

ii. Motor Earthing

(a)	Motors above 90 kW	[50 x 6 mm GI Flat]

(b)	Motors above 30 kW and up to 90 kW	[25 x 6 mm GI Flat]
(c)	Motors above 5 kW and up to 30 kW	[25 x 3 mm GI Flat]
(d)	Motors up to 5 kW	[8 SWG GI Wire]
(e)	Terminal Box	[8 SWG GI Wire]

iii. Space Heater

(a)	For Motors 30 kW rating and above	Space heater suitable for 1Phase, 240V AC, 50 Hz supply
(b)	For Motors below 30 kW rating	No Space heater provided

iv. Painting

(a)	Paint Type	Epoxy based with approved class
(b)	Paint Thickness	[Within 100 to 150 micron.]
(c)	Paint Shade	[RAL5012 BLUE]

5.14.1.4 Specific Requirements

Locked Rotor Withstand Time

a. The starting time of the motor shall be at the minimum permissible voltage.
b. For motors with starting time up to 20 seconds at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 2.5 second more than starting time.
c. For motors with starting time more than 20 second and up to 45 seconds at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be at least 5 second more than starting time.
d. For motors with starting time more than 45 seconds at minimum permissible voltage during starting, the locked rotor withstand time under hot condition at highest voltage limit shall be more than starting time by at least 10% of the starting time.
e. Speed switches mounted on the motor shaft shall be provided in cases where above requirements are not met.

Starting Voltage Requirement

I	All motors (except mill motors):
(a)	[85% of rated voltage for motors up to 4000 kW]
(b)	[75% of voltage for motors above 4000 kW]
II	For mill motors:
(a)	[85% of rated voltage for motors above1000 kW]
(b)	[75% of rated voltage for motors below 1000 kW]

The motor shall be capable of withstanding the stresses imposed if started at 110% rated voltage.

Pump motor subject to reverse rotation shall be designed to withstand the stresses encountered when starting with non-energized shaft rotating at [125%] rated speed in reverse direction.

The motor may be subjected to sudden application of 150% rated voltage during bus transfer, due to the phase difference between the incoming voltage and motor residual voltage.

Winding and Insulation

415V AC	Winding material shall be of copper. Insulation shall be of [Class F with temperature rise limited to Class B.]

Motor Control

a) Motors of rating less than [132 kW] shall be operated by Contactor from respective MCCs. Motors of rating up to [18.5 KW] shall be provided with MPCBs and Electronic overload relays. Motors of rating above [18.5 KW] and below [45 KW] shall be provided with MCCBs and Electronic overload relays. Motors of rating [45 KW] and above but less than [132 KW] shall be provided with MCCBs and CT operated Electronic over load relays.
b) Motors of rating [132 KW] and up to [160 KW] shall be suitable to be controlled by Air circuit breakers from switchgear, PMCCs and shall be provided with comprehensive numerical motor protection relays.
c) Only for firefighting system, motor rated [upto 200kW] shall be fed from 415V switch board.

Starting duty

Motors shall be suitable for [3 nos. consecutive Cold starts ups and 2 nos. consecutive Hot starts ups.] Motors shall be suitable for three equally spread starts per hour when the motor is under normal service condition.

Bearings

a) Anti-friction type radial and thrust bearings (ball, roller) and sleeve bearing shall be rated for minimum standard life of 40,000 hours taking bearing and driven equipment loads (in case the drive is not having separate thrust bearing) into account. If bearings are lubricated, loss of grease shall be scarce and it shall not creep along shaft into motor housing. Facility of removal of excess grease shall also be provided for grease lubricated bearings.
b) Vertical shaft motors shall be provided with thrust and guide bearings. Thrust bearing of tilting pad type is preferred. However, if Anti-friction bearings can take vertical thrust, thrust & guide bearings are not required.
c) Bearing shall be effectively sealed against dust ingress and shall be pressure grease gun lubricated. The bearing and housing shall be so designed that greasing shall be possible while the motor is running, without removal of covers.
d) Where bearing supports are attached to the motor casing, adequate bracing shall be provided on these supports to reduce vibrations and ensure life of bearings.
e) If the bearings are oil lubricated, a drain plug shall be provided for draining residual oil and oil level gauge shall be provided to show precisely oil level required under standstill and running conditions.
f) Unless otherwise approved, bearing lubricating system shall be such that no external forced oil or water is necessary to maintain required oil supply to keep bearing temperature within design limits.
g) Lubricants shall be selected for prolonged storage and normal use of motors in tropical climate and shall contain corrosion and oxidation inhibitors. Greases shall have suitable bleeding characteristics to minimize setting. The selected lubricants shall be indigenously available.

Temperature Rise

a) For Air Cooled Motors, temperature rise of insulation should be limited to [70 °C] over ambient temperature by resistance method.
b) For Water Cooled Motors, temperature rise of insulation should be limited to [80 °C] over inlet cooling water temperature mentioned elsewhere, by resistance method.

Cooling

All motors shall be Totally Enclosed Fan Cooled (TEFC).

Enclosure

a) All motor enclosures shall conform to the degree of protection of [IP54] for indoor and IPW-55 for outdoor installation unless otherwise specified. Motor for outdoor or semi outdoor service shall be of weather proof construction. Motors of large output rating located indoor could have screen protected drip proof (SPDP) enclosure conforming to [IP- 23.]
b) For motors located in outdoor & corrosive locations, FRP canopy shall be provided. In case steel canopy is provided, the same shall be epoxy painted to meet the surrounding atmosphere. Motors located in hazardous areas such as Hydrogen plant shall have flame proof enclosures of Group – IIB conforming to IS: 2148.
c) For hazardous locations such as fuel oil facilities area, the enclosure of motor shall have flame proof construction conforming to IS 2148.

Noise Level and Vibration

Noise level shall be limited to 85 dB (A) at 1.5 meters from the motor. However the same shall be as per IS: 12065 unless otherwise specified. The peak amplitude of vibration shall be within the specified limits laid down in IS: 12075. Motors shall withstand vibrations produced by driven equipment.

Temperature Monitoring

Low voltage motors rated 100 kW and above shall be provided with two PT100 RTDs per phase of winding.

Earthing

Motor body shall have two earthing points on opposite sides. Motor terminal boxes shall also have separate grounding terminals.

Termination

a) Removable gland plates of thickness 3 mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material for single core cables) shall be provided in case of cable boxes. The main cable box / terminal box shall withstand [50 kA for 0.25 seconds for LV motors]. Separate terminal boxes shall be provided for space heaters and RTDs and NCT (if applicable).
b) All terminal boxes shall be capable of being turned through 360 degrees in steps of 90 degrees unless otherwise specified.

Tropical Protection

a) All motors shall have fungus protection involving special treatment of insulation and metal against fungus, insects and corrosion.
b) All fittings and hardware shall be corrosion resistant.
c) Space Heater
d) Suitable single-phase space heaters operated at 240V, 50Hz, 1Phase AC supply shall be provided on motors rated for 30KW and above to maintain windings in dry condition

when motor is standstill. Separate terminal box for space heaters & RTDs shall be provided.

e) The space heater shall be sized to maintain the motor internal temperature above dew point when the motor is in idle condition.

Rating Plate

Motor shall have Stainless steel nameplate(s) showing diagram of connections, all particulars as per IS: 325 / NEMA-MG-1 and following additional information:

a) Type of bearing and recommended lubricants along with location of insulated bearing.
b) Temperature rise under normal/abnormal conditions.
c) In addition to above, an arrow block shall be screwed on to the body of motor on the non-driving end to indicate normal direction of rotation of motor.
d) Year of Manufacture

Drain Plug

Motor shall have drain plugs so located that they shall drain the water, resulting from the condensation or other causes from all pockets of the motor casing.

Dowel Pins

Motor shall be designed to permit easy access for drilling holes through motor feet or mounting flange for installation of dowel pins after assembling the motor and driven equipment.

Painting

The complete motor assembly including fan shall be painted with corrosion proof paints of approved class.

Lifting provision

Motor weighing 25 Kg or more shall be provided with eyebolt or other adequate provision of lifting.

5.14.1.5 Local Push Button Station (LPBS)

a. Each motor shall be provided with push button station as per process requirement i.e. Start/Stop or Emergency Stop.
b. The degree of protection of LPBs shall be IPW 55 for outdoor and IP 54 for indoor applications.
c. All Push Buttons shall be push to actuate type and stop Push Button shall be lockable in off position as per the scheme requirement.
d. The Emergency local stop push button of Stay put type shall be provided with Press to lock & turn to release keyless mechanism.
e. All PBs shall be provided with 2 numbers NO and 2 numbers NC contacts for various interlocking purposes. One contact of stop PB shall be directly wired to switchgear module for direct tripping and another contact to control system.
f. Terminals to be suitable for 2 cores of 2.5 Sq.mm. cable with 20% spare terminals.
g. All LPBS shall be of Poly Carbonate /FRP / Die Cast Aluminium material.

5.14.1.6 Tests

a. Type Test

For each type & rating of LV motors of rating above [50 kW], the Bidder shall submit for Owner's approval the reports of all the type tests as per relevant standards and carried

out within last[five] years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been conducted at an independent laboratory.

In case the Bidder is not able to submit report of the type test(s) conducted within last [five] years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Bidder shall conduct all such tests under this contract free of cost to the Owner and submit the reports for approval.

The following shall constitute the type tests:

i. Visual and dimensional check
ii. Winding resistance measurement
iii. No load test
iv. Mechanical vibration
v. Direction of rotation versus phase sequence
vi. Insulation resistance measurement
vii. High potential test
viii. Locked rotor test
ix. Speed/torque test
x. Over speed test
xi. Temperature rise test
xii. Determination of characteristic
xiii. Degree of protection test for the enclosure.
xiv. Noise level

b. Routine Test
All equipment shall be completely assembled, wired, adjusted and routine tested as per relevant IS / IEC Standards at manufacturer's works in the presence of consultant /purchaser or his representative.

c. Test Witness
The tests shall be carried out in presence of the Owner’s representative, for which a minimum 7 day’s notice shall be given by the Bidder. The Bidder shall obtain the Owner’s approval for the type test procedure before conducting the type test. The test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.

d. Test Certificates
Certified copies of all tests carried out at works and at site shall be furnished in requisite no. of copies for approval of the Owner.
The equipment shall be dispatched from works only after receipt of Owner's written approval of shop test reports.

5.14.1.7 Drawings, Data & Manuals

Drawings, data & manuals for the motors shall be submitted as indicated below:

Dimensional General Arrangement drawing

a) Motor sizing calculation
b) Foundation Plan & Loading
c) Cable end box details
d) Space requirement for rotor removal
e) Thermal withstand curves hot & cold
f) Starting and speed torque characteristics at 80% & 100% voltage

g) Complete motor data
h) Erection & Maintenance Manual
i) Test reports
j) QAP

5.14.2 Variable Frequency Drive (VFD)

5.14.2.1 General

This specification is intended to cover the [design, engineering, manufacture, assembly, testing at manufacturer's works, supply in properly packed condition for transport to site, Erection, site testing and commissioning] of low voltage (415 V) variable frequency AC drives (VFD) along with all associated equipment/accessories for efficient and trouble-free operation as per standards.

5.14.2.2 Applicable codes and standards

All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) / IEC as given below except where modified and/or supplemented by this specification.

IS-3700	Essential ratings and characteristic of semi-conductor devices
IS-3715	Letter symbols for semi-conducting devices
IS-4411	Code of designation of semi-conducting devices
IS-5001	Guide for preparation of drawings for semi-conductor devices
IS-5469	Code of practice for the use of semi-conductor junction devices
IS-5621	Hollow Insulators for use in electrical equipment
IS-6209	Methods for partial discharge measurement.
IS-6297	Transformers and indicators for electronic equipment
IS-8789	Performance parameters for motors
IS-12729	Switchgear and control gear for voltages exceeding 1000V-General requirements
IS-13408	Code of practice for the selection, installation and maintenance of electrical apparatus for use in potentially explosive atmospheres
IEC 146	Semi-Conductor converters
IEC 168	Tests on indoor and outdoor post insulators of ceramic material or glass for systems with nominal voltages greater than 1000V
IEC 270	Partial discharge measurement
IEC 297	Dimension of panels and racks
IEC 326	General requirements and measuring methods for printed wiring Boards
IEC 352	Solder less wrapped connection
IEC-61800-3,4&5	EMC requirements and specific test methods
IEC-60664-1	Insulation coordination for equipment within low-voltage systems
IEC/EN-60204-1	Safety of machinery-electrical equipment of machines
IEC/EN-60529	Degrees of Protection Provided by Enclosures (IP Code)
IEC/EN-61000-3-12	Electromagnetic compatibility
IEEE 444	Protection standards for converters
IEEE 519	Harmonic control & reactive compensation of static power Converters
DIN 41488	Electrical engineering dimensions

Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

The electrical installation shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

5.14.2.3 Design Criteria

a) All VFDs shall be suitable for an ambient temperature of 45 °C and relative humidity of 95%. The VFDs shall be suitable for operation in a highly polluted environment.
b) All VFDs shall be suited for uninterrupted operation under the following variations in bus voltage and frequency:

I.	Voltage Variation	+/-10%
II.	Frequency Variation	50Hz (+) 3% to (-)5%
III.	Combined	10% (absolute sum)

c) The VFD shall be of modern design for similar applications in power plants. The system shall be commutated inverter type with minimum [six] pulse design, [IGBT based] and PWM controlled or better control system.
d) VFD shall consist of Input section (rectifier and filter), control section and output section (PWM module, base drive circuits).
e) VFD shall include an input filter for limitation of the harmonic current. General requirements of VFD shall conform to IEC 61800-2 and IEEE- 519.
f) VFD shall follow EMC directives as specified in IEC-61000.
g) VFD model shall be suitably selected based on actual cable length from VFD to motor terminals. Shielded cables suitable for VFD applications shall be provided by the bidder.
h) For [12 pulse] VFD required 3 winding transformer and necessary cabling shall be provided by the bidder.
i) Bidder shall provide inverter duty motor to withstand voltage stresses produced by PWM action

5.14.2.4 Performance requirements:

a) The system shall be energy efficient, designed as standard product and shall provide very high reliability, high power factor, low harmonic distortion and low vibration / wear / noise.
b) The system shall be suitable for the load characteristics and the operational duty of the driven equipment.
c) The drive system shall be designed to operate in one or more of the following operating modes as to suit characteristics of the driven equipment:
    i. Variable torque changing as a function of speed i.e. speed squared.
    ii. Constant torque over a specific speed range.
    iii. Constant power over a specific speed range where the torque decreases when speed increases.
d) The drive controller shall be equipped with microprocessor based digital regulator with programmable functions. The system shall be designed for linear continuous speed control from [10% to 100%] of driven equipment's rated speed and shall be of a modern proven design.
e) The total harmonic distortion (THD) of the voltage and current at inverter output shall be as per IEC 61800-4 and it shall be considered in the design of the motor.
f) Unless otherwise specified, the overload capacity of the controller shall be 150% of rated current of motor for one minute for constant torque applications, and 115% of

rated current for one minute for variable torque applications at rated voltage. If the motor load exceeds the limit, the drive shall automatically reduce the frequency and voltage to the motor to guard against overload. If load demands exceed the current limit for more than one minute, the drive shall shut down to prevent over heating of the motor and damage to the drive.

g) During operation, the system shall be capable of developing sufficient torque under all load conditions to respond to a 20% alteration in speed set point within a time limit up to 60 seconds.
h) The integrator action of the speed set point alteration shall be independently adjustable for both an upward and a downward alteration. The minimum time interval between set point adjustments by the distributed control system shall be considered as 10 seconds.
i) The drive shall trip in case the speed exceeds 105% of the maximum operational speed or reduces to 95 % of the minimum operational speed for more than 10 seconds.
j) Maximum noise level of motor shall be measured as per relevant IS standard.
k) Variable frequency drive shall be arranged so that it can be operated in an open circuit mode, disconnected from the motor for startup adjustments and troubleshooting/ maintenance.
l) Voltage at motor neutral shall be maintained at ground potential for the total operating condition.

The drive system shall ensure following:

I. VFD induced torque pulsation are limited to maximum 1% (even at low speed) so there is minimal stress to the equipment
II. Motor is protected from dv/dt stresses.
III. No appreciable increase in motor audible noise.

5.14.2.5 Control requirement:

a) The VFD and motor characteristics shall be suitable for load specific torque-speed characteristics.
b) Short time voltage dips up to 20% of nominal voltage (e.g. in case of a large motor start up connected to the same bus as VFD) shall not cause the control system to stop functioning and shall not trip the drive system.
c) The system shall also be equipped with a facility which shall restart the system in case of voltage dip over 20% or power interruptions for less than 2 seconds, with recovery of the voltage to its nominal value. The drive shall have the facility to block this feature, if required by the operator. Upon restart the converter shall be capable of synchronizing on to a rotating motor and develop full acceleration torque within 10 seconds.
d) The power controller shall be controlled to always start the motor in the forward direction. Logic shall be provided to prevent the motor from being started in the reverse direction.
e) The drive motor shall be speed controlled corresponding to 4-20 mA reference input signal unless otherwise specified upon complete loss of the user's speed reference signal, the drive shall automatically run at constant speed at the last speed reference available prior to the loss of signal.
f) It shall be possible to vary the speed of the drive in either manual or auto mode. Auto/manual selection shall be from VFD panel unless otherwise specified.

i. With the selector switch in "manual" mode, the operator shall be able to set the speed through keypad, mounted on front of the drive panel or from speed increase/decrease push buttons from the field. Motor operated potentiometer shall be provided as a speed set point device.
ii. With the selector switch in "auto" mode, speed of the motor shall be controlled from a 4-20 mA signal, from owner's SCADA (Process Control) system. Necessary equipment required for interfacing with SCADA shall also be provided in the drive panel.

g) The required provision for the interface with remote I/O (as per requirement) shall be through hardwired connection (with potential free contacts and transducers)
h) Drive system shall have provision for interface with upper level automation such as electrical control system.
i) The closed loop control feedback for the drive system having output transformer shall be tapped from the secondary side of the output transformer.
j) Bypass Feature
   i. Bypass breaker / contactor-HRC fuse complete with protection, annunciation and metering shall be provided.
   ii. All Variable frequency drives (VFD) having bypass feature shall have motor protection relay along with necessary control and metering etc. Switching scheme shall be such that in case of drive mal-operation, the motor could be taken on bypass control manually, while the drive could be attended by opening its isolation devices.
   iii. Safety interlock between inverter and bypass breaker/contactor shall be provided such that closing of healthy device is inhibited in case of external fault.

5.14.2.6 Specific Requirements

a) Constructional Requirements

I. Panel Construction
   i. The panel shall include suitable semi conducting power devices (Diodes / IGBT) modules with protective devices, reactors (if required), filters (if required), control circuit, control accessories, indication and annunciation etc. The construction of the panel shall provide effective protection against electromagnetic emissions and shall meet the design requirement of integrated standards.
   ii. Upstream breaker includes suitable semi conducting power devices (Diodes / IGBT) modules win shall be provided on the front door.
   iii. Safety Interlock shall be provided so that power cabinet cannot be opened unless the upstream breaker is disconnected, safety-grounding switch is closed and DC link capacitor is discharged. Power source breaker can only be closed once the earthing switch is open and panel door is closed with lock defeat facility.
   iv. The drive shall be suitably housed in sheet steel panels fabricated with 2 mm thick cold rolled sheet steel. The panel shall be suitable for indoor installation, if not otherwise specified. The panel shall be free standing with degree of enclosure protection as IP-42. The maximum and minimum operating height shall be 1800 mm and 400 mm respectively.
   v. Bolted un-drilled gland plate shall be provided at bottom. Clamp type terminals shall be used for connection of all wires up to 10 mm2 and terminal for higher sizes shall be bolted type suitable for cable lugs. Minimum space for power cable termination shall be 600 mm clear from bottom of the cable gland plate.
   vi. Bus bars shall be of electrolytic copper, color coded separately for AC and DC system. All the live parts shall be sleeved / shrouded to ensure complete safety

to personnel intending to carry out routine inspection by opening the panel doors. All the equipment inside the panel and on the doors shall be provided with suitable nameplate.

vii. All the switches component and accessories which are essential for normal and emergency operation shall be mounted on the door and shall be operable externally. Digital meters shall be preferred. Analogue instruments, where provided, shall be switchboard type, back connected, 72x72mm. Scale shall have red mark indicating maximum permissible operating rating.

viii. All panels shall be of same height so as to form a uniform line-up, to give good aesthetic appearance.

ix. All the control wiring shall be enclosed in plastic/ metal channel. Each wire shall be identified at both ends by self-sticking wire marker tapes or PVC ferrules. Power and control wiring inside the panel shall be done with PVC insulated, fire retardant, copper conductor wire. 1.5 mm2 size wire shall be used for control circuits, 2.5 sq.mm for CT/PT circuits and 0.75 mm2 for electronic circuits. The control fuse rating is 10 Amps or less and 2.5mm2 size for control fuse rating above 16A for electrical circuits and 0.7 mm2 for electronic circuits. All wires shall be ferruled and terminals shall be properly numbered. Minimum 20% spare terminals shall be provided.

x. All electronic modules and components shall be accessible from front of panel only. Modular assemblies for both the system control electronic equipment and power electronic equipments shall be used.

xi. All low voltage compartment and cabling shall be electrically and physically separated from the high voltage compartment.

xii. DC link capacitor and pre charging and discharging circuit shall be preferably mounted in the rear of the panel. Suitable removable type hooks shall be provided for lifting the panel.

xiii. Drive keypad, operator control panel required for control, monitoring and measurements shall be supplied and installed outside the panel on the front door. It shall be accessible for operation without opening the front door and shall be non-removable type.

xiv. All equipment shall be complete with double compression glands, lugs etc.

II. Cooling

i. The drive panel shall be naturally cooled or water cooled type as per manufacturer's standards. However, it is preferred to have natural air cooled system. If unavoidable, forced type-cooling system shall be provided. Cooling system shall include well-dimensioned panel, adequate cooling airflow path, module cooling fan and if necessary, panel cooling fan or water-cooling system shall be considered. Bidder shall ensure that the panel dimensions and flow paths have been designed for continuous running at the specified ambient without overheating. For fan cooled drives, redundant ventilating fans (N + 1) shall be provided.

ii. Necessary starters shall be provided within the VFD panels for the ventilation fans, any other auxiliary motor etc.

iii. The system provided shall be interfaced with drive starting and shut down such that safety interlocks such as start permit from cooling system to drive and trip signal from cooling system to drive in case of cooling system failure etc., shall be incorporated in the overall sequence logic.

iv. MCB for motor space heater, auxiliary power supply if required for local panel, drive panel space heater etc. shall be included and mounted in easily accessible location.

b) Motor

The motor shall be designed, constructed and tested in accordance with the Specification for high Voltage Induction / Synchronous Motor, in addition to the following requirements:

i. The motor shall be suitable for VFD control.
ii. The motor shall be suitable for the current waveforms produced by the power supply including the harmonics generated by the drive.
iii. The motor shall be designed to operate continuously at any speed in the operating range for the driven equipment .
iv. The permitted voltage variation shall take into account the voltage drop across the AC drive and all other system components upstream the motor.
v. Motors required to be transferred to DOL by-pass mode shall be rated for specified variations in system line voltage and frequency. Starting current of motor in DOL bypass mode shall be limited to value specified in motor specifications.
vi. The motor shall be constructed to withstand torque pulsations resulting from harmonics generated by the solid-state power supply.
vii. The motor insulation shall be designed to accept the applied voltage waveform, within the Vpeak and dv/dt limits as per IEC-61800-4.
viii. The drive manufacturer shall be solely responsible for proper selection of the motor for the given load application and the output characteristics of the drive.

c) Static Power Converter

i. The static power converter shall consist of a line side converter for operation as a rectifier and a load side power converter for operation as a fully controller inverter. Power converter shall be fast switching, most efficient and low loss type.
ii. The converter shall be co-ordinated with the transformers. The converter shall be able to withstand a three phase short circuit current until interrupted by normal breaker operation.
iii. Adequate short circuit and over voltage protection shall be provided for the converter and inverter system.
iv. All power converter devices shall include protective devices, snubber networks and dv/dt networks as required.
v. The current rating of the converters semi-conductor components shall not be less than 120% of the nominal current flowing through the elements at full load of the VFD through the whole speed range. If the parallel connection of semi conductor is applied, the above current rating shall not be less than 140% of the above values.
vi. All power diodes shall be of silicon type with minimum VBO rating at 2.5 times the rated operating voltage.
vii. The power converter circuit shall be designed so that motor can be powered at its full nameplate rating continuously without exceeding its rated temperature rise nor reducing its service factor due to harmonic currents generated by the inverter operation.

viii. The conversion devices and associated heat sinks shall be assembled such that individual devices can be replaced without requiring the use of any special precautions / tools.

ix. The cooling system of the electronic components, if provided, shall be monitored and necessary alarms shall be provided to prevent any consequential damage to the power control devices.

d) Converter Transformer

i. The converter transformer, if provided, shall be copper wound dry type. Insulation class of dry type transformer shall be H with temperature rise of body limited to 75°C. Dry type transformer shall preferably be mounted inside the drive system panel. The impedances of converter input transformers with more than one secondary winding for minimum 18 pulse systems shall be selected to ensure equal load / current sharing between the secondary windings, the converters and the motor windings under all operational conditions including starting and restarting.

ii. The transformation ratio, impedances, taps and secondary voltage shall be chosen by the drive vendor to optimize system performance.

e) DC link reactor

i. Smoothing reactors for the DC link shall be designed to sufficiently decouple the rectifier and inverter portion of the converter and to limit fault currents in this circuit.

ii. Unless otherwise specified, the reactor shall be dry type, air cored, air- cooled or fan cooled type located within the panel.

iii. Reactor shall be suitable for withstanding earth fault continuously and for operation with the non-sinusoidal current wave shapes and DC components under all operational conditions of the system without exceeding its temperature limits.

iv. Noise level shall not exceed value specified in NEMA TR-1

f) Output filter

i. VFD output current waveform should be inherently sinusoidal at all speeds, with harmonic limits as specified in this specification. Output filter shall be provided if required. Output filter capacitors shall be provided with discharge circuits to ensure that all residual stored charge is reduced to less than 50 V DC within 300 seconds after a loss of AC voltage. All capacitor shall be maintenance free and self-healing type.

ii. The VFD system shall inherently protect motor from high voltage dv/dt stress, independent of cable length to motor. Output filter shall be an integral part of the VFD system and included within the VFD enclosure.

g) Protection, Control, Metering, Indication and Annunciation

i. The Bidder shall provide all the necessary system control, protection, alarm equipment and metering for the entire drive system and its auxiliary equipment.

ii. Automatic sequence control shall include start-up of cooling system, auxiliary system of the motor, interlock checking, automatic start and run-up of drive, planned and emergency shutdown. The same shall be processed through microprocessor-based system.

iii. Protective Relays:

For details on protective relays used, refer to Technical Specifications on MV Switchgear

iv. Operator Control Panel
- Each drive shall be equipped with a front mounted operator control panel consisting of a backlit alphanumeric display and a keypad with keys for parameterization and adjusting parameter which shall not be limited to start/Stop, Local/Remote, auto/manual, Increase/Decrease, menu navigation and protection and measurement parameter selection, etc.
- All parameter names, fault messages, warnings and other information shall be displayed in complete English words or standard English abbreviations to allow the user to understand what is being displayed without the use of a manual or cross-reference table. This shall also be used for the modification of all electrical values, configuration parameters, drive menu parameters, application and activity function access, faults, local control, adjustment storage, self test and diagnostics. Keypad shall be operable with password for changing the protection setting, safety interlock etc. However the parameters such as measurements, setting, mode of drive etc. shall be allowed to be viewed without any password.
- Operator console shall have facility /port to connect external hardware such as Lap-Top etc. Console shall have facility for upload and download of all parameter settings from one drive to another identical drive for start up and operation.
- Drive system control shall also have facility to receive tripping signal from upstream breaker for tripping and also provision for closing up stream breaker after all required process parameters are achieved.
- User-friendly software for operation and fault diagnostic shall be loaded in the drive system panel before commissioning.
- Suitable interface with SCADA to be provided for control and status signals of VFD.

v. Local Motor Control Station
- The local motor control station shall be installed near the motor. Components and accessories that are required in the local motor control station may be mounted on the local field mounted panel envisaged for the driven equipment.
- Meters in the local control station shall be suitable for 4-20mA transducer outputs and shall be calibrated for the actual motor current. Further, for drives with bypass facility, the meters shall be capable of reading bypass full load and starting currents, as well as the drive current.
- Requirement of controls and indications required in the Local Control Station shall be as specified in the data sheet.

vi. Protective Features:
- The system offered shall incorporate adequate protective features, properly coordinated for the drive control and for motor but not limited to the following:
- Incoming line surge protection
- Under / Over voltage protection
- Phase loss, phase reversal protection.
- Programmable Over current protection and under load protection.
- Motor differential protection for motor rated above 1000 kW
- Inverter Fault.
- Over frequency operation.
- Ventilation loss,
- Over temperature of equipment.
- Over speed of motor.

- Specific motor protection, including motor winding, bearing temperatures, over-current, overload, negative phase sequence, locked rotor and earth fault protections etc.
- System Earth fault protection.
- Excitation system protection for synchronous motor
- Over and under frequency, rotor earth fault, field failure protection for synchronous motor
- Additional protection for drive system

vii. Control features

The following controls shall be provided as a part of the Operator Control Panel or through separate switches.

- Start/Stop
- Speed control (Raise/lower)
- Forward/Reverse(if Specified)
- Auto/Manual /test mode
- Local/remote
- Emergency stop
- Start/stop for by pass starter (where specified)
- Trip-Remote Breaker
- Excitation control system for synchronous motors
- Sequential switching of filters

viii. Metering

Digital display of the following parameters shall be as a part of the Operator Control Panel, selectable by the operator.

- Input AC Current
- Input AC voltage
- Input AC frequency
- Output voltage
- Output current VFD / Bypass
- Output frequency
- Motor thermal state
- Drive thermal state
- Motor speed
- Motor energy meter
- DC Link voltage
- Hour Run
- Voltage and current meter for excitation system for synchronous motor.
- KVAR, power factor meter for synchronous motors
- Necessary transducer shall be provided with 4-2OmA output for indicating motor speed and motor current in SCADA unless otherwise specified for other parameters.

ix. Indications

Bidder shall provide indications as required for normal operation and for easy maintenance, which shall not be limited to the following indications both at local and at plant SCADA.

- Motor running
- Motor stopped

- VFD System Fault
- System ready to start
- AC mains ON
- Motor over speed
- Rectifier output 'ON'
- Motor zero speed
- Remote breaker trip
- Excitation system healthy for synchronous motors

Above indications may be provided as a part of the operator control panel, i.e., door mounted keypad or through hardwired indicating lamps/LEDS.

Potential free contacts of items i- iv shall be wired separately for remote indications in SCADA.

x. Audio-visual annunciations
   - The system shall incorporate audio-visual annunciations for protection, for various fault conditions, for the Drive motor, Supply cables, DC Reactor and the Converter, output transformer etc.
   - Alarms shall also be included for the failure of various auxiliaries together with identification of the failing unit, loss of cooling system, various protection devices provided for converter transformer etc.
   - Audio-visual window annunciations shall be provided on the front of the panel All annunciations as required for normal and satisfactorily operation of the drive system shall be included as per Bidder standards. These annunciations can be part of operator console panel or separately mounted type.
   - Bidder shall include audio-visual alarm as required for normal operation and maintenance of the system but not be limited to the following,
     i. Rectifier fuse failure
     ii. Main AC failure
     iii. Inverter fuse failure
     iv. Inverter overload
     v. Inverter high temperature
     vi. Cooling system failure
     vii. Motor failed to start
     viii. Transformer failure
     ix. Excitation system failure for synchronous motor
     x. Battery monitoring healthiness
     xi. Communication and measurement system un healthy
     xii. Motor temperature high
     xiii. Harmonic filters monitoring

xi. Fault Diagnostic

Fault diagnostic shall be built into the system to supervise the operation and failure of the system. The information regarding failure of any of the system including shut down of the system shall be available for a period of minimum 4 days (96 hours) after a shut down even though no supply would be available to the system.

The system may be totally deenergized for maintenance or otherwise. It shall be possible to retrieve the record of events prior to tripping of the system or de-energisation. Auxiliary supply to the system components or to the electronics (firmware) for the diagnostics / display shall be taken care by the manufacturer for this purpose.

xii. External Power supply for auxiliary and Control Circuit

Auxiliary power supply for devices external to VFD module, space heater supply for Motor, VFD panel space heater, auxiliary power supply for transformers, cubicle lamps (CFL) etc. shall operate on 240 volts single phase AC.

All control circuit shall operate at voltage of 110V AC or 220V DC.

Bidder shall include supply of all control transformers, protective devices, required accessories etc. and any other control supply voltage as required for the system.

xiii. Maintenance features

The controller design shall incorporate the following maintenance features:

- Modular construction
- All components shall be easily accessible.
- Standard diagnostics to aid maintenance personnel. These shall include LED or alphanumeric displays, test or measurement points.

xiv. Painting

- All metal surfaces shall be thoroughly cleaned and de-greased to remove mill scale, rust, grease and dirt. Fabricated structures shall be pickled and then rinsed to remove any trace of acid. The under-surface shall be prepared by applying a coat of phosphate paint and a coat of yellow zinc chromate primer. The under-surface shall be made free from all imperfections before undertaking the finishing coat.
- After preparation of the under surface, the panel shall be provided with epoxy-based powder coating. The color shade of the final paint shall be as per manufacturer's standard, unless otherwise specified. Panel finish shall be free from imperfections like pinholes, orange peels, runoff paint, etc.
- All unpainted steel parts shall be zinc passivated, cadmium plated or suitably treated to prevent rust and corrosion. If these parts are moving elements, then these shall be greased.
- Final paint shade shall be light gray and dove gray 631 and 632 as per IS-5 for indoor and outdoor equipment respectively unless otherwise specified.

5.14.2.7 Harmonics Limitations

The harmonics generated on source (Input) side (Both AC) and output side shall be restricted to the following limits: (IEEE-519 for source side and IEC-61800 for load side).

a) Voltage Harmonics	Source side Maximum 5%	Load side Maximum 5% (THD)
b) Current Harmonics 5th 7th 11th	Source side Maximum 30% Maximum 20% Maximum 10%	

Contractor shall indicate clearly the method of achieving above requirement.

5.14.2.8 Tests

The Routine and Type Tests to be performed on the drive system in the presence of the purchaser of consultant shall be as follows:

5.14.2.9 Type Tests

For each rating and type of VFD, the Bidder shall submit for Owner's approval, the reports of all the type tests as per relevant standards and carried out within [last five] years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been conducted at an independent laboratory.

In case the Bidder is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Bidder shall conduct all such tests under this contract free of cost to the Owner and submit the reports for approval.

All type tests shall be conducted as per relevant standards and test certificates of similar panels conducted within last 5 years shall be furnished.

5.14.2.10 Routine tests

1. Visual Inspection
   It involves checking of the various equipments/components fault diagnostic unit, Wiring, Terminals, earthing ratings etc.in line with the approved drawings and visual inspection shall not be limited to the following:
   a) Insulation Test
   b) Light Load and Functional Test
   c) Load characteristics test
   d) Load duty test
   e) Checking of Auxiliary Devices
   f) Checking the properties of the control equipment
   g) Checking the Protective Devices
   h) Checking of control and functional requirements
   i) High voltage test
   j) Leakage and pressure test for cooling water system where provided
   k) Shaft current/bearing insulation
   l) Automatic restart/re-acceleration

   Additional tests on switchgears and dry type transformers shall be carried out based on the requirement defined in the technical specification.

2. Test Witness

The tests shall be carried out in presence of the Owner's representative, for which a minimum 7 days notice shall be given by the Bidder. The Bidder shall obtain the Owner's approval for the type test procedure before conducting the type test. The test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.

3. Test Certificates

Certified copies of all tests carried out at works and at site shall be furnished in requisite no. of copies for approval of the Owner.

The equipment shall be dispatched from works only after receipt of Owner's written approval of shop test reports.

5.14.2.11 Drawings, Data and Manuals

The engineering services scope and the documentation to be issued with the bid are described hereafter. The list shows the minimum requirements for the documentation, so that any additional documentation considered as necessary will be added to this.

I. Engineering, manufacturing, delivering and test schedule
II. Sub-Supplier lists.
III. General arrangement drawings (plan, elevation, section view) with dimensions
IV. Foundation drawing including loading data.
V. Technical Data sheets.
VI. Electrical and control wiring diagram.
VII. Terminal arrangement drawing, interconnection wiring diagram.
VIII. Cross sectional drawing.
IX. Inspection and test plan.
X. Manufacturing Quality Plan.

5.14.3 SCADA, Control System & Instrumentation

5.14.3.1 General

This specification is intended to cover the [design, engineering, manufacture, assembly, testing at manufacturer's works, supply in properly packed condition for transport to site, Erection, site testing and commissioning] of SCADA, Control system & Instrumentation along with all associated equipment/accessories for efficient and trouble-free operation as per standards.

5.14.3.2 Clear & Recycle water (UGR- Underground Reservoir)

1. Requirement of Instrumentation

The main equipment required are listed:

- Full bore electromagnetic flow meter will consist of flow sensor (i.e. flow tube), flow transmitter and flow indicator and integrator and any other item required to complete the system. To avoid the effects of disturbances in the velocity profile, a straight and uninterrupted run, upstream as well as downstream from the location of the flow meter is provided, in line with the applicable standards. Flow measurement will not be allowed to be affected by physical properties of water viz., temperature, pressure turbidity etc., within given limits. Flow meters will be suitable for the water turbidity at site during various seasons. Flow tube will be rugged in construction and will be suitable for continuous operation. Flow tube will have waterproof construction and will be suitable for installation on underground /above ground pipe lines.
- Flow computer and transmitter will be a single unit suitable for panel mounting. It will accept inputs from flow tube, process the signals and will provide an output proportional to the flow rate. The distance between transmitter and flow tube will be 250 m. Taper pieces required for installation of flow meter will not exceed an angle of 8° to avoid disturbance in flow profile.
- Level sensors, transmitter and digital level indicators - 1 No. at each Sump/Reservoir

- Pressure gauges and other instruments at each suction and delivery manifold of each pumping section based on design requirement.
- Pressure switches or transmitters and indicators at each manifold and delivery pipes of each pump.

2. Operation of UGR

- It is proposed to have MCC (Mater Control Centre) at the Clear and Recycle water pump house premise. Clear and Recycle water pump house is required to be automated using latest PLC System. The automation includes all the machinery and processes of UGR.
- The plant pumps / process equipment will operate in auto-mode through PLC at ICP /main control room and necessary instrumentation for the same is provided in the design of the system.
- A pneumatically operated Valves & Gates will be monitored for full open and full close position and all electrical drives for various equipment of UGR will be monitored for on, off and trip status at PLC HMI/SCADA. Green indication for Valve close/motor off status and RED indication for Valve open/motor-on status are to be provided. Indication for Trip will be Amber.

5.14.3.3 Programmable logic controllers (PLC) system

1. Salient Features

- Programmable Logic Controller (PLC) is of Hot Standby Architecture for smooth, reliable, safe, efficient & trouble-free operation with optimum monitoring and control of process plant and equipment. In adverse condition, i.e. in case of failure of Primary PLC, Standby PLC will come into action and maintain control process for smooth working of the plant.
- All Controllers proposed for SCADA system is provided with facility to download the modified logics online i.e. even during the operation of the plant.
- Indefinite High Resolution (IHR) controllers with in-built CPU having less scan time will be used for data acquisition and control of Electrical signals i.e. for Substation and all LV and HV switchgear controlling.
- Normal PLC with inbuilt Analog, Digital I/O cards can be used for data acquisition and control of all remaining auxiliary signals.
- The PLC will be of reputed make, proven technology, and microprocessor based, with its control and monitoring functions distributed geographically & functionally and is designed for fault avoidance by proper selection of components.
- It will have high availability, high reliability & high maintainability.
- The system will be modular in nature and will have facilities for easy expandability of modules to enhance its functionality or performance, if required in future.
- The system will be versatile, rugged and suitable for continuous duty in normal industrial environment.

The system will have following software-based functions:

- “Financial Modelling and sensitivity Analyses” to create a Business Financial Model with implementation plan that will analyse investment returns based on a full range of varied cost inputs.
- “Total System Optimisation” feature that uses the result of financial modelling to optimise the design and operation of plant distribution piping and energy transfer stations. This will include preparation of control system sequences that will implement the optimisation strategies.

The PLC will be suitable to meet the specific process requirement of Pumping Station including monitoring, control, interlocking & sequential operation of the process and is designed accordingly. Application software of the PLC will be developed based on the functional requirements of the process.

Each system is connected to Programmable Logic Controller and the functional distribution of hardware in a multi-level hierarchy to meet specific plant requirements for monitoring, control, process visualisation & optimisation of pumping system. One number Human Machine Interface (HMI) is provided in the PLC panel for monitoring & controlling of the pumping station. All Field Instruments and Electrical drives related inputs and outputs are connected to PLC. Electrical system parameters are connected to PLC system to detect abnormalities in electrical system. Each PLC System will have 20% spare IOs for future requirement.

Raw and Clear Water Pumping Station and Recycle Water Pumping Station will communicate over Fibre Optic Communication Network.

Total operation of the plants will be through properly defined starting and shut down sequences. Emergency plant tripping sequence will be designed with specific time and approval.

2. Codes and Standards

PLC will comply with international Standards such as NEMA, IEC, ANSI, ISA, IEEE, DIN and VDE.

3. Design and Construction Requirements

PLC H/W & S/W will be from the same family and will be sourced from renowned Vendors/System Integrators.

PLC will be microprocessor based with 32/64-bit Redundant processor and is fully programmable and capable of performing control relay logic, including timing, counting, sequencing, and interlocking to provide the required functionality.

The PLC will be high performance processors suitable for real time process application. High inherent reliability, self-checking, error-recovery and trouble-shooting features will be some of the features of PLC. The PLC will have a modular/modular chassis design which allows for ease of future expansion. The processor module can be easily removed from the I/O chassis for service or repair. The I/O chassis will have slots for installing I/O cards, communications, or other special function modules. All I/O cards and modules will be capable of being installed in any open slot in the chassis or will be DIN rail mounted. Module and channel level diagnostics will be standard feature.

The PLC will have suitable power supply and can be easily serviced or replaceable. The system will be capable of being powered on 120VAC / 230VAC / 24V DC as per manufacturing standard. The PLC will be rated to operate from 0 to 60 Degrees C, with a humidity rating of 5 to 95% (non-condensing). All module circuit boards will be encased and protected such that, when properly installed, they are not exposed to accidental contact by personnel.

The PLC will be of high quality and reliability with replacement processors, power supplies, chassis, I/O and specialty modules that are readily available on an urgent or emergency basis. All PLC products will be fully supported, and spares

will be available for purchase for up to ten (10) years from the date of the original system purchase.

4. Basic Processor Functions

The system will be provided with two identical central processors configured such that they operate in Hot-Standby mode. Redundant system with hot back up redundancy feature will be built in the CPU. CPU will have the memory expansion capability up to 7 MB. Both the CPUs will have separate backplane and associated hardware for redundancy. CPU system will be able to communicate with GPRS Modem to communicate with Web SCADA. SCADA connectivity with the CPU will be on Ethernet network (10/100 Mbps with open Modbus TCP/IP protocol). In the event of hardware failure in primary system, the standby system will provide dual connectivity with the SCADA. PLC Components like CPU and I/O modules, Remote IO Modules will be of the same logic family. It will take note on the importance of this obligation.

The system will be designed and implemented such that when the Main processor fails, the Standby one will automatically take over. The change-over will be seamless, smooth and without any time delay and will not cause any disruption to the overall distributed control system and to the ongoing processes. The PLC system will be expandable and will be modular in construction, so as to capable of future

expansion without hardware modifications. The system hardware, application software and database will be sized to accommodate a total of 50% increase in signal capacity and up to 100% increase in an individual zone. Sufficient plug-in modules will be provided and wired to terminals ready to accept future signals of up to 10 % for each IO card. Each IO card will be able to accept at least two more I/O cards without requiring replacement of, or additions to, the original equipment. The system will be modular and capable of integrating into a network with Central SCADA Monitoring Centre (CSMC).

Features:

In summary, following features in the PLC are provided:

- Real-time control of output points for turning on and off digital devices such as motor starters and solenoids.
- Read the status of real world digital inputs from limit switches, float switches, and other field devices.
- Real-time control of analog process control variables.
- Read the status of real world analog set points and feedback values.
- Perform timing, counting, sequencing, and interlocking functions for pump/equipment control.
- Process local alarm handling functions.
- Math and Advanced Functions.
- Four function math in floating point or signed integer format.
- Convert to/from BCD.
- Data comparison and manipulation.
- Scaling from integer data into engineering units such as flow, level and pressure.
- Full P&ID Instructions for control of process control variables such as flow, level and pressure.
- Compute Instruction which executes a mathematical expression and can be used for totalizing functions.
- Trigonometric and Exponential math functions.

- Real-Time Calendar Clock for time stamping alarms and events.
- Automatic restart of the system on resumption of power shall be provided.

5. Memory Unit

Memory unit will comprise of highly reliable memory chips which are industry standard, proven design with fast random access and suitable for operation in process environments. Main memory will be modular, facility will be provided for the upgrading and expansion of memory to meet future demands.

Not less than 50 % spare program memory and data memory space will be provided. System initialization and application software will be stored in Memory Card or EPROM. Operating data will be stored in a RAM fitted with an internal battery backup. The battery backup provided will support the memory on loss of power.

6. I/O Modules

Standard rack mounted plug in I/O modules is provided. I/O Modules will be of the same family as that of PLC CPU. It will take note on the importance of this obligation. Field wiring will be terminated in screwed terminal blocks and interconnected to the processor I/O system with prefabricated cables and plug- in card type connectors. 20% extra modules of installed capacity for each type of module is provided as spare. Provision is made for future expansion of additional 20% extra I/O modules of the installed capacity. I/O modules shall be as follows:

- Inputs will be optically isolated.
- Filters will be provided for noise rejection for Analogue Output status will be indicated by an LED
- All outputs will be fuse protected and have fuse failure indication. The fuses may be mounted externally from the output module
- All the modules will be of addressable type.
- Ethernet, I/O modules will be connected to the PLC by on-board Ethernet 10/100 Base-T connection port. Ethernet, I/O modules will support multiple communications including TCP/IP and Modbus ASCII and RTU allowing connection to any device supporting these protocols over standard Ethernet backplane.

PLCs will be capable of performing the necessary logic to control the system as previously defined. These capabilities will include the following:

1.	Discrete input/output	10	Latch/unlatch relays
2.	Analog input	11.	Counters
3.	Analog output	12.	Comparators
4.	Timers	13.	Ladder logic
5.	Pump Controller	14.	Flow Totalization/Integration
6.	Pump Alternation	15.	Intrusion Detection
7.	Mathematical Function Blocks	16.	Time of Day Control w/Lockout
8.	Stage Blocks	17.	Ramp Blocks
9.	Trending	18.	Data Logging

5.14.3.3.1 PLC Programming

PLC programming shall be carried using Ladder/FBD. The logic shall be prepared using proprietary programming software and shall be comprehensively annotated with subroutine and rung comments to assist further development and maintenance. The system shall support a simple programming of the application software comply with IEC 61131-3. The system shall support a structured, modular programming. At following standard operations are expected:

- Logic functions
- Timer functions
- Counter functions
- Skip functions
- Comparison functions
- Limit value functions
- Arithmetic functions
- Physical unit functions

It shall submit the logic diagrams for review. It shall include the as-built logic in the final submission.

7. Programming Unit

The programming unit shall be of the portable type, industrial model designed to be used during commissioning on site. A functional keyboard which supports different type of programming methods shall be included, as well as a CRT or TFT display.

At least the following functions is expected

- On-line programming
- Off-line programming
- Flexible corrections during input
- Full screen editing functions
- Absolute and symbolic programming
- Input of comments and title blocks for complete documentation
- Complete application software documentation functions. Printouts of application software logic functions shall preferably be in Ladder logic diagrams.
- Load and transfer functions

The computer shall be provided complete with proprietary PLC programming and SCADA software complete with plant mimics and documentation software. Communication cables required to interact with the PLC, (E.g. Modbus Cable) would be supplied. The software shall provide facilities for:

- Insertion of comprehensive program subroutine and rung comments;
- Search and find and search and replace ‘contacts’ and ‘coils’;
- Simulation functions and testing of the program by changing the status of contacts and monitoring the outputs;
- Preparation of coil and contact list and their locations and memory maps;
- Upload and down load programs to the PLC on line;
- Carry out on line maintenance and fault finding on the PLC.

5.14.3.4 SCADA/HMI

The SCADA will be a fully integrated microprocessor based control and data acquisition system which will monitor, control, display, record and trend all assigned plant inputs and outputs. The SCADA will be a fully dual redundant microprocessor based computer system such that reliable and automatic plant control can be achieved. The main process monitoring, and control will be by means of VDU based process operator workstations that shall be located in the central control room.

SCADA/HMI system will be Dual Redundant server system. The system will be designed and implemented such that the failure of the central processor does not inhibit continuous automatic control of the plant. In the event of such a failure, historical data will be

recoverable to a condition where a worst-case maximum of 15 minutes of historical data is lost.

Failure of a single outstation or communications to that outstation will not affect control or operation of any other out-station, unless the failed out-station provides essential data to another outstation, in which case the non-failed outstations will revert to fail-safe mode.

1. Computer

The computer hardware will be of current technology at the time of installation. Standard server stations, Standard PC technology with modern hardware, Windows operating system and data transmission over Industrial Ethernet will be used for the engineering workstations.

The engineering system will be an open system, that, permits the importing of project data from Microsoft Excel, SQL etc. It will be possible to import/export messages to/from Excel and Access for simple processing. Removable memory media is provided for each workstation. It will back up all database and configuration data both on removable media and on non-removable storage media without the system being off-line.

Appropriate hardware to suit the process requirements and data archiving is proposed. The computer will comprise of a personal computer (PC) type architecture, with IBM compatible Pentium IV based system or better, capable of running a multi-tasking real-time operating system suitable for process control applications.

All workstations, servers, communications equipment and peripherals will be from reputed manufacturers, suitable for continuous operation and will be the most currently available models at the time of installation. Adequate spares are included to meet the specified requirements and future expansion.

The system will support hardware and software interconnectivity to external Programmable Logic Controllers (PLC‟s) over an RS-232/RS-485/Ethernet using Profibus/Modbus, Ethernet or similar protocol.

A historical data storage system with removable media for archive and backup is provided. The data storage system will store alarms and events, with the time of occurrence for one month and selected analogue signals connected to the system. All alarms and events will be archived in a first in first out buffer for a period of 40 days.

2. Visual Display Unit (VDU):

Visual Display Units (VDUs) are color monitor screens, capable of displaying information in alphanumeric, bar histogram, graphical and mimic diagram formats. Monitors will simultaneously display a minimum of 256 colors, non- interlaced, low radiation, and flat screen with no discernible flicker. Display of characters will be legible and stable on a shadow mask tube, having a resolution of not less than 1024 by 768 pixels and a refresh rate of not less than 70 Hz. The units will include all the necessary picture controls to adjust the sharpness, contrast and position of the image. LCD VDUs will be flat screen. Minimum requirements: brightness 250 cd/m2, 500:1 contrast ratio, 1600 x 1200 pixels, 55-inch.

Printers:

Color Laser Jet Specifications and features:

All-in-one functions	Print, copy, scan, fax, standalone scan-to email, photo card slots
Multitasking capability	Yes.

Print speed, black (normal quality mode)	Up to 21 ppm
Print speed, color (normal quality mode)	Up to 21 ppm
Print speed footnote	Exact speed varies depending on the system configuration, software program, and document complexity.
First page out (color)	As fast as 17.9 sec
Monthly duty cycle	Up to 40,000 pages
Footnote for duty cycle	Duty cycle is defined as the maximum number of pages per month of imaged output. This value provides a comparison of product robustness in relation to other LaserJet or Color LaserJet devices, and enables appropriate deployment of printers and MFPs to satisfy the demands of connected individuals or groups.
	Paper Heading:
Paper handling standard, input	50 sheet multi-purpose tray 1, 250-sheet input trays 2 and 3, 50-sheet ADF
Paper handling standard, output	150-sheet face-down output bin
Envelope capacity	Up to 30 envelopes
Envelope feeder	No
Duplex printing (printing on both sides of paper)	Automatic (standard)
Document finishing	Sheet fed
Media sizes, standard	Letter, legal, executive, envelopes (No. 10, Monarch)
Media sizes, custom	Tray 1: 3 x 5 to 8.5 x 14 in; Tray 2, Tray 3: 3.94 x 5.83 to 8.5 x 14 in
Media types	Paper (bond, brochure, colored, glossy, letterhead, photo, plain, preprinted, prepunched, recycled, rough), transparencies, labels, envelopes
Media weight	Tray 1: 16 to 47 lb (up to 58 lb with Color Laser glossy photo papers); tray 2, tray 3: 16 to 43 lb (up to 47 lb with postcards, up to 58 lb with Color Laser glossy photo papers)
Weight	71.2 lb
Processor speed	450 MHz
Memory, standard	160 MB
Memory, maximum	416 MB
	Scanner Specification:
Scanner type	Flatbed, ADF
Scan resolution, optical	Up to 1200 dpi
Bit depth	42-bit
Scan size, maximum (flatbed)	8.5 x 11.7 in
Scan size, maximum (ADF)	8.5 x 14 in
Scan speed (default)	Up to 15 ppm
Automatic paper sensor	No

Copier Specification:

Copy speed (black, best quality, A4)	Up to 20 cpm
Copy speed black (best, letter)	Up to 20 cpm
Copy speed color (best, letter)	Up to 20 cpm
Copy resolution, black	Up to 600 x 600 dpi
Copy resolution, color	Up to 600 x 600 dpi
Copy reduce/enlarge settings	25 to 400%
Maximum number of copies	Up to 99 copies

Fax Specification:

Faxing	Yes
Fax transmission speed (seconds	3 sec per page

perpage)	
Fax memory	Up to 250 pages
Fax note	Based on standard ITU-T test image #1 at standard resolution. More complicated pages or higher resolution will take longer and use more memory.
Fax resolution, black (dots per inch)	Up to 203 x 196 dpi
Speed dials, maximum number	Up to 120 numbers
Auto redial	Yes
Fax delayed sending	Yes
Fax broadcast	119
Junk fax barrier	Yes
Polling	Yes (receive only)
Remote retrieval	No
Fax forwarding	Yes

5.14.3.4.1 Hardware

The system will support hardware and software interconnectivity to other networks generally in accordance with the ISO Open System Interconnect 7- layer reference model.

5.14.3.5 Central SCADA/HMI

The central SCADA/HMI will comply to the below mentioned specifications:

1. Industry Standards:

The system will comply the following industry standards:

- ODBC
- OLE
- ActiveX
- COM/DCOM
- DDE and Advance DDE
- Microsoft Windows 7/windows10
- TCP/IP
- OPC DE
- OPC Alarm and Events (A&E)
- XML
- .NET

2. Graphical User Interface for UGR SCADA:

The editing package will include a Wizard / Symbol / Object Library to permit the inclusion of pre-developed or third party graphic objects.

The editor will include a utility or tool for determining which points are referenced in a screen, which objects reference them, and which points are not currently defined or known to the software. This tool will also include provision to search and replace point names - for both single objects and groups of objects.

Graphic objects on these screens can be linked by name to actual device and virtual data through the distributed point database, direct OPC-DA, and Historical expressions in either in real time or historical sense.

The software will support the following dynamic attributes:

- Annunciation, movement, blink, rotation, and fill (uni-directional and bi- directional)
- Gradient fill

- Object border animation
- Object visibility
- Blink fill and blink rate
- Transfer tags for screen transfer or popup windows
- Procedure tags to invoke user defined scripts/programs
- Object and or application help screens
- Alarm information
- Trends charts
- Set point tags for point value changes
- Animated frames that can include other graphic objects
- Zoom to Best Fit, Resize Window to Zoom
- Manual and automated rubber band zooms
- Automatic font scaling when changing window sizes
- Graphic objects will include:
- Embedded OLE, including ActiveX objects, sound, video, clip art, spreadsheets, etc.
- SPC charts
- Trend charts
- Historical Data displays
- Alarm displays
- Arcs
- Lines
- Circles
- Ellipses
- Lines
- Polylines
- Polygons
- Rectangles
- Text strings
- Buttons
- 3-Dimensional Piping creator

Graphics screens will support compliant scripting language. The graphical editor and viewer will be capable of being an ActiveX container and will support ActiveX "methods". The methods will be used by the compliant scripting language.

The graphical interface will have historical playback and review capabilities. The user will be able to select a period of time and then replay the graphical screens and watch the process parameters change on the screen in replay mode.

The graphical run time will be able to optimize the display using anti-aliasing. The handling of graphic images will be such that they can be scaled without distortion The software will provide the following defined user access levels as a minimum and additional levels as given below:

Default level:

The default level will permit users to view all displays except those specifically assigned to a higher level of access.

Operator level:

The operator will permit authorized users to access default level activities in addition to the following:

- Perform control actions;
- Acknowledge alarms;
- Enter or modify manually entered data for inclusion into reports.

System Manager level:

The system manager will permit authorized users to access default level and operator level activities in addition to the following:

- Modify alarm and control set points, dead bands and time delays;
- Enter or modify historical data;
- Add, delete or modify individual I/O points or point attributes;
- Add, delete or modify field device configurations;
- Create, delete or modify control algorithms;
- Create, delete or modify graphic displays;
- Create, delete or modify system reports;
- Configure trend displays;
- Access the operating system;
- Assign access levels and user passwords;
- Perform any other system maintenance function.

3. Web Technology

The Central Control room will also consist of Web Clients capable of displaying entire data right from Clear & Recycle water supplied to end user. The web-clients will be available without a need to load any additional client software on the user's PCs. Users will be able to view the information as well as with sufficient password protection, enter or modify information of pumping station and distribution network. In addition, the software will provide the ability to view point and alarm reports in excel, pdf format in standard web browsers. The web server software will allow for point data to be transferred between servers across the Internet with proper security.

The Web SCADA at Central Control Room will provide following features:

- Displaying the entire pumping station data such as Pump health, ON/OFF status, flow rate and Pressure, total time of operation, Electrical parameters.
- Displaying the entire data from Tapping Points, Water Distribution Centers, District Outlets, Air-Valves, Surge Protection System, and Water Meters etc.
- Control of all the Pumps, Valves, Tapping Points, Water Distribution Centers & District Outlets etc.
- Display the communication healthiness of field units and PLC System.
- User will be able to change valve operation timings from the graphical screens.
- Control center will be capable of downloading data to FCU Units and uploading data from the FCU Units.
- Control Center will have a program to design and display an event report for each Pumping Station and Water Distribution Network.
- Printer interface facility for printing report.
- The user will be able to define all field Units and their associated configurations,
- The user will be able to define all software application functionality and download (send) the data to the field units, in order for them to perform the on-site function.

- The user will be able to upload the existing data from the field units in order to monitor the entire system.
- The Control Centre will provide the ability for the user to "zoom in" to the level of single element characteristics (i.e. Input/Sensor, Output/Valve etc.) at each site.
- The user will be able to monitor site conditions like inside, Battery Voltages, GSM/Radio signal strength.
- The user will be able to monitor the Panel door status at central Control Room.

4. Redundancy for UGR SCADA

- The system will support software-based redundancy solution as well as hardware dependent, high availability architectures as well.
- Redundancy applies to both hardware and software and implies minimal loss of continuity during the transfer of control between primary (active) and redundant (backup) components.
- The system will support Server Redundancy. Server redundancy involves a primary factory monitoring server and a redundant "Hot Standby" server. The redundant server is essentially a mirror image of the primary server, running alternate monitoring/control processes and applications.
- Data collection is performed via independent or shared network paths to the same devices, depending on the protocol.
- Upon detection of failure of the primary server, the secondary server will assume control of data collection, alarm functions, applications, and allow user access with minimal loss of continuity. When the primary server comes back on line, control will be transferred back, and the secondary server will resume its backup role.

5.14.3.6 Other support facilities

1. SCADA Room Power & UPS:

The SCADA room processor(s), Monitors, logging printer and communications equipment will be powered through an uninterruptible power supply (UPS) via a dedicated distribution system. The UPS will provide full functioning of these equipment for a minimum of four hours in the event of a power failure. UPS capacity will be over-sized in terms of rating and power duration by 100% to provide for future additional equipment. UPS batteries will be sealed lead acid maintenance less type.

The UPS distribution cable sheaths will be of a color which distinguishes them from other service cabling. Each master station device will be provided with a local isolating device such as a fused spur or switched socket outlet.

1) Laptops for Portable Programming Unit

- Latest operating system software that will be compatible with Engineering Software including Automation Software
- Intel Core i7 (3.4 GHz/2.4 GHz)
- Turbo Boost Technology
- GB GDDR5, 4 GB RAM & 1
- Optic fiber cable (OFC)

The OFC will serve as the transmission medium for a fiber optic data transmission system between Clear Water Pumping Stations, Recycle water pump house and the Master control room building.

5.14.3.7 Standards for Cable:

1. Codes & Standards:

The manufacturing, delivery, installation and testing of the cable Conduit shall meet the requirements established in the following codes and standards:

- ISO 161-1 Thermoplastics Pipes – Nominal Diameters; Nominal Pressures
- ISO/DIS 1167 Thermoplastics Pipes – Resistance to Internal Pressure – Test Method
- ISO/DIS 2505-1 Thermoplastics Pipes-Longitudinal Reversion- Determination Methods
- ISO/DIS 2505-2 Thermoplastics Pipes-Longitudinal Reversion- Determination Parameters ISO/TR 10358 Plastics Pipes and Fittings- Combined Chemical Resistance Classification Table
- DIN 8074 Polyethylene (PE) - Pipes PE 63, PE 80, PE 100, PE-HD Dimensions
- DIN 8075 Polyethylene (PE) Pipes General Quality Requirements
- Wherever codes, standards and recommendations are mentioned, the latest published revision or issue shall be applicable.
- Optical fibers
- ITU-T G.652 characteristics of a Multi-mode optical fiber cable, and/or IEC 60793-1-1 optical fibers - generic specification IEC 60793-2 optical fibers - product specifications
- Fiber optical Cable
- ITU-T L.10 Optical fiber cables for duct and tunnel application, and/or IEC 60794 -1
- Optical fiber cables - generic specification IEC 60794 -2 Optical fiber cables - indoor cables IEC 60794 -3 Optical fiber cables - outdoor cables.

Standards for Measuring Methods:

- IEC 60793-1-2 Optical fibres – generic specification – measuring methods for dimension
- IEC 60793-1-3 Optical fibres – generic specification – measuring methods for mechanical characteristic
- IEC 60793-1-4 Optical fibres - generic specification - measuring methods for transmission and optical characteristic
- IEC 60811 Common test methods for insulating and sheathing materials of electric and optical cables.

Other Standards:

ITU-T K.25 Protection of optical fibre cables IEC 60304 Standard colours for insulation for low-frequency cables and wires wherever codes, standards and recommendations are mentioned in the latest published revision or issue will be used.

2. OFC Laying Procedure

The fiber optic cable will be laid in a buried cable conduit. A fully dielectric fiber optic cable, suitable for ducted or direct buried applications, filled with compound to prevent axial and longitudinal ingress of water and/or soluble chemicals throughout the cable is provided. The cable will have loose tubes as secondary coating of fibers. The cable length will be either 1,000 m or 2,000 m per drum, depending on the actual required total length. FOC will be installed after backfilling and removing of all heavy machinery by the cable blowing method.

Traction elements will be made out of Kevlar or equivalent. The allowable tensile loading of the cable will be 2.500 - 3.000 N, suitable for direct blowing or pulling the cable into cable ducts.

The outer cladding of the cable will consist out of black PE. Other color coding and labelling of the particular cable components will be according to IEC 60304. The color-coding system will be discernible throughout the design life of the cable. Cable markings will be printed on the outer fiber cable jacket. The markings will be permanent, insoluble in water and be legible for the duration of cable life. The markings will be printed at intervals of not more than 2 meters.

3. Optical Fiber racks:

Optical Fiber Racks will be installed in all the network and PLC panels, which will contain pigtails and output connector. Optical fiber cores will be spliced to join with pigtails so that the corresponding output connector can be utilized for the corresponding local panel.

4. Tests:

Factory Acceptance Test

Each particular cable length will be factory acceptance tested and will be delivered together with the respective test reports.

i. Attenuation tests of each fiber at 1.300 +30/-15 nm and at 1.550 +30/- 70 nm with OTDR according to IEC 60793-1-4 double-sided will be performed.
ii. Dispersion tests of each fiber at 1.300 and 1.500 nm according to IEC 60793-1-4 will be performed.

These measurements will be performed on each fiber prior to cable manufacturing and on the fabricated cable. Tension and temperature test of the fiber optic cable, as homologation test and determination of resulting attenuation and variation in attenuation according to IEC 60793-1-4 will be performed.

Receipt of Cable Test:

Each particular cable length will be tested upon receipt on site. Attenuation tests of each fibre at 1.300 +30/-15 nm and at 1.550 +30/-70 nm with OTDR according to IEC:60793-1-4 double-sided will be performed along with determination of optical length.

Test protocols:

Test protocols will be provided for all activities conducted in course of tests.

Delivery Documents:

The documents to be provided per cable drum will comprise:

- Drum number
- Manufacturer
- Cable type
- Cable length
- Data sheet
- Results of FAT

Documents before OFC Installation:

Before commencement of the FOC laying works the tests to be performed after cable receipt will be available and will prove that the cable is faultless. For tests after laying and splicing, reference can be made to the Specification of “Fibre Optic Cable Conduit and FOC Installation”.

5. Transport, Unloading and Storage

The material will be brought to site, unloaded and stored (if necessary) in such a way that damages are avoided. Storage supports and stacking heights will be selected in such a way that steady deformations of the cable conduits are avoided.

6. Cable Conduit

The cable conduits shall especially be suitable for blowing in fiber optic cables and shall reduce the friction and abrasion of the fiber optic cable during the installation process to a minimum. The inner surface of the cable conduit shall therefore provide optimum sliding characteristics achieved by longitudinal rills.

Enclosures

Direct buried splice closures will be used for straight through splicing and branch splicing of single mode fiber cables. The splice closures (loose buffer tube with central strength member) will be suitable for a single mode fiber optic cable.

In general, the enclosures will be used to splice one (1) fiber cable but will have the capability of splicing additional branch cables whenever the need arises. The following minimum functional requirements are provided:

a. Mechanical protection of the splice
b. Accommodation for redundant fibres
c. Termination of the Fibre Optic Cable

The dimension of the concrete shafts will be designed in such a way that the cable loop and the enclosures at a splicing point can be laid without to under- run the minimum allowable bending radius of the fibre optic cable.

Optical Distribution Frame

The termination of each fiber in transmit and receive direction will be provided on an optical distribution frame (ODF) for access to the transmission equipment. The ODF for receive and transmit direction will be dimensioned in accordance to the specified number of fibers plus additionally 20% of spare capacity. The ODF will be installed in termination cabinets, which may be combined with the communication system.

7. Marker

Buried passive markers (Ball EMS) will be used.

8. Warning Tape

A detectable reinforced underground marking and warning tape will be laid in the ground approx. 30 cm above the protection conduit.

Patch Cords, Pigtails, Optical Plug Connection

The patch cord consists of a single-phase fibre optic cable with plug connections on both ends. Pigtails are fibre cables pre-assembled with a connector at one end. The optical plug connection consists of a plug and an adapter for the connection with a further plug. All connectors will be from the same type as the connectors of the telecommunication system. The fibres of the patch cords and pigtails shall be according the specified fibres. All Component will have a service life of more than 15 years with a minimum of contact durability of 1000.

9. Cable Laying Procedure

The cable will be laid with a minimum of splicing joints and if possible, without any joint. The cable laying shall be started after the cable conduit has been installed and tested

(calibration and pressure test) successfully between two points of cable termination. After the cable conduit has successfully been tested and the trench surfaces have been reinstated, the fibre optic cable will be blown in, respectively pulled in at difficult sections.

The cable will be laid in buried conduits. The laying process has to be in compliance with cable manufacturer's recommendation (tensile load rating, pulling force, crushing force, minimum allowed bending ratings, minimum outdoor laying temperature, etc.). The use of additional lubricants during the cable installation will be avoided. At difficult sections (e.g. road crossings) it will be allowed to pull the cable, if the requirements mentioned above are considered. At cable joint points, a surplus cable of approx. 10 m will be provided for splicing. After splicing, the surplus cable will be coiled up. The surplus cable and the enclosure will be installed in a prefabricated concrete shaft. Markers will be used to locate the position of the concrete shafts.

Inside buildings, the fiber optic cable will be laid on cable trays or ducts. The fiber optic cable will be tied-in, laid, terminated and relieved from strain, applying all applicable regulations. Grommets through walls and floors required in course of the cable laying will be opened and closed under consideration of fire safety regulations.

Connectors Tests

The connecter loss shall not exceed 0.5 dB per connecter.

Installation Test

Immediately after a cable is installed, a rough optical time domain reflectrometer (OTDR) test will be performed to verify if a cable damage has occurred during the installation.

Splice Test

A unidirectional OTDR-testing will be performed after a splice is done.

Acceptance Test

After laying, installation, splicing and termination of each cable section the following tests will be performed on each fibre:

Attenuation tests of each fibre at 1.300 +30/-15 nm and at 1.550 +30/-70 nm with (OTDR) IEC 60793 double-sided.

Attenuation tests of each fibre at 1.300 nm and at 1.550 nm with optical power meters single-sided.

Having identified, which splices have a loss exceeding the criteria, the next step is to re-burn these splices to reduce the loss. Only if the measurements confirm that all splices, terminations and attenuations of the several cable sections are according to the cable/termination specification of manufacture, and to this specification, a cable section can be completed.

Test Protocols

Test protocols will be provided for all activities conducted in course of tests

10. Cable Splicing

The splices will be produced by use of fully automatic splicing devices applying fusion splicing technology. The splicing will be conducted with the procedure outlined by the manufacturer of the equipment with particular emphasis on cleanliness. For fiber optic cable connection, only electric-arc fusion splicing is recommended. Only for test purposes (e.g. receipt of cable testing) mechanical splicing is recommended. Each single splice will not introduce to the fiber an attenuation exceeding 0.1 dB. The splices

will be accommodated in splicing enclosures. At cable joint points, all fibers of the fiber optic cable will be connected through by splices. All fibers of the cable tied-in to a station will be spliced in a fiber optic terminal box with splicing modules. All fibers will be spliced to pigtails which will be terminated on an optical distribution frame with optical connectors providing access for a data transmission system to the optical fibers. The fiber optic terminal box and the optical distribution frame will be housed in the cabinet for the data transmission system. All spare and standby fibers terminated at the optical distribution frame will be connected through by patch cords.

5.14.3.8 Cables

1. Power & Control Cables

All power & control cables for use on medium / low voltage will be heavy duty type, aluminium/ copper conductor. PVC/XLPE insulated, inner sheathed, armored and overall PVC sheathed as described below

Cables will be sized based on the maximum continuous load current and the voltage drop. The derating due to ambient air temperature, ground temperature, grouping and proximity of cables with each other etc. will be taken into account. Below grade cables in paved areas will be in concrete lined trenches with concrete covers having proper slope and suitable drainage arrangement to avoid water collection. In unpaved areas cables will be in lined trenches or directly buries in ground. In hazardous areas trenches will be completely filled up with sand. Concrete lined cable trenches will be sealed against ingress of liquids or gases wherever the trenches leave a hazardous area or enter control room or substation.

The cable trenches will be sized depending upon the number and voltage grade of cables. Where underground cables cross roadways, pipe sleepers at grade, etc., they will be protected by being drawn through PVC sleeves/ducts or suitable RCC Pipes to provide a permanent crossing. Pipes laid for mechanical protection will be sealed at both ends. High voltage, medium/low voltage, control and signal cables will be separated from each other by adequate spacing or running through independent pipes, trenches or cable trays as applicable. Cable trays, racks and trenches will be sized to allow for 20% future provision.

Cable installation will provide minimum cable bending radii as recommended by cable manufacturer. Cable route markers will be installed at every 30m interval all along the routes of directly buried cable trench and also at locations where the direction of cable trench changes. All power and control cables will be of continuous lengths without intermediate joints. Where joints are unavoidable, same can be provided. All cables will carry tag numbers for easy identification.

In case of control cables, all cores will be identified at both sides by their terminal numbers using PVC ferrules as per interconnection diagrams.

Sequential marking of the length of the cable in meters will be provided on the outer sheath at every one meter. The embossing/engraving will be legible and indelible. Control cables having 6 cores and above will be identified with prominent and indelible Arabic numerals on the outer surface of the insulation. Colour of the numbers will contrast with the colour of insulation with a spacing of maximum 50mm between two consecutive numbers. Colour coding for cables up to 5 cores shall be as per IS Specification(s).

2. Communication Cables

Suitable for supporting communication over Profibus, Serial (Modbus Protocol), Ethernet etc. as per the communication option selected for various proposed analysers, instruments, VFDs, power analysers, relays and instrument, as applicable (existing instrument/equipment where applicable will normally be without communication port or if available will be with Modbus, Profibus or Ethernet communication). Communication cables will be shielded and will be laid in PVC ducts of minimum 1" size (for buried cables)/on ducts/trays (for in air/overhead cables). It will offer the price for various communication cable options as specified in the price bid and in case it is opting for any other communication option not mentioned there in, he shall quote the price in "Other Communication" option providing all necessary details in the technical bid. However, it shall note that selection of communication option other than those specified in the price bid are subject to review of client / consultant and client reserves to reject the proposal without assigning 258 any reason there of in which case it shall offer instrument / equipment with communication options mentioned in the bid (Profibus, Modbus, Ethernet,). Necessary repeaters, couplers, termination kits, converters, connectors / plugs, etc. as applicable for connecting with necessary instrument / equipment shall be included appropriately based on the quantity (BOM) furnished for all instrument / equipment for proposed as well as existing instrument / equipment for necessary connection to communication network and communicate with PLC/SCADA system In general, cables for Ethernet shall be twisted pair with RJ45 connector (Specify the repeater requirement for more than 90 Mtr. Length or as per manufacturer guideline), for Modbus it shall be twisted pair, shielded cable with terminators, for Profibus-DP it shall be shielded twisted-pair line or a fiber optic cable (with transmission standard EIA RS485).

3. Network Cable – CAT6 UTP Cable: -

The copper cable will either be 4-pair 100 ohms Balanced Twisted Pair cable (UTP) with rip cord and dielectric central isolation member:

The 4-pair UTP cable will meet and exceed the following specifications Will comply to the following standards:

- ANSI/TIA/EIA-568B.2-1
- ISO/IEC 11801:2002 2nd Edition (Category 6)-IEC 61156-5 1st Edition
- LSOH: IEC 332: Part 1, IEC 754 and IEC 1034
- UL CM
- Minimum bend radius 1.00"
- 100 % of final production reels are tested to 550 MHz
- be 0.57mm (0.23 in) (24AWG) solid bare copper
- The maximum jacket diameter (for 4-pair UTP cable) shall not exceed 6.35 mm (0.25 in).
- sequential meter markings on jacket
- be appropriate for the environment in which it is installed.

4. Laying of Cables:

Cables will be laid on trays, in trenches, conduits, ducts as necessary. Instrument cables will not be buried in ground as far as possible. Cable joints in instruments signal and power supply cables are not recommended. In case some of the instrument cables are to be buried in the ground, it shall be as per standard/good Engineering practice.

Necessary materials such as junction boxes, glands, lugs etc. required for termination of cables are included. Each cable will be terminated to individual panel/terminals box. Cable glands will be of Nickel plated Brass and of Double Compression Weather proof type. Flame proof gland wherever required shall be with Ex (d) certification. A distance of minimum 300 mm will be maintained between the cables carrying low voltage AC & DC signals and a distance of minimum 600 mm will be maintained between cables carrying HT & LT cables.

Identification of each cable will be by proper ferrules at each junction as per cable schedule to be prepared. All cables will be identified close to their termination point by cable numbers as per cable interconnection schedule. Identification tags will be securely fastened to the cables at both ends.

5. Instrument Earthing

All the non-current carrying metal parts of the electrical installation and mechanical equipment will be earthed properly. The cables armour and sheath, electric panel boards, lighting fixtures, ceiling and exhaust fan and all other parts made of metal will be bonded together and connected by means of specific earthing system. An earth continuity conductor will be installed with all the feeders and circuit will be connected from the earth bar of the panel boards to the conduit system, earth stud of the switch box, lighting fixtures, earth pin of the socket outlets and to any metallic wall plates used. All the enclosures of the motors will be connected to the earthing system.

The following standards are applicable.

- IS: 3043 – 1966 Code of practice for earthing.
- Indian Electricity Act and Rules

All codes and standards are the latest. Where not specified otherwise, the installation will generally follow the Indian Standard Code of Practice or the British Standard Code of Practice in absence of Indian standards.

All branch cables/tubes, cables on various civil units/structures will run on cable trays only. Cable trays will be made out of galvanized mild steel sheets of 2.5 mm thickness. The width will be so selected that 40-50% space is available for future use. Suitable cable clamps for binding cables/tubes at every 500mm are provided.

6. Junction Box:

Junction Box material will be Cast Aluminium (LM-6) only and weather proof to IP- 65. Flame proof junction boxes are proposed with Ex (d) certification in addition. The boxes will have terminals suitable for a minimum of 4 mm2 cable termination mounted on rails. 20% spare terminals are provided in junction boxes. Each junction box will have 10% or minimum whichever is higher. Spare entries are provided with plugs.

7. Air-conditioners

All control room, SCADA Panel room, Control command Centre, VFD panel room will be provided with air conditioning as per the approved heat load calculation and approved lay out.

5.14.3.9 Instruments

1. Pressure Indicators:

Direct reading, pipe mounted Pressure gauges of Stainless Steel with 6-inch phenolic dial (white dial with black numerals), 316 SS Bourdon tube, nylon movements and micrometer type adjustable aluminium pointer with accuracy of

+/-1% of span including accessories like siphons for steam services, snubbers for pump discharge applications and chemical diaphragm for corrosive and oil services and name plate, etc. Material of accessories will be SS. IP65 degree of protection for enclosure. Over range protection will be 50% above maximum pressure. Armoured capillary of 15 M will be provided as required.

2. Pressure Switches/ DP Switches

Non-indicating type, field mounted Pressure Switches of aluminium casing (epoxy coated), and 316 SS element and accuracy of +/-1% of span, including accessories like snubbers for pump discharge applications and chemical diaphragm for corrosive and oil services, name plate & mounting brackets. Material of accessories will be Auto reset micro switch with internal adjustment for set values with 2 SPDT contacts rated for 0.2 A at 220 V DC. IP 65 degree of protection for enclosure. Over range protection 50% above maximum pressure. Scale for setting will be provided.

3. Temperature Indicators (Thermometers)

Thermometers will be Industrial type, Bi-metallic for low temperature applications (<80O C), inert gas actuated vapour pressure type for above 80O C of SS bulb and capillary. Body material-Die-cast aluminium. Dial size-150 mm with white dial and black numerals and process connection-1/2''NPT (M). Accuracy-+/- 1% of span. IP65 protection class. Accessories include nameplate, mounting brackets and SS Thermowell. Thermowell process connection- M33X2 and 1/2''NPT (F) on thermowell for thermometer.

4. Thermowells

Pipe/ equipment mounted temperature test wells of 316 SS with a process connection of M33x2 thread and instrument connection of ½" NPT (F) in general or 150 RF flanged. Accessories like name plate, plug with chain, etc. will be provided. Material of accessories will be SS. Thermowell will be hex head of barstock assembly. In case flanged wells are required for any specific application, the same will be supplied as required. The thermowell construction will meet the ANSI 19.3 (latest) requirements. Thermowell will be designed such that the resonant frequency is above the exciting frequencies generated by vortex shedding in the process fluid. All Test thermowell shall have the plug of SS316. IBR certification as applicable will be required.

5. Temperature Elements (RTD)

Duplex type, PT – 100, with accuracy of +/-0.5% of span, response time 1-2 seconds; Spring loaded mineral insulated three (3) wire RTD assembly with 316 SS Thermowell housed in aluminium casing (epoxy coated) having a process connection of M33 x 2 thread and instrument connection of ½" NPT (F) in general or 150 RF flanged. IP 65 or equivalent degree of protection for enclosure. Material of accessories (name plate, etc.) will be SS. Thermowell with hex head with screwed cover & SS chain, bar-stock assembly. Element lead size will be 18 AWG. The insulation resistance at 540 Deg C will not be less than 5M ohms. Repeatability over full range will be better than 0.02%. RTDs will be ungrounded. RTD will be supplied as an assembly complete with thermowells meeting ANSI 19.3 (latest) requirements.

6. Level Gauges

Tubular/ float type level gauges with brass guard rods & brass holders will be provided. Material of float & float chord will be 316 SS & cage materials will be fabricated steel and the material of accessories (name plate, etc.) will be SS. IP65 degree of protection for enclosure. Connection will be screwed or flanged (ANSI class 150 RF).

7. Level Switches

Top mounted float type level switches for water tanks/ sumps will be supplied with still tubes to suit the requirement. Micro switch with 2 SPDT contacts rated for 0.2 A, 220 V DC. Material of float & float chord shall be 316 SS & cage materials will be fabricated steel and the material of accessories will be SS. IP65 degree of protection for enclosure. Accessories like name plate, drain valve for external case type level switches, mating flange, gaskets (asbestos), fasteners, bolts & nuts, etc. will be supplied.

8. System/ Marshalling Cabinets

These cabinets will house signal-conditioning cards, input/ output cards, processor cards & associated power supply units. Indoor located, free standing vertical type system cabinets with IP-42 enclosure and with 3 mm thick sheet metal of cold rolled steel; double doors with neoprene gaskets; anti-vibration pads of 15 mm thick; blower louvers in each cabinet with brass mesh; fire proof compound (50 mm thickness) for sealing cable entry (bottom); fire detector for each cabinet. Beacon lamp will be provided in each cabinet to indicate the cabinet having fault condition.

The colour of the cabinets will be indicated at detailed Engineering stage. Doors will have concealed type of hinges and swing of 100O. The doors will be provided both at the front and rear. Power supply distribution will be provided on per cabinet basis with all associated MCBs, protections, etc. The system cabinets, racks in system cabinets, slots in the racks & the terminals will have identification numbers. A stainless-steel metal tag (plate) will be fixed to the inside of the door & the layout of the racks, slots details of the card type/ service will be inscribed on this metal tag. Each cabinet will be provided with one each 3 pin receptacles for 220 V AC, 1¢, 50 HZ and for +24V DC. Cabinet will be delivered totally wired. All electronics will be mounted & wiring connections at these hardwares will be terminated by Bidder. Quantity shall be as required. All cabinets will have common key for the locks. In each cabinet, a 24 V DC Voltmeter will be provided to check the Field Interrogation voltage.

9. Flow Meter:

Electromagnetic Flow Meter of appropriate size will be installed at the end of the manifold to measure the quantity of water discharged in to the Distribution Chamber.

Full bore electromagnetic flow meter will consist of flow sensor (i.e. flow tube), flow transmitter and flow indicator and integrator and any other item required to complete the system. To avoid the effects of disturbances in the velocity profile, a straight and uninterrupted run, upstream as well as downstream from the location of the flow meter will be provided, as required by the flow meter manufacturer and in line with the applicable standards.

Flow measurement will not be affected by physical properties of water viz., temperature, pressure turbidity etc., within given limits.

A lockable enclosure will be provided for the flow transmitter cum computing unit, if required.

Flow meters will be suitable for the water turbidity at site during various seasons. Flow tube will be rugged in construction and will be suitable for continuous operation. Flow tube will have waterproof construction and will be suitable for installation on underground/above ground pipe lines.

The flow computer and transmitter will be a single unit suitable for panel mounting. It will accept inputs from flow tube, process the signals and will provide an output proportional to the flow rate. The distance between transmitter and flow tube will be maximum 250 m. Taper pieces required for installation of flow meter will not exceed an angle of 8° in order to avoid disturbance in flow profile.

General:

Accuracy of flow measurement during FAT	±0.5% of measured value
Overall accuracy of flow measurement loop	±1.0 % of measured flow

Flow tube

Application	:	The water pumping mains
Type	:	In line full bore electromagnetic
Size of flow tube	:	As approved by the Authority
Process connection	:	Flanges as per BS 4504
Weather Protection Class	:	IP 68 as per IS 13947
Surge protection devices (SPD) between flow tube and flow transmitter	:	Required for protection from lightning surges
Material of Construction:		
Electrodes	:	SS 316, self-cleaning pipe
Coil Housing	:	carbon steel coil housing
Flanges	:	Carbon steel
Grounding ring	:	SS 316
Flow tube Lining	:	EPDM/Neoprene/PTFE

Flow Transmitter Unit

Type	:	Microprocessor based with facility to configure the ranges
Type of display	:	4-digit backlit LCD/ LCD, for flow rate in m3/hr. 8-digit Backlit LCD/ LCD for totalized flow in ML
Units of display	:	Flow rate -m3 / hr Totalized flow – ML
Input	:	From flow tube
Output	:	4-20 mA DC (isolated) proportional to flow rate
Power Supply	:	230V AC
Zero and Span Adjustment	:	Required
Weather Protection Class	:	IP 68 as per IS 13947
Battery backup for totalized		
Flow Type	:	Online
Capacity	:	2.5 mVA
Backup Time	:	8 hours
Facility for on line diagnosis	:	Required

Calibration:

The Electromagnetic flow meter will be wet calibrated for the full flow range specified as per BS EN 29104/International Standard (Methods of evaluation of electromagnetic flow meters). The calibration method will be either gravimetric method as per ISO 4185/International Standard (Measurement of fluid flow in closed conduits – weighing method) or volumetric method as per ISO 8316 (Calibration by Volumetric Method). The 'test bed' will be accredited by appropriate National/International certifying authority. The flow meter will be acceptable if the accuracy and repeatability is equal to or better than those specified.

Flow Indicator and Integrator

Flow indicator and integrators will be modular in design. It will consist of two separate dedicated displays for flow rate indication and total flow indication. It will accept 4-20 mA DC isolated input. The flow integration will be carried out in the Programmable Logic Controller (PLC). The flow indicator cum flow integrator will provide 4-20 mA retransmission output proportional to flow rate.

Digital flow indicator and flow integrator will be a combined unit.

Facility shall be available in the analog signal multipliers and in the flow indicator and integrator for providing excitation voltage for the flow transmitter in case of 2-wire flow transmitters.

Sl. No.	Details	Description
1	Type	Microprocessor based
2	Mounting	Front facia of Control Panel
3	Display	Digital, seven segment back lit LCD / LED display
4	Digit Height	14 mm or Higher
5	No. of Digits for	
	Flow indicator	4 Digits
	Flow integrator	6 Digits
6	Input	4-20 mA DC (Isolated) from flow transmitter through analogue signal multiplier (Refer Note 2)
7	Zero and span adjustment	Required
8	Manual Reset Facility for flow integrator	Required (shall be password protected)
9	Engineer-in-Charge units:	
	- Flow rate indicator	Cum/hr
	- Flow integrator	ML
10	Battery backup for integrator	Required
11	Retransmitted output	4-20 mA proportional to flow rate
12	Alarm outputs	1 NO + 1 NC for high and low alarms (adjustable)
13	Communication port	RS-485 (With Mod bus protocol) for interfacing with PLC
14	Weather Protection	Class IP-52 of IS 13947 Part I
15	Accuracy	± 0.25% of span or better.

Installation

The installation of the Electromagnetic Flow meters will be done at the locations decided by the Engineering section. It covers field hydraulic testing of the Electromagnetic Flow meters after installation for the specified test pressure for the respective pipeline section.

Pressure Transmitters

Transmitters will be manufactured from material suitable for use with the process medium and for the site ambient conditions.

The transmitter will be of suitable IP or as per data sheet, yoke mounting, provided with mounting arrangements suitable for minimum 2" pipe mounting. The materials of construction will be suitable for the local climatic conditions and where necessary suitable, weather proof enclosure with viewing windows shall be provided. Pressure sensors will be fully temperature compensated Transmitters will be powered by 10-30V DC with 4 to 20 mA output and SS-316L wetted parts.

Level Transmitters

Suitable Level Transmitters/Level Switches are provided to measure liquid level of tanks/sump like treated water/backwash service water sump, backwash water over head tank (ESR), dirty water sump, and all alum/PAC solution preparation& dosing tanks. The purpose is to monitor tanks/sump levels locally and at ICP at main control room as well as provide low level trip for safety of pumps against dry running, start/stop of pumps in auto mode through suitable logic, low/high level alarm annunciation at HMI/SCADA at control room, etc. Ultrasonic level measurement will be provided wherever necessary and based on site feasibility. The measurement will be accomplished by using non-contact, echo time measuring equipment operating at ultra-sonic frequency. Level transmitter will consist of a sensor incorporating both transmitter and receiver along with integral controller or a separate control unit. Control unit shall be programmable and shall have as per data sheet. The sensor will be suitable for mounting in the open, or within an enclosed tank, and will be with environmental protection. The transmitter will provide 4 to 20 mA with relevant IP 65 Class protection.

Ultrasonic Transmitter:

Ultrasonic Transmitter is to measure each channel/weir flow as provided for the clear and recycle in the Outlets. The brief specifications are given below:

Type	:	Ultrasonic, fully user Programmable, microproc. based
Mode of Operation	:	Flow
Accuracy	:	± 0.25% of range OR 6 mm, whichever is greater
Resolution	:	0.1 % of range OR 2 mm, whichever is greater
Outputs	:	4-20 mA analog output proportional to flow Programming Device In-Built in controller or Hand-held Local Digital Display Flow in Engg. Units
Power	:	230 V ac ± 15%, 50Hz OR 24 V DC

Control Unit Protection	:	IP-65 as a minimum
Operating Temp	:	0 to 50 deg C
Proc. Temp. Compensation	:	Required, Built-in temp. sensor in transducer
Sensor MOC	:	PVDF or equivalent suitable
Transducer Protection	:	IP-68
Transducer Cable Length	:	10 m minimum
Communication Port	:	As given by manufacturer

Erection will be as per site requirement.

Flume Flow (Instantaneous and Totalised) readings will be continuously displayed locally and at PLC HMI at main control room and also at ICP (Control Panel) in main control room on panel mounted indicators/totalizers. The instrument will be competent to perform open channel measurements for all kind of flumes & weirs.

Online Residual (free) Chlorine Measurement System

Free Chlorine readings will be continuously displayed locally and remotely at ICP at main control room.

On-line type Free Residual Chlorine analyzer is provided to measure free residual chlorine values in Clear & Recycle water Pump House.

The specifications for this are given below:

Type	:	Microprocessor based, programmable
Measurement type	:	DPD Colorometric type
Range	:	0-10 mg/l or suitable
All wetted parts MOC	:	Non-corrosive material
Analog Output	:	4-20 mA proportional to residual chlorine
Contact Output	:	Min. 2 potential free changeover contacts
Local Display	:	Free Chlorine value
Accuracy	:	+5% of reading or better

Mtg / Sensor Holder Type: Flow Through assembly or suitable as required (Suitable sampling system shall also be provided, if required)

Sensor Cable	:	included, min. 5m length or higher as suitably required

Power:

230 V AC, 50 Hz

Transmitter Housing	:	Weather proof to IP-65 / NEMA-4X as a minimum
Electrical Connection	:	½" NPT
Sensor Failure Alarm	:	Required
Instrument Canopy	:	Required

5.14.3.10 Spares

Start-up spares will be as required. Essential spares are included as detailed below:

For field instruments, air filter regulators, E/P converter and junction box and drive modules a minimum of one (1) No., or 10% of the quantity of each type and range, whichever is higher are provided.

PLC System

a) All modules like Signal distribution modules, signal conditioning modules, I/O modules, Processor modules, Power supply modules, Network cards etc., – 10% of each type, or minimum one (1) No. whichever is higher.
b) Each type of fuse – 5 Nos., or 30% of each, whichever is higher.
c) Local Panels, System Cabinets 10% of each type, or minimum one (1) No. whichever is higher for the following items:
   - Fuses of each type and rating.
   - MCB of each type.
   - Terminals of each type
   - Male & female parts of pre-fabricates Cables – 6 Nos., of each type.
   - Solenoid valves (for each valve):
   - Coil – 2 Nos., of each rating and insulation.
   - Plunger – 1 No. of each type and size.
   - Seat – 1 No. of each type and size
   - Gaskets – 2 sets of each type and size.
   - O-rings – 5 sets of each type and size.
   - Diaphragm – 2 Nos., of each type and size.
   - Wiring, Termination & Accessories.
d) 10% of each type, or minimum one (1) No. whichever is higher shall be supplied for the following items:
   - Fuses of each type & rating.
   - Miniature circuit breaker of each type & rating
   - Terminals of each type.
   - Space heater with thermostatic controls.
   - Fire detectors.
   - Blower.
   - Blank CD's for software back-up: 30 Nos.
   - Cable clamps each type.
   - Male & female pre-fabricated cables – 6 Nos., each type.
   - Spare terminal in each terminal block in all cabinets.
   - Spare space for counting additional terminal blocks in all cabinets.
   - Wiring raceways to accommodate additional 30% space of total quantity.

5.14.3.11 Applicable Standards

All equipment will comply with applicable national and local laws regulations and standards, in addition to those listed below:

ISO 9000 and 09004	:	Quality Systems
IEEE 587	:	Power Supply Surge Protection
IEC 61131-3	:	Programming Languages for Programmable Controllers
IEC 61158-2	:	Communication Protocols
ISO 9075 (BS 6964)	:	Structured Query Language (SQL)
BS 5515	:	Documentation of Computer Based Systems
BS 7165	:	Recommendation for Achievement of

		Quality in Software
BS EN 50081	:	Electromagnetic Compatibility
ISO 3511	:	Process measurement control functions instrumentation symbolic representation
ISO-OSI	:	7 Layer Communication Model
IEEE 472-1974	:	Surge protection
IEC 61850	:	PLC sub-station automation protocol.
IEC 8705101	:	Modbus protocol conversion
ISO 9000 and 09004	:	Quality Systems

5.14.3.12 Automation System for Remote Control and Monitoring

The proposed Automation System shall be able to control and monitor the required parameters from Control Centre with the help of licence free radio frequency and GPRS system.

A. Remote Control Centre (RCC)

The Remote-Control Centre (RCC) will provide a management tool for controlling the all Reservoir Inlets in the water network. Remote control station will be web based application so that user can monitor and control each Reservoir from any place with the help of internet connection.

System configuration:

- The Remote-Control Centre will be able to configure system's parameters for optimal operation.
- The user will be able to define all field Units and their associated configurations,
- The user will be able to define all software application functionality and download the data to the field units, in order for them to perform the on-site function.
- The user will be able to upload the existing data from the field units in order to monitor the entire system.
- The Control Centre will provide the ability for the user to "zoom in" to the level of single element characteristics (i.e. Input/Sensor, Output/Pump etc.) at each site.
- The user will be able to monitor site conditions like inside panel temperature, Battery Voltages, GSM/Radio signal strength.
- The user will be able to monitor the Panel door status at central SCADA. Management tools:
- Accumulation reporting, historical trends views and Events/Alarms logging.
- Interface to third party database and communication systems such as SMS, paging alarms and weather stations.
- Time based and/or Volume based Weekly Auto schedule will be stored into the controllers.
- Onsite Critical alarms and events are sent by email /SMS to user given email ID or mobile nos.

Edit Mode:

The Remote-Control Centre will provide both functionality of what is known as Runtime Mode and Edit Mode (when changes to the runtime screens are needed).

B. Zonal Field Control Unit (ZFCU).

- The ZFCU will provide communication capabilities and interface between the Remote-Control Centre and Field Control unit which is on the site.
- The ZFCU will have the ability to perform "regular" Field Control Unit's functionalities, such as monitoring sensors or activating pumps, in addition to its ZFCU functionalities.
- As part of the Control Centre a front end (FEP) will be requested (HW and/or SW) enabling the communication between the Control Centre and the Field Control Units.
- The Control Centre will be able to interface with various software applications such as, weather stations, and other management SW packages.
- The Remote-Control Centre will be able to execute and support following features:
- Displaying the entire data of Field Control Unit such as, flow rate/accumulated flow, and total time of operation, balance time in the form of tables and graphical screens
- Displaying Field Control Unit's events and alarms and ability to report them utilizing SMS technology.
- Display the communication healthiness of field units.
- The user will be able to change valve operation timings, from the graphical screens
- The user will be able to operate valve from the graphical screens
- The user will be able to call the downloading and uploading data from the Field Control Units
- Remote-Control Centre will allow the quantity of water as per the Demand set by the operator.
- Remote-Control Centre will have a program to design and display an event report for each Reservoir in the water network.
- Remote-Control Centre will have a program to calculate the predicted flow load, over the hydraulic system.
- Remote-Control Centre will have a program for displaying sensors data historical trends and alarms.
- Remote-Control Centre will have an Off-Line program for the Field Units in addition to the current run-time unit's program.

C. Field Control Units (FCU)

- FCU will have Logic board incorporating microcontroller/microprocessor and data storage components.
- FCU will run on solar power or long-life lithium battery.
- FCU will be with I/O port required for on-site sensor connection. I/O boards may be expanded/ replaced on-site. These may be inputs such as water meters, reservoir level, pressure meters, or general digital inputs, or outputs such as valves, pump starts, general relays, etc.
- Communication Ports - enabling the Field Unit to communicate with the Remote-Control Centre, and/or each other, and on-site programming/diagnostic tool (such as laptop).

- FCU will be able to operate not only the local I/Os (on board I/O connections), but remote I/Os as well.
- FCU will be able to update the Remote-Control Centre database upon request (by the remote-Control Centre) or by exception. The Field Unit shall be able to report to the Remote-Control Centre every defined alarm which occurs in the field.
- FCU will be capable of functioning in a stand-alone mode (no Remote-Control Centre), as well as a part of a system with a Remote-Control Centre.
- FCU will be able to perform Store & Forward functionality - receive information from other sites, store it in memory, and then transmit (forward) the data to another site.
- FCU will be able to support both local I/O's and Remote I/O's modules. The remote I/O modules shall be equipped with radio technology, allowing the Field Unit full access and control, as if they are locally connected.
- FCU will be able to report by exception (known as burst) to the Control Centre upon any Change-of-State (COS)
- FCU will be equipped with a multi-tasking Operating System, specially designed for a real-time environment.

D. Radio/GPRS communication Network

- The Radio/GPRS communication network will be able to make the communication link between the Remote-Control Centre and Reservoir with conventional (865-867MHz licenses free) frequency or using GPRS network.
- The communication protocol will be able to support multiple logical channels per physical port, enabling simultaneous Central-to-Field Control Unit and Field Control Unit -to-Field Control Unit sessions.
- The communication protocol will be able to support the following messaging methods:
  - Burst (also known as Contention) - this is transmission upon change of state.
  - Polling (also known as Interrogation) - automatically or manually request for data updating.
  - Report by Exception - the unit shall only report data that have changed since the last poll

5.14.3.13 Closed Circuit Television System (CCTV)

CCTV System is proposed which will include the provision of CCTV Day/Night cameras, CCTV infra-red floodlights and control panel, video signals data servers and panel enclosure complete with router/hub, digital video recorders, surge and lightning protection devices. For this, necessary configuration, user licenses of any software for the System and associated equipment fittings and cabling necessary for the completion of the works are proposed. The CCTV will be configured on Operator Workstation. Essential software will be considered on the same.

Following areas are prepared and are to be covered under CCTV surveillance.

- Clear Water Pumping Station
- Recycle Water Pumping Station
- Clear Water Control Room

- Water Distribution Centers
- Central Control Room
- Panel rooms.
- Substations and Transformer yards
- Entrance gates
- Security cabins
- Major equipment areas

The CCTV camera shall be inside and outside the buildings mentioned above. Exact Locations and final quantities shall be decided during detail engineering.

Voice Communication

- Communication system will be between control room, machine hall floor, Powerhouse security room & switchyard through EPABX system with spare outlet. The main controller should be compatible with P&T system with a capacity for 2 P&T lines. The following items are provided:
- EPABX system
- Telephone instrument sets
- UPS for above system

5.14.3.14 Commissioning

Commissioning includes operating the equipment in a variety of modes and sequences to prove its satisfactory operation, prior to commencing the formal site inspection, testing and operation of the system

5.14.3.14.1 Site Acceptance Tests (SAT)

After installation and commissioning, the contractor shall demonstrate, by tests in the field, compliance of the values, functionalities, quality and reliability of the complete system and its components, both hardware and software, as specified and as per guarantees.

Contractor shall fully participate in interfacing to the equipment of others. It shall be Contractor's responsibility to ensure satisfactory functioning of the system in conjunction with related equipment like exchanges, data equipment and other communication equipment of the Owner. Problems relating to such interconnections has to be resolved.

After tests as above, the complete system shall be on continuous uninterrupted service with all functionalities and interconnections to Owner's equipment for 4 weeks without any failures or manual interventions for correction, modification.

5.14.3.15 Operation Manuals:

As part of the Installation Works and before beginning of the training, programmer, Executor/System Supplier will prepare and provide 6 copies of complete operating and maintenance instructions for the system, referring specifically to the Plant. The documents will also be presented on computer disk in Microsoft Office 2007/2021 Word or latest version available for Windows software format.

These manuals shall include the following information:

- Detailed descriptions of the Plant operation and control scheme.

- Manufacturer's original operation and maintenance procedures.
- Complete parts list for all items of the Plant.
- Recommended spare parts list.
- Detailed maintenance instructions for all items as necessary to maintain the items in good working order, including all step-by-step procedures for troubleshooting and fault correction.
- Detailed descriptions of the Plant operation and control scheme.
- Manufacturer's original operation and maintenance procedures.
- Complete parts list for all items of the Plant.
- Recommended spare parts list.
- Detailed maintenance instructions for all items as necessary to maintain the items in good working order, including all step-by-step procedures for troubleshooting and fault correction.
- Configuration of data base, reports, logs and screen displays.
- Data communication interface standards and protocols.
- FBD/Ladder and control loop flow diagrams.
- Programme user instruction for all software
- The system shall provide on line, complete user documentation, including examples of how to operate the various modules within the system.

5.14.3.16 Training

The Executor/system supplier will conduct training courses for personnel selected by the department. Training will be conducted by personnel employed by the Executor/ system supplier familiar with the system supplied and who have experience and training in developing and implementing instructional courses. The executor will arrange training for the department personnel for 5 days before the conduction of FAT. This training will be separate from the training for department (2 sessions of 5 days each) which shall be conducted during SAT.

The Executor/system supplier will submit information on the training program, prior to shipment of the equipment. This submittal shall include a course outline; time required, course schedule, sample workbook and instructor qualification for each level. The Executor/ system supplier will make a workbook on each course available to every person taking the courses listed herein. The workbook will be of sufficient details so that, at a later date, a trainee can review in detail the major topics of the course. The training times will be scheduled by the department in advance with the Executor/system supplier so as not to disrupt the department's ability to operate the plant.

Operations and Maintenance Training

Training will be provided for ten department personnel at the system supplier facility on operations and maintenance of all system components. The training program will be divided into two segments and will consist of at least five working days, each of 8 hours duration. The maintenance training program will be developed for personnel that have electronics maintenance and repair experience requirements and a general knowledge of computer systems.

As a minimum, the following subjects will be covered:

- System Architecture and Layout
- Hardware Components

- Module Switch Settings (Configuration Switches)
- I/O Modules
- Power Supplies
- Data Highway:
- Programmer connection
- IOP programming and diagnostic techniques
- Battery replacement and recharging
- PC and workstation familiarization and maintenance:
- Troubleshooting
- Disassembly
- Cleaning
- Component Replacement
- Re-assembly

The operation training program will include the following topics:

- Power-up, bootstrapping and shutdown of all hardware devices
- Interpretation of all standard displays
- Appropriate actions for software and hardware error occurrences
- Use of operator interface displays and keyboards
- Use of printer including replenishment of supplies
- Manual data entries
- Creation and editing of graphic operator display screens.
- Loading of any required software into the system
- Data base creation and editing.

After completion of the automation and actual plant operation starts working on PLC/SCADA System the concerned staffs likely to run the plant is required to be fully trained for the operating features and preventive maintenance aspects and preliminary trouble shooting methods of the system. This training at site will be of one-day duration which will be attended by 4 to 6 persons at various levels to be deputed by the Department. Additionally, it is considered to provide class room training of required duration (up to 7 days) for up to 2 persons of SMSS at PLC supplier's /Clients training centre within the country covering the selection & programming aspects of PLC /SCADA system.

6. WASTE WATER SYSTEM

6.1 Scope

The objectives of preparing an Underground Sewerage Scheme for Atal Puram Township Area are:

The contractor has to provide the entire Atal Puram Township Area with Piped Sewerage System with 12.0 MLD Capacity Sewage Treatment Plant Based on Sequencing Batch Reactor (SBR) Technology with successive Operation and Maintenance for the period of 5 years.

The Under Ground Sewerage Scheme would facilitate to prepare a workable or implementable plan for the Atal Puram Township Area. Total sewer laying work is to be done for a length of approximately 23.404 kilometres including Construction of around 800 Nos. of Manholes. **The number of Manholes is for reference only. The exact number of Manholes will be finalized as per approved design**

On all roads & lanes where dominant population exists, sewer laying is to be laid. Trunk mains are to be laid as per the suitable connectivity of Mains- Branches & laterals. Sewer lines are to be laid left /right side of the road as per the suitability, of available width of roads and ease of Household /property connectivity.

After treatment of sewage at STP, the effluent quality is proposed to be achieved to standards of CPHEEO and/ or NRCP norms & then it is to be recycled for further use for flushing water & horticulture demand and also discharged into natural nearby water body.

Sewage sump well is proposed to be constructed for 30 min detention period and the average sewage flow to be designed for the ultimate demand. Pumping units are proposed to be installed for the sewage flow for 15 years.

Sewage treatment plant is proposed on SBR technology.

The bidder should do Design, engineering, supply, construction, erection, hydraulic testing, commissioning of Sewage Pumping Station and commissioning of Sewage Treatment Plants of 11.44 MLD Capacity (including TPS) consisting of Inlet Chamber with bypass arrangements, Screen Chamber, Raw sewage Pumps, Grit Separator, Stilling Chamber and Reactors, Air Blowers, Blower room, Disinfection using ACF and DMF system, sludge pumps, Centrifuge, Administrative cum Laboratory building of area not less than 450 m2, necessary pumps and motors piping work, valves, gates, flow meters tools & Plants, Spare parts, effluent disposal system including pumping system (if required) etc, including provisions for storm water drains, wash water system, hydrants etc. as Complete work including all civil, mechanical, electrical and instrumentation and SCADA. The scope shall also include inlet & outlet arrangements and bypass arrangement controlled with sluice gates/valves, etc, complete including all taxes and duties, GST etc., complete as directed by Engineer in charge. The plant includes the civil, mechanical, electrical and instrumentation components as per proposed technology and scope of work and as per design based on sound engineering and established and prevalent norms. Sewage Network, Sewage Pumping Station & STP will have SCADA system so that whole plant can be operated from control room at one point and all relevant information is available in control room at any given point. The price shall also include cost of online Testing facility.

While designing STP, care has to be taken for reaching effluent standards as per the guidelines given in the CPHEEO manual and NRCP guideline.

The execution shall be done in two years' time period and after that operation and maintenance for 5 years with three 3 years DLP.

6.2 Approach & Methodology Adopted

6.2.1 Methodology

An integrated approach shall be taken to achieve economy in construction while designing the sewage system. The sewage collection system should be identified based on topography, physical boundary and household connectivity by sewer connection & adoptability of stakeholders. Underground Sewerage Scheme is to be designed considering the topography of the Atal Puram Townghip area. Sewerage project shall be done for ultimate demand of design and works are to be done accordingly. All civil works are to be designed for 30 years design period and all Electro Mechanical components are to be designed for 15 years and other for 30 years, renewal of equipment of various components proposed.

6.2.2 Process followed

Consideration of population projection of the Atal Puram Townghip Area is to be as per the approved Master Plan Worked out sewerage to be collected and disposed of for various stages if required.

Finished Levels should be taken from Road Design levels of Atal Puram Townghip Area

Designed various components from the scheme should be as per guidelines given in the manual on Sewerage and Sewage Treatment by CPHEEO, New Delhi / NRCP Guidelines.

6.2.3 Design Parameters/ Norms Adopted for Sewerage Scheme.

Sewerage design will be influenced by a number of factors, principal among these are the following:

- Topography
- Population Projections
- Spatial Population Distribution
- Water Supply in the Region

All designs should conform to the "Manual on Sewerage & Sewage Treatment - 2013", of Central Public Health and Environmental Engineering Organization (CPHEEO), Ministry of Urban Development, Government of India.

6.3 Stages of Sewerage System

There will be four stages in the entire sewerage system as follows.

- Collection of Sewage
- Transportation of Sewage
- Treatment of Sewage – Sewage Treatment Plant
- Effluent Disposal System

In general, the sewers will slope will be in the same direction as the roads, drains or natural ground surface and will be connected to trunk sewers. The discharge point may

be a treatment plant, a pumping station, or an intercepting sewer. In this case, final disposal point will be treatment plant.

Sewers are to be laid away from potable water supply and other utility lines as far as possible when such situations are unavoidable, sewers are to be encased in concrete or provided with sleeve pipes. Tees, chambers will be provided on sewer lines in order to avoid breaking the sewer for future connections.

CPHEEO Manual stipulates that generally 80% of the water supply may be expected to reach the sewers. However, sewers should be designed to approved population and water demand & waste water flow.

6.4 Design Period for Sewerage Components

The length of time up to which the capacity of a sewer will be adequate is referred as design period. In the sewer system, the flow is largely a function of population density and water consumption. The design period is different from planning horizon year. Table 1.1, CPHEEO Manual gives design period for different components of sewerage system and sewage treatment. (Reference: Table 2.1, Chapter -2, Page-2-9 of CPHEEO(Sewage) Manual, 2013

Table 6-1: Design Period for various components

Sl. No.	Component	Recommended Design Period (in years)	Remarks/ Clarifications
1	Sewer Network (Gravity Collection System)	30	The system will be designed for the prospective population.
2	Pumping Stations (Civil Works)	30	Duplicating machinery within the Pumping station would be easier/cost of Civil Works would be economical if executed once for full design period.
3	Pumping Machinery	15	Life of Pumping Machinery is considered as 15 years as per practice/guidelines.
4	Conveyance System	30	Provision will be kept for the entire design period
5	Sewage Treatment Plant (STP)	10	The plant will be designed ultimate demand.
6	Effluent Disposal System	30	Provision of full design capacities in the initial stage is economical.

6.4.1 Peak Factor – Carrying Capacity

As per CPHEEO manual, the Peak Factor or the ratio of maximum to average flows depends on the contributory population and the following values are recommended as. Table 3.2, Chapter -3, Page-3 of CPHEEO (Sewage Manual, 2013) which should be adopted.

Table 6-2: Peak factor

S. No.	Contributory Population	Peak factor
1	Up to 20,000	3.00
2	20,001 to 50,000	2.50
3	50,001 to 7,50,000	2.25
4	Above 7,50,000	2.00

6.4.2 Ground Water Infiltration

Some quantity of ground water or subsoil water may infiltrate into sewers through defective joints, broken pipes etc. This is significant when water table is high and head of ground water is more than the head of sewage in sewers. Some quantity of sewage may leak out from defective joints and defective pipes when head of sewage is more in sewers than head of ground water outside. Infiltration and leakage mainly depend on quality of construction and water table levels. Infiltration can be considered, vide Para 3.2.7 CPHEEO Manual stipulation (minimum - maximum) Reference: Table 3.3, Chapter -3, Page-4 of CPHEEO (Sewage Manual, 2013

Table 6-3: Infiltration Flow Considerations

Infiltration Condition	Units	Minimum	Maximum
Service Area	Litres/hectares	5,000	50,000
Pipe Length	Litres/ Kilometer/ day	500	5,000
Manholes	Litres/each/day	250	500

Once the flow is estimated as per the above criteria, the design infiltration value shall be limited to a Maximum of 10% of the design value of sewage flow.

6.4.3 Gravity - Flow:

For design purposes, the flow of sewage in pipes is presumed to be steady and uniform flow. The most popular equation for calculating the velocity and head loss for flow conditions in gravity sewers is Manning's formula for designs of gravity sewers.

For open channel flow, Manning's formula is used for designing slope and diameter of the sewer line to carry the design flow.

Table 6-4: Roughness Coefficient Considerations

Pipe Channel	Roughness Coefficient, n
Cement concrete, with collar joints, good	0.013
Cement concrete, with collar joints, fair	0.015
Concrete, spun with socket-spigot joints (RCC and PSC)	0.011
Steel, welded	0.013
Steel, riveted	0.017
Steel, slightly tuberculate	0.020
Steel, spun cement mortar lining	0.011
Ductile Iron, spun cement mortar lining	0.011
HDPE smooth/ DWC Pipes	0.010

6.4.4 Pipe Selection

The materials used extensively for sewerage in most Indian cities are glazed stoneware / vitrified clay and reinforced concrete pipes for gravity sewers whereas ductile iron pipes are employed for rising / force mains of pumping stations.

The contractor shall use Concrete pipes conforming to IS 458 of appropriate strength with proper anti-corrosive lining which may even last for about 50-60 years. Considering the capital cost, durability and availability of the pipes, RCC NP3 pipes bearing ISI mark with SRC (Sulphate Resistant Cement) lining will be used for 700mm and above diameter, whereas HDPE DWC (double wall corrugated) pipes of SN8 grade as per IS 16098 (Part 2) amended upto date to be used for below 700mm diameter.

6.4.5 Non-Silting or Self-Cleansing Velocity / Minimum Velocity

Sewage contains organic and inorganic matter. Therefore, if the velocity of flow in sewer is low, this solid matter is likely to settle down and deposited, thus blocking the flow. The minimum velocity required to prevent silting in sewer is called self-cleansing velocity. The velocity should be attained once a day or preferably twice a day to keep the sewer free from trouble of blocking.

Sewers have to be designed such that self-cleansing velocity is developed with minimum discharge. A velocity of 0.6 m/s would be required to transport sand particles of 0.09 mm size with a specific gravity of 2.65 vide Para 3.4.3 of CPHEEO Manual (Sewage) recommends a minimum velocity (self-cleansing velocity of 0.6 m/s, for present peak flow and 0.8 m/s at design peak flow for sanitary sewers).

6.4.6 Non-Scoring or Maximum Velocity

Erosion of sewer (bottom surface) is caused by sand and other gritty material deposited in the sewer accompanied by excessive Velocity. Velocity in a sewer desirably should not exceed 3 m/sec for RCC pipes and 1.5 m/sec for SW pipes at any time else it will cause erosion of bottom of pipe. Sewerage should not be introduced without ensuring adequate water supply. Reference: Table 3.3, Chapter -3, Page-4 of CPHEEO (Sewage Manual, 2013) Reference: Clause 3.15.5, Chapter -3, Page-28 of CPHEEO (Sewage Manual, 2013

6.4.7 d/D Ratio

All sewers will be designed to flow up to a maximum depth of 0.80 times (i.e. 80%) the internal diameter of sewer at ultimate peak flow (As per the CPHEEO Sewerage Manual) in order to ensure proper ventilation in sewers. However, such provisions will be simultaneously checked for self- cleansing velocity in present peak flow condition. (At d/D-0.8 max velocity will be achieved more than full supply. Similarly at d/D-0.95, the max discharge will be achieved more than full supply)

6.4.8 Minimum Size of Sewer Line

Minimum diameter for public sewer shall not be less than 150 mm (internal) except for sharply falling gradients. A minimum sewer size of 160 mm is therefore proposed to be adopted.

6.5 Construction Materials for Manholes

Manholes provide access to sewers for inspection and cleaning. They are normally provided at change in direction, change in pipe sizes, changes in gradient and at junction points.

6.5.1 Material of Construction

R.C.C. Circular Manhole shall be used.

6.5.2 Depth of Manholes

As per the prevailing topography, ground water table during proposed construction, antecedent Rainfall and other physical parameters etc. the maximum allowable depth for gravity flow sewers are restricted to a maximum allowable invert depth of up to 3.50m.

6.5.3 Precast Reinforced Cement Concrete (RCC) Manholes Proposed

Reinforced Cement Concrete (RCC) Manholes shall be used as per the IS Specification(s) as all manholes are having depth more than 1.5m.

6.5.4 Horizontal Separation

A Water/Sewer pipe line should be laid such that there is at least 3 meters' separation, horizontally from any existing or proposed drain or Water/sewer line. If local conditions prevent this lateral separation, a water main may be laid closer to a storm or sanitation sewer, provided that the main is laid in a separate trench, or on an undisturbed earth shelf located on one side of sewer at such an elevation that the bottom of the water main is at least 0.5 meters above the top of the sewer. (Note: It is formally followed only, the said separation should be maintained for safety, if both are laid side by side. In our case both are proposed along the side of different lane.

6.6 Proposed Sewage Pumping Well

6.6.1 Definition And Purpose

A pumping station is a component of the sanitary sewage collection system that conveys domestic and other suitable sewage to a sewage treatment facility. The need for pumping sewage arises when:

- The existing topography and required minimum sewer grades create deep sewers that have high construction costs. The sewage is raised and then conveyed by gravity.
- The sewage must be raised to get head for gravity flow through a sewage pumping well.
- Discharge outlets are below the level of the receiving body of water.
- An existing gravity system is not yet available. A pumping station will enable development and growth in accordance with the applicable Indian Standards Codes, CPHEEO Manual.

6.6.2 Engineering Factors

Total sewage flow generated, phasing of the development and design period of the proposed treatment plant;

1. Topography of the proposed development and pumping site;
2. Total energy consumption;
3. Groundwater depth and any possibility of infiltration; and
4. Environmental Factors
5. To meet requirements laid down by the regulatory authorities;
6. Aesthetic impression of the pumping station; and
7. Odor and mosquito nuisance, which affects property value, public health and well-being.

6.6.3 Design Criteria

6.6.3.1 General

The design of the pumping station must conform to the current Indian Standard, CPHEEO Manual, and all other related standards, codes and regulations, unless authorized and approved by the ADA and other approval authorities.

The following information is to be provided prior to the commissioning of any pumping station:

- Provide a pre-start health and safety review as per Central Pollution Control Board, UP Pollution Control Board/ UPPWD/ ADA and the Electrical Safety Code
- Provide a plastic laminate fact sheet on the pumping station, including lowest elevation, location of force main outlet to gravity system and bypass invert elevation. The fact sheet shall be a minimum size of 0.30Mtr.x 0.50Mtr.and mounted adjacent to the control panel.
- Provide a plastic laminate with process flow diagram indicating valves and key interlocks shall also be included.
- A separate information document providing firm design range for inflow rate, optimum inflow rate for station that they are designing to, estimated operating costs for the pumping station including HVAC, heating and odour control, estimated pump life, retention time, volume and drain time of the force main, life of pumping station and when next upgrade is required due to estimated projected flow, detention time in force main and odour potential considerations.

6.6.3.2 **Site Layout and Servicing**

Pumping stations and access to pumping stations are to be located above the 100 year flood limits unless approved otherwise by the ADA and/or UP Guideline and other regulatory agencies. The site shall have good vehicular access and maneuvering area, and minimize potential adverse environmental impacts. The facilities layout shall allow for future expansion, and comply with front, rear and side yard set backs according to the applicable zoning and site plan standard and requirements, and convenient location of portable generator.

Pump House construction shall be architecturally pleasing, in relation to approved by Engineer, and low maintenance. Permanent structures shall be masonry and/or concrete construction as approved by Engineer. Temporary structures, if any shall not be of wood frame construction. Cladding for temporary structures shall be of pre-formed FRP or pre-finished metal and include provisions to protect the building from vehicles.

Pump House insulation requirements, interior finish, and minimum interior building temperature shall be as directed by the EIC.

Pump House design, layout and construction materials shall be to the satisfaction of the EIC. Facility design and layout shall have regards to making confined space entry user friendly, optimizing sight and retrieval lines and comply with Indian Standard and/or CPHEEO regulation.

Landscaping of the site shall be low maintenance and architecturally pleasing, well-graded, minimal grass areas and landscaped to the satisfaction of the EIC. Site drainage shall not drain onto adjacent private property.

Fencing shall be 1.8m high masonry and/or concrete construction as approved by Engineer with lockable gates that are sized appropriately. Include warning and ADA address signage. Barbed wire fence shall be used as per Indian Standard, and as directed by the Engineer-in-charge.

Provide adequate exterior lighting of the pumping station facilities such as access, parking, provide security hardware and alarms for all exterior doors, windows and exterior equipment to the satisfaction of the Engineer-in-charge.

Exterior lighting may be controlled by motion sensor or photo-eye as directed by the Engineer-in-charge.

All control equipment and panels shall be indoors unless approved by the Engineer-in-charge.

All utility meters such as gas, hydro, water meter reader, shall be mounted on the exterior of the building.

Access to the site shall include provision for parking of maintenance vehicles and standby/emergency equipment. Roads shall be asphalt surfaced in parking and maneuvering areas and provide convenient removal and storage of snow, and turn around for trucks, tankers and heavy equipment.

All utilities including phone and computer communications servicing the site shall be underground unless authorized by the Engineer-in-charge. Design, installation and planning of services shall be according to requirements of applicable codes, regulations and the Indian Standard, CPHEEO, UP utility authority.

6.6.3.3 Structural

The pumping station shall be evaluated for uplift and resistance to all combined or single loadings considering soil conditions, ground water level, and frost action. Uplift shall be determined when the structure is completely empty and dry, free of equipment, roof slab removed, and the structure watertight. Design the base slab to withstand all earth loadings when the structure is completely filled to maximum level, roof slab on, and all equipment installed. Provide crane and hoist design including appropriately sized hatches for convenient pump and equipment removal.

Location of crane, hoist, and hatches, and arrangement of piping, pumps and equipment shall be such to facilitate ease of removal and installation of equipment.

6.6.3.4 Flow Capacity

The pumping station flow capacity shall be based on the peak hourly flow rate determined from the peak flow calculation as outlined in Section 4.0, SEWER DESIGN and consider low flow conditions, as approved by the Engineer-in-charge. The flow capacity of the pumping station should be able to maintain a desirable cleansing velocity of 0.9m/s with a minimum velocity of 0.60m/s, and a maximum velocity of 3.0m/s in all piping. The design of proposed pumping stations shall allow for future modification or expansion to meet the requirements of the tributary area of the pumping station.

6.6.3.5 Pumps

Multiple pumps shall be provided and sized to provide firm capacity. When two pumps are used, firm capacity shall be maintained by one and/or two pump(s) as approved by the Engineer and shall be of the same size.

When multiple pumps are used, firm capacity shall be maintained by the remaining pumps when the largest pump is out of service. The capacity of the largest pump will be equal to the required firm capacity. All pumps must undergo a hydrostatic and operating test performed by the manufacturer prior to installation.

All pumping stations that are required to handle screenings shall be designed to handle the screenings in a method that is in keeping with the low maintenance philosophy of the pollution control operation. Pumping stations shall be equipped with in-channel grinders upstream of pumps and shall be installed so that sewage flow by- passes the grinders through coarse screens in the event the grinders fail or require maintenance.

Pumps handling raw wastewater shall be capable of passing spheres of at least 76mm diameter. Pump suction and discharge openings shall be at least 150mm in diameter.

Pumps shall be positioned so that under normal operating conditions, they will operate under a positive suction head. When the pump is a suction-lift type, it shall be a self-priming or a vacuum-priming type pump.

Electrical equipment and components such as motors, lights, cables, conduits, switch boxes, control circuits, etc., shall comply with the IEC Safety Code, IS approved, and comply with the Indian/ Agra SCADA Standards.

Each pump shall have a separate intake. The configuration of the wet well and pump intakes shall prevent vortex formation and air locking.

Design a sump with two pumps in the dry well to remove leakage or drainage and discharge above the maximum high water level of the wet well. Provide dual check valves and gauges on discharge and suction lines for each sump pump. Do not connect water ejectors to a potable water supply. Provide drainage for all floor and walkway surfaces. Pump seal leakage is to be conveyed via appropriately sized channel/s complete with grating directly to the sump. Size the sump pump to convey the maximum pump seal water discharge that would occur in the event of a pump seal failure and provide necessary alarm activation. All sump pumps are to be submersible.

The pumps and controls of pumping stations, and pumping stations operated as part of treatment facilities, shall be selected to operate at varying delivery rates and designed to deliver as uniform a flow as practicable in order to minimize hydraulic surges.

The minimum efficiency, duty life, type and materials of construction for pump and impeller shall be approved by the Engineer-in-charge. Preferred voltage will be as approved by Engineer.

Dry pit submersible pumps are to be considered in areas susceptible to flooding.

Design all pumps must to prevent air locking.

6.6.3.6 **Channels**

Dual channels will be utilized and equipped to allow isolating and de-watering each unit. The channel invert shall be 150-200mm below the inlet of the sewer and the entrance to channels shall be designed for equal flow distribution. Design guards to protect maintenance personnel from equipment and drainage to prevent slippery floor areas.

6.6.3.7 Pump Controls

All controls shall comply with the Indian SCADA Standards

6.6.3.8 Valves and Fittings

Provide suitable shut off valves on the suction line of dry pit pumps. Pump suction lines should be designed using 90o short radius down-turned flared elbows; wall pipe shall be flanged with water stop collar; all valves including eccentric reducer shall be flanged; all flanges welded; minimum pipe size shall be 150mm diametere. All isolation valves shall be located inside chambers for access.

Shutoff and check valves with suitable guards are required on the discharge line of all pumps except screw type pumps. Locate check valves between the shut off valve and pump. Use appropriate check valves and install horizontally on the discharge piping. Ball checks may be installed vertically on the discharge pumping. All valves shall be capable of withstanding normal pressure and water hammer. All valves shall be operable from the floor level and be readily accessible for maintenance. Use outside levers for

swing check valves with suitable guarding. All valves, valve operators, fittings, concentric increasers, elbows, double branch elbows, and risers shall be flanged, all flanges welded. Spacers shall be 150-300mm long with one flanged end and one grooved end for Victaulic coupling.

Valves, check valves, drains, fittings and headers shall be of stainless steel, 316 or better, construction. Pipe materials shall be approved by the Engineer-in-charge. Identification including flow direction of all piping is required. Painting of non-stainless piping is also required.

Pump discharge to connect to main header pipe with a "Y" connection above the spring-line so that any gravel in the system doesn't flow back into the discharge pipe causing blocking of check valves.

6.6.3.9 Flow Measurement

Flow measurement devices are required for all pumping stations and properly located for accurate readings with valving and fittings for maintenance with minimum downtime. Flow monitoring equipment shall be able to determine and record rate of flow, duration, volumetric sum, and frequency for each pump and each bypass, and interface with Indian Standard SCADA requirements.

Provide a spool piece for each mag meter and provide a spool piece for each bypass as directed by the Engineer-in-charge. The spool piece depends on Force main location and wet well retention time. If it is determined that enough time is available to remove the Force main and install a spool piece safely, then a Force main by-pass would not be required.

6.6.3.10 **Wet Wells**

All pumping stations with a capacity greater than 125 cum/hr capacity shall have divided wet wells that are properly interconnected. The wet well shall have provisions such as a shear or sluice gate or valve to facilitate continuous operation during maintenance and to allow dewatering of one portion of the wet well.

The volume of the wet well shall be based on the design average flow with a filling time of a minimum of 30 minutes between the firm capacity start and by-pass. When the wet well is designed for flow equalization, provisions to prevent septicity shall be included. Factors to consider when determining the size are: the volume required for pump cycling based on the pump manufacturer's duty cycle recommendations; appropriate dimensions to minimize turbulence; vertical separation between pump control points; sewer inlet elevation; capacity required between alarm levels, basement flooding and overflow elevations; and the number, spacing and size of pumps. The high-water level shall be set 300mm below the invert of the inlet sewer and the low water level shall be 300mm minimum or twice the pump suction diameter above the centre line of the pump volute. The wet well floor shall have adequate slope to the intake hopper and the horizontal area of the hopper shall be kept to a minimum.

Provision for air displacement in wet wells shall be made by natural means consisting of 0.10% of the well cross-sectional area, or a minimum two 100mm diameter inverted "j" or gooseneck pipes with insect screens extending 900mm above finished grade. One vent pipe should extend to within 300mm above the obvert of the inlet sewer. The other vent pipe should extend to the underside of the wet well roof slab.

Wet wells are to be designed to be self-cleaning and to minimize grit accumulation.

6.6.3.11 **Heating and Ventilation**

Adequate ventilation, as per National Building Code and Indian Standard shall be provided for all pumping stations. Underground dry wells and wet wells with screens or mechanical equipment require mechanical ventilation. The ventilating fan should be orientated to direct fresh air into the wet well at a point 900mm above the alarm level rather than just exhaust from the wet well. Interconnection between the wet well and dry well is not allowed and vents shall not open or be connected to any building ventilation system. Where continuous ventilation is required, air shall be pre-heated. Consideration for the installation of air scrubbers shall be made as directed by the Engineer-in-charge.

For dry wells, over 4.6m deep, multiple air inlets and outlets should be used. Dampers, fine screens or other obstructions are not to be used on exhaust or fresh air ducts.

Switches and controls to operate ventilation equipment shall be conveniently located and marked. All intermittently operated ventilation equipment shall be interconnected with the respective lighting system. Consideration should also be given to automatic controls where intermittent operation is used. The manual lighting and ventilation switch shall override the automatic controls.

The fan blades shall be fabricated from non-sparking material. Automatic heating and dehumidification equipment shall be designed for all dry wells. The electrical equipment and components shall meet the requirements for electrical equipment in Section 4.3.5.

Wet well ventilation may be either continuous or intermittent. Continuous or intermittent ventilation shall meet or exceed the number of complete air changes per hour as required by CPHEEO Sewage Manual, recent copy. Air shall be forced into the wet well by mechanical means rather than solely exhausted from the wet well. The air change requirements shall be based on 100 percent fresh air. When permanent ventilation equipment is not practical, portable ventilation equipment shall be designed for use at submersible pump stations and wet wells.

Dry well ventilation may be either continuous or intermittent. Continuous or intermittent ventilation shall meet or exceed the number of complete air changes per hour as required by Indian Standard. A two-speed ventilation system may be used to conserve heat. The air change requirements are based on 100 percent fresh air.

Locate the fan switch for ventilation equipment to the satisfaction of the Engineer-in-charge.

An engineered heat recovery system that considers energy efficiency and recovery is to be designed where:

- there is a requirement for100% fresh air into a space within a pumping station
- an air scrubber system is required for wet well odour control

Engineering designs should consider potential for a heat recovery system in the sewage wet well such as a glycol recovery system to capture and return heat to the station.

6.6.3.12 **Water Supply**

Water supply shall be potable. Water supply shall be equipped with back-flow preventers to prevent contamination of the water system and all plumbing shall conform to the National Building Code.

6.6.3.13 **Access**

Access shall consider the National Boiling Code and ADA/ UP Building policy. Provision shall be made to facilitate easy and efficient removal of pumps, motors, and other mechanical and electrical equipment. A suitable and safe means of access for persons wearing self-contained breathing apparatus shall be provided to wet and dry wells and valve chambers.

Stairs shall be provided for vertical heights greater than 1.2 metres. Maximum vertical distance between work platforms and landings shall be 3 metres. Safety landings shall be constructed as work platforms.

Equipment such as access hatches, ladders, service platforms, guards, grates and handrails, shall be constructed of a suitable material when exposed to wet/and or corrosive conditions.

6.6.4 Suction-Lift Pump Stations

Suction lift pumps shall also meet the applicable design requirements of Section 4.3 above.

Suction-lift pumps shall be of the self-priming or vacuum-priming type. Suction-lift pump stations using dynamic suction lifts exceeding the limits outlined in the following sections may be approved upon submission of factory certification of pump performance and detailed calculations indicating satisfactory performance under the proposed operating conditions. Such detailed calculations must include static suction- lift as measured from "lead pump off" elevation to centerline of pump suction, friction, and other hydraulic losses of the suction piping, vapor pressure of the liquid, altitude correction, required net positive suction head, and a safety factor of at least 1.8 m.

Self-priming pumps shall be capable of rapid priming and re-priming at the "lead pump on" elevation. Such self-priming and re-priming shall be accomplished automatically under design operating conditions. Suction piping should not exceed the size of the pump suction and shall not exceed 8.6 m in total length. Priming lift at the "lead pump on" elevation shall include a safety factor of at least 1.5 m from the maximum allowable priming lift for the specific equipment at design operating conditions. The combined total of dynamic suction-lift at the "pump off" elevation and required net positive suction head at design operating conditions shall not exceed 7.5 m.

Vacuum-priming pump stations shall be equipped with dual vacuum pumps capable of removing air from the suction-lift pump automatically and completely. The vacuum pumps shall be adequately protected from damage due to wastewater. The combined total of dynamic suction-lift at the "pump off" elevation and required net positive suction head at design operating conditions shall not exceed 7.5 m.

The pump equipment compartment shall be above grade or offset and shall be effectively isolated from the wet well to prevent a hazardous and corrosive sewer atmosphere from entering the equipment compartment. Wet well access shall not be through the equipment compartment and shall be at least 1m by 1m clear opening with spring-loaded, shock assist hatches. Gasketted replacement plates shall be provided to cover the opening to the wet well for pump units removed for servicing. Valving shall not be located in the wet well.

6.6.5 Submersible Pump Stations

Submersible pumps shall meet the applicable requirements under Section 4.3, except as modified in this Section.

Submersible pumps and motors shall be designed specifically for raw wastewater use, including totally submerged operation during a portion of each pumping cycle and shall meet the requirements of the Indian Electrical Safety Code for such units. An effective method to detect shaft seal failure or potential seal failure shall be provided.

Submersible pumping stations shall be designed so that pumps are readily removable and replaceable without dewatering the wet well or disconnecting any piping in the wet well. Location of crane, hoist, and hatches, and arrangement of piping, pumps and equipment shall be such to facilitate ease of removal and installation of equipment.

Electrical supply, control, and alarm circuits shall be designed to provide strain relief and to allow disconnection from outside the wet well. Terminals and connectors shall be outside the wet well. Controls shall be designed in accordance with Indian SCADA Standards.

The motor control center shall be located outside the wet well, be readily accessible, and be protected by a conduit seal or other appropriate measures meeting the

requirements of the Indian Electrical Safety Code, to prevent the atmosphere of the wet well from gaining access to the control center. The seal shall be so located that the motor may be removed and electrically disconnected without disturbing the seal.

Pump motor power cords shall be designed for flexibility and serviceability under conditions of extra hard usage. They shall meet the requirements of the Indian Electrical Safety Code standards for flexible cords in wastewater pump stations. Ground-fault interruption protection shall be used to de-energize the circuit in the event of any failure in the electrical integrity of the cable. Power cord terminal-fittings shall be corrosion resistant and constructed in a manner to prevent the entry of moisture into the cable. They shall also be provided with strain relief appurtenances and be designed to facilitate field connecting.

Valves required shall be located in a separate valve chamber. Provisions shall be made to remove or drain accumulated water from the valve chamber. The valve chamber may be dewatered to the wet well through a drain line with a gas and watertight valve. Check valves that are integral to the pump need not be located in a separate valve chamber if the valve can be removed from the wet well in a convenient and efficient manner.

Separate valve chambers shall be insulated and heated to prevent freezing.

6.6.6 Alarm and Monitoring Systems

Pumping station alarms and equipment shall comply with the pumping station control philosophy as described in the Indian Standard SCADA Standards.

Integration into the SCADA system is to be complete by Agra Smart City forces. This includes PLC programming and operator interface all as per the current applicable charge-out rates.

6.6.7 Emergency Operation

The objective of emergency operation is to prevent the discharge of raw or partially treated wastewater to any waters and to protect public health by preventing back up of

wastewater. Pumping stations shall be designed to provide temporary pumping around the station and enable isolation of the Force main and pumping station, by means of isolation valves inside and outside the pumping station.

6.6.7.1 Emergency Power

Emergency power is required for all pumping stations. There shall be sufficient capacity of emergency power to start up and maintain the total confirmed pumping station capacity of the station, the SCADA system and all other electrical equipment for 24 hours, unless otherwise approved by the Engineer-in-charge.

All pumping stations shall be equipped with an onsite generator. A genset plug compatible with existing City generators may be installed as directed by the Engineer-in-charge.

Generators shall be capable of running full station load powered by natural gas or diesel as directed by the Engineer-in-charge. The design of generators shall meet all applicable regulations.

6.6.7.2 Instructions and Equipment

Wastewater pumping stations and portable equipment shall be supplied with a minimum of five complete sets of operational instructions, including emergency procedures, maintenance schedules (1 Consultant, 2 Operations, 1 pumping station, 1 Wastewater Division), and such tools and spare parts as may be necessary. The consultant will ensure that this documentation will be provided along with the necessary training for operation and maintenance of the equipment prior to commissioning.

6.6.8 Force Mains

At design pumping rates, a desired cleansing velocity of at least 0.90 m/s) shall be maintained. The minimum force main diameter for raw wastewater shall not be less than 150 mm.

An air relief valve shall be at high points in the force main to prevent air locking. Vacuum relief valves may be necessary to relieve negative pressures on force mains. The force main configuration and head conditions should be evaluated as to the need for and placement of vacuum relief valves. Fittings and isolation valves shall be stainless steel.

Force main design shall include transient analysis and consider the provision of water hammer relief.

Force mains should enter the gravity sewer system at a point not more than 200 mm above the flow line of the receiving maintenance hole.

Pipe and joints shall be equal to water main strength materials suitable for design conditions. The force main, reaction blocking, and station piping shall be designed to withstand water hammer pressures and associated cyclic reversal of stresses that are expected with the cycling of wastewater lift stations. The need for surge protection chambers shall be evaluated. Force main pipe materials shall be approved by the Engineer-in-charge.

Force main construction near streams or water works structures and at water main crossings shall meet applicable CPCB requirements.

Friction losses through force mains shall be based on the Hazen and Williams's formula or other acceptable methods. When the Hazen and Williams formula is used, the following value for "C" shall be used regardless of pipe material:

Pipe Diameter	C-Factor
150mm	100
200-250mm	110
300-600mm	120
Over 600mm	130

When initially installed, force mains may have a significantly higher "C" factor.

Force main shall be tested to ensure there is no leakage. Specify method of testing.

6.6.9 Safety

The design of the pumping station shall give due regard to safety for the protection of maintenance personnel and visitors from hazards:

a) Enclose the station site with 1.8m Masonry & Concrete Boundary Wall, lockable gates, designed to discourage entry by unauthorized persons and animals; provide safety, unauthorized entry and municipal address signage, as per City standards;
b) Handrails and guards are to be installed around tanks, trenches, pits, stairwells, and other hazardous areas;
c) Gratings are to be installed over areas where access for maintenance is required;
d) Confined space entry shall comply with the Pollution Control Operation and UPPCB regulations. Facility design and layout shall have due regard to make confined space entry user friendly, optimizing sight and retrieval lines;
e) All personnel must be trained to operate and maintain pumping station equipment and facilities to the satisfaction of the Pollution Control Operation;
f) Gas detection and monitoring equipment where required. Where gas alarms are provided, install an indicator light outside the building so that the operator can check gas levels before entering the building
g) Portable ventilation and blower equipment, intrinsically safe, with sufficient hose, where required;
h) Portable lighting equipment intrinsically safe, where required;
i) Appropriately placed warning signs for slippery areas, non-potable water fixtures, low head clearance, open service maintenance holes, hazardous material storage areas, flammable fuel storage areas, etc.;
j) Adequate ventilation in pumping chambers;
k) Provisions for lockout and tag-out of mechanical and electrical equipment;
l) Eyewash fountains and safety showers were required;
m) Fire extinguishers and emergency lighting.

6.6.10 Sediment & Erosion Control

The Agra Development Authority requires an Erosion Sediment Control Plan (ESCP) be designed for most Capital Works, Operational and Development Projects. The complexity of the ESCP is determined by the sensitivity of the area that is to be protected.

6.6.11 Design Criteria for Mechanical Works

The following factors are considered in the selection of technology for sewage pumping well.

6.6.12 Pumping Stations Mechanical

6.6.12.1 General

This subsection covers general requirements of mechanical works for sewage pumping stations. All valves, DI and/or MS pipes and specials used in the pumping stations shall conform to the specifications laid down below. The design criteria, material specifications, workmanship and testing of materials used for all civil works shall confirm to provisions laid down. Pre-dispatch inspection, pre-commissioning tests, commissioning and trial runs shall be done by the Contractor by his own cost. Cost for all the shop tests and/or Pre-dispatch inspection to be borne by the Contractor. During these tests (shop tests and/or Pre-dispatch inspection) ADA Officials and PMC Team will also accompanied.

- All the Materials used shall confirm to the relevant BIS and should be delivered at site of work. The Contractor is responsible for safe custody of machinery and other equipments under this contract till handing over to the employer.
- The rates should include all the minor items of civil works, if any required for installation complete.
- All necessary civil works for erection of all equipments and accessories offered by the contractor under this contract should be done by the contractor
- Test certificates for machinery and equipments should produced along with supply
- The bidder should enclose the performance curve duly indicating the duty point for the size of the impeller selected (family curve should not be furnished). The Performance curve should furnish complete range of operation and the curve should be authenticated by the manufacturer or his authorized dealer. In the event of non compliance the offer shall be summarily rejected.
- The contractor shall make necessary arrangements to get supply of electricity from RELIANCE ENERGY for operating the machinery and equipment. Necessary payment to be made to the EB shall be borne by the employer
- Before supply of machinery, equipments and other accessories prior approval of the Engineer should be obtained giving the name of makes and other details required.
- Obtaining approval of electrical layout diagram for the installation of all the equipments (transformers, generators, pump sets and other accessories) and obtaining safety certificates on completion of work from competent state electrical authority should be arranged and got approved by the contractor at his cost.
- All the materials should be supplied as per ADA approved design and should be of ADA approved makes mentioned below:-

Sr. No.	Description	Make
1	Submersible Pump non clog	
2	Make of Motor	
3	Make of Transformer	
4	Diesel Generator	
5	Starter	
6	Switch Fuse and circuit breaker	
7	Cables	
8	Valves	

- The right of choosing the make among the makes offered by the contractors rest with the ADA only

- The submersible pumps centrifugal pumps, turbine pumps, submersible motors, motors for turbine and centrifugal pumpset transformer, generators, Panel Boards, to be supplied by the firm will be inspected by the Inspecting Agency fixed by the Employer at the manufacturers premises and test certificate will be issued. The contractor should make necessary arrangements for the inspecting staff at his own cost for testing the above pumpsets.
- If the complete plant or any portion thereof is found to be defective the Engineer shall give the contractor a notice in writing to verify such defects. If the contractor fails to rectify the defects within the specified period the Engineer will rectify the defects at the contractor's risk and cost.

6.6.12.2 **Submersible Sewage pump**

Non clog submersible pump set

The submersible sewage pump shall be of non-clog design. It shall be suitable for pumping raw unscreened sewage containing sludge, long fibers, plastic pieces, cigarette butts, etc. The pump shall be able to pass through soft solids of minimum 100 mm dia and capable of dealing with sewage / sludge with specific gravity of 1.05. Pumps shall be of 960 rpm for high duty pump and 960/1450 rpm for low duty pumpsets, efficiency of the pumpset 60/75 for Low/High duty.

Impellers shall be of single / double vane non-clog design. Additionally, a special contra-block cutting and tearing system should also be incorporated on the suction side of the pump for disposing off soft material which would otherwise clog the pump.

Maintenance free antifriction, permanently grease filled ball bearing shall be provided and this shall take care of all the axial and radial forces at any point of operation. The weights of the revolving parts of the pumps including the unbalanced hydraulic thrusts of the impellers shall be carried by thrust bearings provided in each pump assembly.

The pump installation design shall be such as to facilitates automatic installation and removal of the pump without having to enter into the sewage pit. Profile gasket shall be provided in automatic coupling system so to avoid metal to metal contact between the pump and delivery bend to ensure leak-proof joint.

I. Pump Construction

a. Pump Casing

Pump casing shall be of CI as per IS 210 Gr FG 200 with 2.0% to 3.0% nickel. The internal surfaces shall be free of rough spots. The casing shall have centre line discharge.

The high-capacity pumps at New Pump house shall work in parallel two at a time to discharge peak flow. Third pump will be stand by.

b. Impellers

Impellers shall be of stainless steel (CF8M) construction. Impeller shall be of single/double vane non clog design. Additionally, a special contra-block cutting and tearing system should also be incorporated on the suction side of the pump for disposing off soft material which would otherwise clog the pump.

c. Pump Shaft

The pump shaft shall be of stainless steel (SS-410) as per manufacturer's standard. The shaft shall be of one piece construction.

d. Pump Bearings

Pump bearings shall be of the antifriction type. The bearings shall be able to take normal thrust loads due to unbalanced hydraulic loads on the impellers plus the weight of all rotating parts of the pumps. Pump bearings shall be designed with a minimum life of 40,000 hours. The bearings shall be grease lubricated for life, and shall be maintenance free.

e. Guide Rail Assembly

The assembly shall have CI pedestal, bracket, delivery bend, MS Galvanised guide rail pipe of 50 mm NB of Class C, upper guide rail holder, etc. The pedestal and bracket shall provide automatic coupling between pump delivery flange and discharge bend (standard bend / duck foot bend). Alternatively, the guide system can be with wire rope and pedestal cast integrated with discharge bend.

f. Mechanical Seals

Double mechanical seal shall be provided to prevent pumped liquid entering into the motor winding. The seal shall be situated in oil chamber to ensure proper lubrication. The seals shall be fail proof at the depth of submergence involved in each case.

The face combination of lower mechanical seal shall be silicon carbide. Vs. Silicon Carbide and upper mechanical seal shall be Carbon Vs Chrome Steel.

g. Moisture Sensor

Moisture sensor (seal monitor) shall be provided in the oil chamber to detect the failure of the mechanical seal.

The sensor will trip the pump-motor in the event of ingress of moisture into the oil chamber.

h. Lifting Chain

Each pump shall be provided with carbon steel lifting chain of adequate strength. The chain shall have rings of same size, fixed at an interval of about 1M for engaging the hook of the chain pulley block.

i. Foundation Nuts and Bolts

- foundation nuts and bolts shall be provided
- Protective Coating
  - The pumps shall be epoxy painted

j. Pump Balance

All rotating parts shall be statically and dynamically balanced as per the relevant standards

k. Submersible Motor

Motor shall have integral cable entry port and cable entry shall be properly sealed. It shall have provision for preventing reverse rotation.

Each phase of the motors shall be provided with thermic switches with bimetallic electromechanical temperature detectors. The motor shall operate satisfactorily at all operating levels in wet well.

Motor shall be sealed against entry of liquid being pumped by using two mechanical seals.

l. Submersible Motor Cable

Each pump shall be provided with submersible cables as per approved design and/or as specified in BOQ both for power and control cables.

m. Special Condition

The tender should also furnish the list of authorised dealers for the supply of spares for submersible pumps and list of ADA/ Govt. of UP authorised workshops for carry out repairs to the submersible pumps along with the address while tendering.

The submersible pumps shall be suitable for pumping contaminated effluents, industrial waste water, storm water, sewage etc.

The pump shall be vertical spindle type, having duties as specified below. The pumps shall be capable of handling 100 mm size solids. The impeller shall be non-clog and semi-open type. Double mechanical seals shall be provided. Pump sets shall have double bearing between pump and motor. Pumps shall be provided with automatic coupling device and all necessary fixings for guiding the pumps during lifting/lowering. The pump shall not exceed 960rpm. Casing shall be of cast iron with 2%-3% nickel Impeller: SSCF8M, shaft SSAISI 410. Guide rail system – CI/SGI. Motor to be of appropriate rating for the proposed pump duty. Submersible squirrel cage induction motor suitable for coupling with the pump without overload conforming to specifications. Starting current shall not exceed 200% of rated full load current. Protection against increase in stator winding temperature (155 deg C) shall be provided.

Class of insulation shall be F. The degree of protection shall be IP68 as per IS 4691. Motors shall be suitable for continuous operation in fully submerged condition. The motor shall be supplied wit 25 metres of round submersible pre-insulated copper cable of appropriate capacity. The pumpset shall be supplied with guide rail system with guide pipe of length suitable to the system, duck foot elbow suitable for delivery nozzle and nonreturn valve, dismantling joint etc. Including control panel with automatic start and automatic stop controlled by sewage levels in the suction well. Manual control shall also be provided. Painting may be done as per relevant Bureau of Indian Standard Specifications.

6.6.13 Technical Specification for Non-Clog

Submersible Grit Pump

6.6.13.1 General

The submersible grit pump shall be non-clog design. It shall be provided with agitator connected to the extended shaft to keep the silt in suspension. Pump shall be suitable to handle silt particles with specific gravity of 1.05. For ease installation, pump shall be provided with skirt base arrangement Submersible Motors have to be designed with maximum factor of safety to ensure non-overloading, while handling silt particles. Impellers shall be of single/double vane non-clog design. Additionally, a special contra-block cutting and tearing system should also be incorporated on the suction

side of the pump for disposing off soft material, which would otherwise clog the pump. Maintenance free antifriction, permanently grease filled ball bearings shall be provided and this shall take care of all the axial and radial forces at any point of operation. The weights of the revolving parts of the pumps including the unbalanced hydraulic thrusts of the impellers shall be carried by thrust bearings provided in each pump assembly. The reverse rotation prevention system shall be incorporated in the pump design to ensure that the pump does not start rotating in the reverse direction due to wrong electrical connection.

6.6.13.2 **Pump Construction:**

a) Pump Casing:

Pump casing shall be of CI as per IS 210 Gr FG 200 with 2.3% Nickel the pump casing shall have protective coating from corrosion. The internal surfaces shall be free of rough spots. The casing shall have centreline discharge.

b) Impellers:

Impellers shall be of Stainless Steel (CF8M) construction. Impellers shall be of single/double vane Semi-open non-clog design. Additionally, a special contra-block cutting and tearing system should also be incorporated on the suction side of the pump for disposing off soft material, which would otherwise clog the pump.

c) Pump Shaft:

The pump shaft shall be of stainless steel (SS 410) as per manufacturers standard. The shaft shall be of single piece construction.

d) Pump Bearing:

Pump bearings shall be of the antifriction type. The bearings shall be able to take normal thrust loads due to unbalanced hydraulic loads on the impellers plus the weight of all rotating parts of the pumps. Pump bearings shall be designed with a minimum life of 80,000 hours. The bearings shall be grease lubricated for life, and shall be maintenance free.

e) Mechanical Seals:

Double mechanical seal shall be provided to prevent pumped liquid entering into the motor winding. The seal shall be situated in oil chamber to ensure proper lubrication. The face combination of lower mechanical seal shall be Silicon Carbide Vs Silicon Carbide and upper mechanical seal shall be Carbon Vs Chrome Steel.

f) Moisture Sensor:

Moisture sensor (seal monitor) shall be provided in the oil chamber to detect the failure of the mechanical seal. The sensor will trip the pump-motor in the event of ingress of moisture into the oil chamber.

g) Lifting chain:

Each pump shall be provided with carbon steel lifting chain of adequate strength. The chain shall have rings of same sizes as chain, fixed at an interval of about 1M for engaging the hook of the chain pulley block.

h) Submersible Motor

The submersible motor shall be dry, squirrel cage type, suitable for three phase supply, continuous duty, with class ‘F’ insulation. Winding of the motor shall be impregnated by resin. Motor shall have integral cable entry port and cable entry shall be properly sealed.

The pump motor may often require starting after intermittent clogging. The motor should therefore incorporate aluminum die cast rotors only to ensure better

starting torque characteristics. The enclosure for motor shall be IP-68. Each phase of the motors shall be provided with Thermic switches or bimetallic electromechanical temperature detectors. The motor shall operate satisfactorily at all operating levels in wet well. Motor shall be sealed against entry of liquid being pumped by using two Mechanical seals.

6.6.14 Motor

6.6.14.1 Type of Motors

The motors (suitable for submersible pump) shall be 415V AC squirrel cage induction motor with drip proof screen protected continuous rating. The motor shall be capable of working in the range of (380-440V) 3 phase 50 cycles at the speed of minimum 1500 RPM.

6.6.14.2 Output of Motors

The motor shall be capable of developing the mechanical output for the required conditions, shall have continuous normal rating to suit the maximum load when operated at the pump speed. The efficiency and power factor shall be to start the wide range of load conditions and shall be designed and manufactured in accordance with relevant BIS.
The motor HP shall be such that is should safely take the load when the total head is reduced by the rise of water level in rived during flood conditions in the rives. The HP of motor of offered shall have a margin 10% above the BHP absorbed by the pumpset at duty point and also above the maximum HP absorbed by the pump offered.

6.6.14.3 Spare Parts

Supply of spares and tools shall be made as per the list prescribed in ADA's approved design with index card.
TOOLS
Standard tools for the maintenance of the equipments shall be supplied as detailed.

D/E spanners 6mm to 32mm	1 No Best Quality as approved by Engineer
Ring spanners 6mm to 32mm	1 No Best Quality as approved by Engineer
6 inches chain wrench	1 No Best Quality as approved by Engineer
24 inches Pipe wrench	1 No Best Quality as approved by Engineer
200 mm insulated cutting plier	1 No Best Quality as approved by Engineer
Hacksaw frame with blade	1 No Best Quality as approved by Engineer
Crow bar 5 feet	1 No Best Quality as approved by Engineer
Grease gun Liver type	1 No Best Quality as approved by Engineer
Ball peen hammers	1 No Best Quality as approved by Engineer
Screw Drivers 200,300,400 mm	1 No Best Quality as approved by Engineer
Electrical tester	1 No Best Quality as approved by Engineer

6.6.14.4 Dewatering / Drain Pumps

The capacity of the dewatering pumps at intake and clear water pumping station shall be 50 cum/hr minimum. The capacity of the drain pump for clear water pumping plant shall be 5 cum/hr minimum.
The pumps shall be electric motor driven. The pumps shall be vertical, centrifugal, non-clog type. The impeller shall be mounted on the extended shaft of the motor.
The pump motor shall be suitable for working with or without submergence in water. The motor rating shall be more than the maximum power required by the pump from shut off to run out.
Dewatering pumps shall be with flexible delivery piping of minimum 100 mm size.
A common delivery pipe of minimum 50 mm size, as per IS 1239, is to be provided for a set of drain pumps.
Each drain pump shall be provided with a standby.
Acceptable indigenous makes are ABS Pumps, KSB Pumps Ltd., Kirloskar Brothers Ltd., or equivalent, as approved by the Engineer.

Drawings and information to be provided by Contractor

- **Pump data sheets and performance curves**
- **Leaflets/ manufacturer's literature of pumps**

6.6.14.5 Backwash, Cooling Water and Lubricating Water Pumps

The Contractor shall work out the pump parameters for the above pumps. Pump capacity shall be at least 10% more than the calculated figure.

6.6.14.6 Inspection Requirements

All pumps shall be assembled in the shop to ensure correct fitting of all parts and shall be match marked before shipment.
Impeller and pump rotating assembly shall be dynamically balanced as per ISO 1940 / Gr. 6.3 / VDI 2060.
Pump casings shall be subject to hydrostatic pressure testing as an assembly at 150% of the pump shut- off head or 200% of the pump rated head, whichever is higher. The hydrostatic pressure shall be held for not less than 30 minutes after all leaks have been stopped between attachments.
Standard running test shall be conducted at manufacturer's works to measure the capacity, total head, efficiency and power. These tests shall form the basis for pump acceptance except for vibration and noise. The pumps shall be tested over a range comprising shut off head to maximum flow. Minimum seven readings approximately equidistant shall be taken for plotting the performance curve. The following formula shall be taken for computing the pump efficiency:

6.7 Classification of Sewage Treatment Plants

When characteristics of raw wastewater, the intended use and quality of receiving waters and their assimilative capacity are known, extent or degree of treatment needed for the wastewaters (sewage) can be determined.

6.8 Proposed Sewerage Treatment System

6.8.1 Design Criteria

The following factors are considered in the selection of technology for sewage treatment.

6.8.2 Engineering Factors

Total sewage flow generated, phasing of the development and design period of the proposed treatment plant;

1. Topography of the proposed development and STP site;
2. Total energy consumption;
3. Groundwater depth and any possibility of infiltration; and
4. Possibility of recycling wastewater for non-potable purposes.
5. Environmental Factors
6. To meet requirements laid down by the regulatory authorities for effluent discharge standards;
7. Aesthetic impression of the STP; and
8. Odor and mosquito nuisance, which affects property value, public health and well-being.

6.8.3 Process Considerations

1. Wastewater flow and characteristics;
2. Degree of treatment required;
3. Re use efficiency;
4. Performance characteristics;
5. Availability of land, power requirements, equipment's and manpower skills;
6. Cost considerations;
7. Capital cost required for land, construction and equipment etc.
8. Operating costs including staff, chemicals, fuel, electricity, transport, maintenance etc.

The design of Sewerage system is based on CPHEEO's "Manual on Sewerage & Sewage Treatment - 2013". The design norms of sewerage systems are as follows.

6.8.4 Design Parameters

6.8.4.1 Effluent Standards

Effluent Standards prescribed by Ministry of Environment, Government of India are given below: Reference: Page No. 3 & 4, Ministry of Environment, Forest & Climate Change Notification, New Delhi dated 13th October, 2017

Table 6-5: Effluent Standards prescribed by Ministry of Environment, Government of India

Parameter	Unit	Effluent Standards for Discharge into WaterBodies		Effluent Standards for Discharge on Land
		Existing Standards	Standards Revised on3.02.2010	
PH		5.5 – 9.0		
BOD	mg/L	30	20	100
TSS	mg/L	50	30	200
Faecal	MPN/100	Desirable – 1,000		Desirable – 1,000
Coliforms	ml	Permissible – 10,000		Permissible – 10,000

6.8.5 Sewage Treatment Plant (STP)

The design of the proposed Sewage Treatment Plant is to be under process based on the following criteria:

1. Amount of Sewage generated based on a standard rate of water consumption and infiltration;
2. Temperature and Altitude of the project area;
3. Influent wastewater Characteristics;
4. Pre-treatment (usually required for industrial grade wastewater that may be discharged into the domestic sewerage system);
5. Applicable pollution control standards and regulations for effluent quality, treated wastewater discharge and solid waste management (sludge disposal);
6. Availability of land;
7. Availability of skilled manpower to operate the STP;
8. Availability of Capital and O&M funds.

6.8.6 Concept Note on Sewage Treatment Plant

In a wastewater treatment plant the wastewater goes through several stages of treatment:

1. Preliminary Treatment: Involves removal of oversized particles, rags, stones, fat, oil & grease and grit.
2. Primary Treatment: The organic solids contained in wastewater are separated by gravity sedimentation or other solid liquid separation techniques, and the separated solids are removed in the form of sludge
3. Secondary Treatment: Biological treatment where microbes are used to convert the organic matter in the wastewater to sludge, which can be settled down in Final Settling Tank.
4. Tertiary Treatment: Involves further removal of the organic matter, nutrients and / or pathogens remaining in the effluent from the secondary treatment stage. Tertiary treatment may involve BOD and TSS removal, nitrogen and phosphorus removal, and / or effluent disinfection by chemical treatment.
   An activated carbon filter (ACF) is a water treatment device used in sewage treatment plants (STPs) to remove organic contaminants, odor, and color.
5. Excess bio-solids should be stabilized so that they do not degrade further on storage and can be safely disposed of in landfill or reused as organic fertilizer. Sludge stabilization is achieved by either anaerobic or aerobic digestion. The dewatered sludge should not be self-flowing and should be transportable by truck. Sludge is to be thickened by filter press or any method, filtrate (supernant liquid) to be disposed in to recycling sump and the solid to drying bed.

6.8.7 Advantages of SBR

1. Smaller footprint because of absence of primary, secondary clarifiers and sludge digester;
2. Process is simplified, separate secondary clarifiers not required and intermittent return activated sludge pumping is provided;
3. Ability to withstand hydraulic and organic shock loads;
4. Recent track record available in large applications in India;
5. Can be operated as a selector process to minimize sludge bulking potential;
6. Quiescent settling enhances solids separation (low effluent SS).
7. Disadvantages of SBR
8. Higher maintenance skills are required;
9. Complete automation is required.

6.8.8 Recommendations

Based on above quantitative and qualitative comparison and past experiences on the performance of various treatment plants in different parts of the country, following recommendations are made for the adoption treatment technology for different sizes of the STPs.

Table 6-6: Recommended STP Technologies for various sizes

Flow (MLD)	Up to 1 (very low)	1 - 3 (low)	3 – 20 (medium)	20 – 80 (large)	More than 80 (very large)
Recommended Technology	MBR	MBBR	EA	SBR	ASP

However, the sewage treatment plant has to be on Sequential Batch Reactor (SBR) technology.

The SBR based Sewage Treatment Plant shall consist of the following Units:

1. Inlet Chamber (Stilling Chamber);
2. Fine Screen Channels;
3. Grit Removal Units;
4. Sequential Batch Reactor (SBR) Basins;
5. Chlorine Contact Tank & Chlorination House;
6. Sludge Sump & Pump House;
7. Sludge Thickener;
8. Thickened Sludge Sump and Centrifuge feed pumps;
9. Sludge Dewatering – Centrifuge;
10. Air Blower Room;
11. MCC & Control Building.
12. Inlet Chamber
13. An Inlet Chamber shall be provided ahead of the Fine Screen Channels to receive the sewage from the Pumping Stations via Rising Mains.
14. Fine Screen Channels

Screening is an essential step in Sewage Treatment Plant to remove floating materials like rags, wooden pieces, plastics, pouches, etc. which otherwise would damage pumps and interfere with the satisfactory operation of various treatment units. Fine Screen shall consist of SS Bars (grade 316) placed across the Channel to trap the floating materials. The Bars shall arrest the floating materials, which have to be removed periodically.

Mechanical Fine Screens are considered. The screening process is done by Bar Screens with 5 mm clear opening (as per cl. 5.6.1.3 of CPHEEO manual) to trap the floating materials. The mechanically operated Screens shall be equipped with a mechanism, which shall automatically rake at a pre-set timer control. The screenings shall be collected in a hopper located above the water level such that the screenings can be easily collected and disposed. The screens shall be designed to handle ultimate peak flow.

6.8.9 Grit Removal Units

The screened sewage shall flow through Grit Removal Units consisting of Mechanical Grit Removal Mechanism in two Grit Chambers. Grit in sewage consists of coarse particles of sand, ash and clinkers, eggshells and many inert materials inorganic in nature. Grit is a non-putrescible and possesses a higher hydraulic subsidence value than organic solids. Hence, it is possible to separate the gritty material from organic solids by differential sedimentation in a grit channel. Grit removal is necessary to protect the moving mechanical equipment and pumps from abrasion and accompanying abnormal wear and tear. It is separated in a Grit Chamber of Detritus type with designed detention period. The grit washing and removal mechanism shall be fully automatic. The grit chamber (Detritus type) shall be capable of handling ultimate peak flow.

6.8.10 Flow Measurement

Electro-magnetic type flow measuring instruments will be installed on the rising main prior to Inlet chamber and outlet of chlorine contact tank for measuring the incoming and outgoing treated sewage quantity.

6.8.11 SBR Process

Raw sewage after Preliminary Treatment shall be conveyed by gravity into the SBR Basins. There shall be a total of two SBR Basins in the plant of equal capacity.

These SBR Basins shall work in sequence and the influent flow shall be distributed using Automatic Sluice Gates provided in the Inlet Channel to SBR Basins. The SBR Basins shall be equipped with Air Blowers, Diffusers, Return Activated Sludge (RAS) Pumps, Surplus Activated Sludge (SAS) Pumps, Decanters, Auto Valves and PLC etc. All cycles shall be automatically controlled using PLC.

Excess sludge with dry solid content at approximately 1% shall be pumped intermittently from SAS Pumps. The sludge shall then be conveyed further to sump of sludge pump house.

6.8.12 Process Description

The raw sewage free from debris and grit is received for biological treatment in SBR Reactors for removal of organics, nitrogen and phosphorus. The activated sludge bio system is designed using Advanced Cyclic Activated Sludge Technology which operates on extended aeration activated sludge principle for the reduction of BOD, SS, Nitrification, De-nitrification and Phosphorous removal, using energy efficient fine bubble membrane diffused aeration system. In its simplest form, the sequences of fill, aeration, settle and decant are consecutively and continuously operated all in the same Tank, allowing up to 30-40% space saving. No Secondary Clarifier shall be required to concentrate the sludge in the Reactor. The return sludge is recycled and the surplus sludge is wasted from the SBR Basins itself. The complete biological operation is divided into four cycles. A basic cycle comprises:

i. Fill
ii. Aeration
iii. Settlement
iv. Decanting

These phases in a sequence constitute a cycle, which is then repeated. During the period of a cycle, the liquid volume inside the Reactor increases from a set operating

bottom water level. During the Fill- Aeration sequence, mixed liquor from the aeration zone is recycled into the Selector. Aeration ends at a predetermined period of the cycle to allow the biomass to flocculate and settle. After a specific settling period, the treated supernatant is decanted, using a moving weir Decanter. The liquid level in the Reactor is so returned to the bottom water level after which the cycle is repeated. Solids are wasted from the Reactor during the decanting phase. The system selected is capable of achieving the following:

Anoxic de-nitrification of nitrates in the Biological Selector Zone of SBR (Anoxic Zone) using incoming wastewater

Bio-degradation of organics present in the wastewater by Extended Aeration Process

Nitrification and de-nitrification of Ammonical nitrogen in the aeration zone of SBR Basins

6.8.13 Removal of Phosphorous

6.8.13.1 Decanter Assembly

The clean supernatant is removed from the Basin using a Decanter assembly complete in stainless steel construction. The moving weir DECANTER is motor driven and variable frequency drives are provided to control the rate of movement of the Decanters. After the required level of supernatant is removed the Decanter is returned to its position through reversal of the drive. The Basin is now ready for the next cycle to begin.

6.8.13.2 Operational Simplicity - Fully PLC Based Intelligent Control

The complete SBR plant operation is controlled automatically through a PLC system, which is a major factor in reducing Operating Costs. This also prevents mal operation of the various set process parameters within the plant. All key functions like sludge recycling, sludge wasting, aeration intensity, cycle time control and decanting rate etc. are automatically controlled as well as data logged. Complete historical records of plant operation are available on touch of a button.

6.8.13.3 Sludge Dewatering System

Sludge Dewatering System shall consist of the following:

1. Sludge Sump and Pump House
2. Sludge Thickener
3. Thickened Sludge Sump and Centrifuge Feed pumps
4. Centrifuge & Polyelectrolyte Dosing System

A Sludge Sump and Pump House shall be provided for collection and transfer of sludge from SBR Reactors to sludge thickener. The thickened sludge will be collected in a sump from where it will be pumped to centrifuge for dewatering. Polyelectrolyte Dosing System comprising Solution Preparation Tanks with Agitators and Dosing Pumps shall be provided to enhance the dewatering efficiency of centrifuge. The dry solids content of dewatered sludge will be 20%. The dewatered sludge shall be transported in trucks for disposal to sanitary landfills or for use as manure on agricultural land. The filtrate from the centrifuge and supernatant from thickener shall be recycled to the Receiving Chamber.

6.8.14 Chlorination System

Chlorination System shall be provided to meet the fecal coliform standards. Chlorination System shall include mainly of two units namely Chlorine Contact Tank and Chlorination House. In Chlorine Contact Tank, disinfection of treated wastewater shall take place by keeping treated sewage in contact with chlorine. Chlorination House shall incorporate vacuum type gaseous Chlorinators along with all accessories and required numbers of Chlorine Tonner. Chlorination house will be provided with mechanical ventilation and other safety and monitoring equipment.

THE POST CHLORINATION MUST BE PROVIDED BEFORE ACTIVATED CARBON FILTER (ACF) TREATMENT.

6.8.15 Disposal

Treated sewage after chlorination shall be discharged into nearby water body or can be reused for horticulture and irrigation. Part of treated effluent shall be used for fulfilling the requirements for firefighting, flushing etc. in the plant.

6.8.16 Environmental & Social Issues of the Proposed Components

6.8.16.1 Construction of New Sewerage Network

Under this activity permanent negative impact is not expected, however, the typical environmental issues associated with sewerage schemes are:

a. Surface and ground water contamination due to leakage and/or improper joints in sewers;
b. Contamination in drinking water line due to leakage and/or improper joints in sewers and water supply lines;
c. Non-functioning of utilities and/or requirements for relocation of utilities due to sewer laying;
d. disruption of traffic due to narrowing and congestions during sewer laying works;
e. Damage of public /private properties and other sensitive establishments along the sewer alignment during construction;
f. Improper disposal of excess excavated soil and construction debris;
g. Over use of municipal water sources /supply for meeting construction water demand;
h. Air and noise pollution during construction due to operation of equipment and vehicles.
i. Construction of Sewage Treatment Plant
j. STP will be concentrated in one location .The typical environmental issues associated with sewage treatment facility are:
k. Change in channel hydraulics, triggering erosion and siltation problems, if sewage treatment plants are in flood plains;
l. Change in hydrology and drainage patterns due to the construction activity, particularly, if sewage treatment facility is located in flood plains;
m. Issues associated with the disposal of sludge, if sewage is likely to be contaminated with heavy metals due to mix of industrial waste with sewage;
n. Emission of methane, if not utilized for power generation or any other gainful applications. Water logging problems due to improper/inadequate disposal arrangements of treated effluent;

o. Pollution of water bodies if released effluent not conforming to stipulated discharge standards during operation and maintenance phase;
p. Health and safety issues associated with storage and handling of chemicals for sewage treatment facility operation and maintenance;
q. Health and safety issues associated with operation and maintenance of sewage treatment facility, particularly exposure to microorganisms, methane and other noxious gases, sludge contaminated with heavy metals etc.

6.8.16.2 Occupational Health & Safety Measures

Any construction projects and operation of sewerage system associate risks of occupational hazards to the workers engaged for the projects. Careful planning and availability of proper PPEs for the workers should be ensured before commencement of work. The contractor must do everything reasonable to protect the health and safety of workers. (CPHEEO Manual (Sewage)4.1.3, pg-4-2)

6.9 Characteristics of Sewage

Sl. No.	Parameters	Typical Sewage Characteristics as per CPHEOO Manual
1	BOD (mg/l)	250
2	TSS (mg/l)	375
3	COD (mg/l)	450
4	Oil & Grease (mg/l)	45
5	Total N (mg/l)	50
6	Total P (mg/l)	71
7	Faecal Coliform (MPN/100ml)	1012-1016
8	Residual Chlorine (mg/l)	-

6.10 Water Quality Standards Proposed After Treatment

The contractor should maintain the Water Quality Standards for natural nalla /Water body/ as per CPCB classification of Designated Best Use criteria of rivers for bathing are as given below:

Table 6-7: Water Quality Standards for River / Natural Flowing Water Bodies
(vide CPHEEO MANUAL (Sewerage), Table-5.2, Chapter-5, Page-5-2)

Parameters	Standards
PH	6.5 to 8.5
BOD	3 (mg/l) or less
Parameters	Standards
DO	5 mg/l or more
Faecal coliform	500 (MPN/100 ml)
Desirable	2500 (MPN/100 ml)
Maximum Permissible	Standards

Table 6-8: Recommended Guidelines for Treated Sewage by CPHEEO
(vide CPHEEO Manual (Sewerage) November 2013 page 5-4 & page 5-120)

Parameter	Recommended Values
BOD mg/L	Less than 10
SS mg/L	Less than 10
TN mg/L	Less than 10
Dissolved P, mg/L	Less than 2
Faecal Coliforms MPN/100 mL	Less than 230

6.11 Sewerage Scheme Components Design

6.11.1 Design of Sewer Laying Works

The sewer lines should be designed and L-sections should be prepared. The drawings along with Excavation & bedding of Manhole are provided in the respective drawings.

Manning's formula for circular conduits (Sewers) is to be taken for design.

$$Vf = 3.968 \times 10^{-3} \times d^{2/3} \times 1/n \times s^{1/2}$$

$$Qf = 3.118 \times 10^{-6} \times d^{8/3} \times 1/n \times s^{1/2}$$

Where,
Vf = Velocity in m/sec. While sewer is running full;
Qf = Discharge in lps. while sewer is running full;
d = Inner diameter of sewer in mm;
n = Manning's coefficient of roughness; s = Slope of hydraulic gradient;
Or, Q=0.312 x 1/n x D8/3 x S1/2 in m3 /Sec D in mtr
Values of Manning's Coefficient (n) for Pipes are shown in Table 6-4: Roughness Coefficient Considerations

6.11.2 Design of Sewerage Treatment Plant

STP IS to be constructed for 12.00 MLD;

Sequential Batch Reactor (SBR) technology is proposed for Sewerage treatment; Location- Plot no UT-2 (Latitude- 795036.0846 N & Longitude- 2999036.9817E)

Sewage Treatment Plant (STP) is envisaged for sewage flow of 12.00 MLD. The land available is given in the respective drawing. Strategical exact positioning of location of STP is decided after considering the presence of nearby water body for the outflow from STP.

It is proposed to make the system (STP) automatic for achieving higher efficiency and to minimise cost towards human resources by providing PLC-SCADA. For this purpose, compatible sensor logic for influent and effluent qualities and ensuring quality rotations till then the effluent qualities are achieved as per recommended guidelines for treated sewage by CPHEEO. For this purpose, monitor control and command centre establishment (Centrally placed) is envisaged and provisions are inbuilt accordingly.

Land assigned for Construction of Sewage Treatment Plant is 1.46 Acre.

6.11.3 Design of Transformer & Taking Power Line from Electric Sub-Station

Design of capacity of transformer has to be done by the STP contractor and cabling is to be done taking electric power line from nearby electrical substation.

6.11.4 Design of Effluent Disposal Arrangements

It is proposed to use treated waste water after treatment coming from STP for use in Flushing and Horticulture & Landscaping works and remaining let out in to the water body proposed inside the Atal Puram Township. treated waste water standards are ensured as given in CPHEEO Manual.

6.11.5 Operation And Maintenance of the System

The efficient operation of sewerage system needs flawless construction and getting 100% households, amenity blocks, PSP Plots, Commercial, etc. connected. It is necessary to have most efficient and financially viable operational system for sustainability of the assets created and its efficient operation and maintenance. It is envisaged to make provision of 5 years' operation and maintenance of the total sewerage system with 1 years of defect liability period.

The maintenance cost is framed and given below considering depreciation of assets created with lapse of time and provision for major breakdowns and repairs, cost towards consumables and energy charges. The maintenance cost includes cost towards human resources and transportation facilities invariably required for operation and maintenance of the system. For making the sewerage system self-sustainable based on basic concepts of civic services considering no profit and no loss in fixing tariff towards giving each household with sewer connection and recurring charges towards operation and maintenance.

6.12 Safety & Environmental Plan

The safety and environmental plan should be followed at site during the execution state.

Table 6-9: Safety & Environment Plan

Activity	Activity / Action Plan Impact		Responsibility
Excavation	Air Pollution / Noise Pollution	Use ear plug & nose masks when necessary for performing task. Excavated soil shall be arranged both side on trench properly at a safe distance	By Contractor / Agency
Removal of Excavated Stuff	Water Pollution	Ensure that excavated soil shall not be flown in nearby nali & nalla and extra stuff/Soil & be transported to site as per direction of Engineer-in-charge.	By Contractor / Agency
Site Housekeeping		The construction site and surrounding are to be maintained in a clean and presentable condition at all times. Constriction activities shall avoid causing unnecessary disruption & nuisance to adjacent landowners & the public as a whole	By Contractor / Agency
Fire	Air Pollution	The Contractor shall ensure that	By Contractor /

Activity	Activity / Action Plan Impact		Responsibility
Prevention & Control		there is basic firefighting equipment available on site as per requirement of the local Emergency Services. If any emergency or misshapen then Environmental / Safety shall attend to the requirements immediately	Agency
Health & Safety		We shall Ensure that First-Aid kit is provided at site Office as per relevant standards	By Contractor / Agency
Tree Safety		Unnecessary tree cutting prohibited shall be adhered to in case progress is affected by any tree. Cutting of tree shall be done as per Provisions of Forest/related dept. norms, plantation of equivalent	By Contractor / Agency
Power Generator	Air Pollution	Installation of Power generator/DG set as per standard norms shall be ensured at site	By Contractor / Agency
Material		Material /dumping through truck / trali etc. shall be done carefully & more careful dumping of sand & packed through thick polythene bag	By Contractor / Agency
Health Safety of Workers		Ensure to arrange medical camp for labours & proper facility like clear water, latrine, good quality food etc	By Contractor / Agency
Public Awareness		Before start of any alignment of pipe residents shall be informed line Proper sign boards, display boards, barricading, taps shall be on site to avoid any misshapen during work progress	By Contractor / Agency
Vehicle / Machine	Air Pollution	We shall Ensure that certification is necessary from concerning respective departments are kept with vehicle	By Contractor / Agency
Site Clearance		Ensure that after daily progress of work, site is cleaned. No material/Pipe pieces etc. shall be remained on the road	By Contractor / Agency
Proper Place of Vehicle		Necessary vehicles shall be provided for safety	By Contractor / Agency
Attention	Water pollution	Work carefully, in the case any damage during the construction like damage occur then proper coordination with concern authorities shall be done & damages are attended to on priority.	By Contractor / Agency

6.13 IMPORTANT NOTE:

The number of Property Chamber have to be decided on basis of Waste Water Generated from the population of that plot. There are some big plot in which no of complexes may be developed in future. The house sewer from individual complex may be connected to property chamber through common manifold /lateral/submain sewer. Connection from each of property chamber of all plots through higher dia pipes have been shown in the map for reference.

7. MANUFACTURING / SUPPLYING LAYING AND JOINTING OF PIPES

7.1 Reinforced Cement Concrete (RCC) NP-3 Pipes

7.1.1 Scope

This Specification covers the requirements for manufacturing, testing, supplying, jointing and, testing at work sites, of Reinforced Cement Concrete (RCC) NP-3 pipes, of both pressure and non-pressure varieties used for sewers and storm water drains.

ALL THE RCC PIPES WILL BE USED FOR THIS RFP, MUST BE MANUFACTURED WITH SULPHATE RESISTANT CEMENT INSTEAD OF OPC/PPC CEMENT

7.1.2 Applicable Codes

The manufacturing, testing, supplying, jointing and testing at work sites of RCC pipes shall comply with all currently applicable statutes, regulations, standards and Codes. In particular, the following standards, unless otherwise specified herein, shall be referred. In all cases, the latest revision of the Codes shall be referred to. If requirements of this Specification conflict with the requirements of the Codes and standards, this Specification shall govern.

7.1.3 Codes of practice

IS: 458	Specification for Concrete Pipes (with and Without Reinforcement).
IS: 3597	Method of Tests for Concrete Pipes
IS: 5382	Specification for Rubber Sealing Rings for Gas Mains, Water Mains and Sewers
IS: 456	Code of Practice for Plain and Reinforced Concrete
IS: 783	Code of Practice for Laying of Concrete Pipes
IS 12330	Code for Sulphate Resistant Cement

7.1.4 Design

Design of RCC pipes shall be in accordance with the relevant clauses of IS: 454.

The details of reinforcement shall be as per Clause 5.2 of IS: 458. The ends of pipes shall be in accordance with relevant clauses of IS: 458.

7.1.5 Manufacturing

7.1.5.1 General

1. The method of manufacture shall be such that the form and the dimensions of the finished pipes are accurate within the limits specified in relevant IS: 458. The surfaces and edges of the pipes shall be well defined and true, and their ends shall be square with the longitudinal axis.

The ends of the pipes shall be further reinforced by an extra ring of reinforcement to avoid breakage during transportation.

2. The RCC pipes and collars / rubber rings shall be systematically checked for any manufacturing defects by experienced supervisors so as to maintain a high standard of quality.
3. Engineer-in-charge shall at all reasonable times have free access to the places where the pipes and collars / rubber rings are manufactured for the purpose of examining and testing the pipes and collars / rubber rings and of witnessing the test and manufacturing.
4. All tests specified either in this Specification or in the relevant Indian Standards shall be performed by Supplier / Contractor at his own cost and in presence of Engineer-in-charge if desired. for this, sufficient notice before testing of the pipes shall be given to Engineer-in-charge.
5. If the test is found unsatisfactory, Engineer-in-charge may reject any or all pipes of that lot. The decision of Engineer-in-charge in this matter shall be final and binding on Contractor and not subject to any arbitration or appeal.

7.1.5.2 Materials

Materials should conform to the requirements given in IS: 458.

7.1.5.3 Curing

Pipes manufactured in compliance with IS: 458 shall be either water cured or steam cured in accordance with the relevant requirements of IS: 458.

7.1.5.4 Dimensions

1. The internal diameter, wall thickness and length of barrel and collar of pipes, reinforcement (longitudinal and spiral), type of ends and minimum clear cover to reinforcement and strength test requirements shall be as per the relevant clauses / tables of IS: 458 for different class of pipes.
2. The tolerances regarding overall length, internal diameter of pipes or socket and barrel wall thickness shall be as per relevant clauses of IS: 458.

7.1.5.5 Workmanship and finish

1. Pipes shall be straight and free from cracks except that craze cracks may be permitted. The ends of the pipes shall be square with their longitudinal axis so that when placed in a straight line in the trench no opening between ends in contact shall exceed 3 mm in pipes upto 600 mm diameter (inclusive), and 6 mm in pipes larger than 600 mm diameter.
2. The outside and inside surfaces of the pipes shall be smooth, dense and hard, and shall not be coated with cement wash or other preparation unless otherwise agreed to between Engineer-in-charge and the manufacturer or supplier.
3. The pipes shall be free from defects resulting from imperfect grading of the aggregate, mixing or moulding.
4. The pipes shall be free from local dents or bulges greater than 3.00 mm in depth and extending over a length in any direction greater than twice the thickness of barrel.

5. The deviation from straight in any pipes throughout its effective length, tested by means of a rigid straight edge parallel to the longitudinal axis of the pipe shall not exceed, for all diameters, 3 mm for every metre run.

7.1.6 Testing

All pipes for testing purposes shall be selected at random from the stock of the manufacturer and shall be such as would not otherwise be rejected under the criteria of tolerances as mentioned in IS: 458.

During manufacture, tests on concrete shall be carried out as per IS: 456. The manufacturer shall supply, when required to do so by Engineer-in-charge the results of compressive tests of concrete cylinders or cubes made from the concrete used for the pipes. Every pressure pipe shall be tested by the manufacturer for the hydrostatic test pressure.

The specimen of pipes for the following tests shall be selected in accordance with Clause 9.1 of IS: 458 and tested in accordance with the methods described in IS: 3597:

1. Hydrostatic test.
2. Three edge bearing test or sand bearing test.
3. Absorption test.
4. Bursting test.

Note: Three edge bearing strength to produce 0.25 mm crack in case of special design of pipes shall be as follows:

300 mm Ø	1200 kg/m
350 mm Ø	3040 kg/m
400 mm Ø	3460 kg/m
450 mm Ø	4160 kg/m
500 mm Ø	4160 kg/m
600 mm Ø	4720 kg/m
700 mm Ø	5320 kg/m
800 mm Ø	6060 kg/m
900 mm Ø	6760 kg/m
1000 mm Ø	7400 kg/m
1100 mm Ø	8200 kg/m

7.1.7 Sampling and inspection

In any consignment, all the pipes of same class and size and manufactured under similar conditions of production shall be grouped together to constitute a lot. The conformity of a lot to the requirements of this Specification shall be ascertained on the basis of tests on pipes selected from it.

The number of pipes to be selected from the lot shall be in accordance with column with column 1 and 2 of Table 9 of IS: 458.

Pipes shall be selected at random. In order to ensure randomness, all the pipes in the lot may be arranged in a serial order and starting from any pipe, every “r th” pipe be selected till the requisite number is obtained, “r” being the integral part of N/n where “N” is the lot size and “n” is the sample size.

All the pipes selected as per Clause 8.1.7 shall be inspected for dimensional requirements, finish and deviation from straight.

The number of pipes to be tested for tests under Clause 8.1.6 shall be in accordance with column of Table 9 of IS: 458. These pipes shall be selected from pipes that have satisfied the requirements mentioned in Clause 8.1.7

A lot shall be considered as conforming to the requirements of IS: 458 if the following conditions are satisfied.

1. The number of defective pipes (those not satisfying one or more of the requirements for dimensions, finish and deviation from straight) shall not be more than the permissible number given in Column 3 of Table 9 of IS: 458.
2. All the pipes tested for various tests as per Clause 8.1.6 shall satisfy corresponding requirements of the tests.
3. In case the number of pipes not satisfying requirements of any one or more tests, one or two further sample of same size shall be selected and tested for the test or tests in which failure has occurred. All these pipes shall satisfy the corresponding requirements of the test.

7.1.8 Marking

The following information shall be clearly marked on each pipe:

- Internal diameter of pipe.
- Class of pipe.
- Date of manufacture, and
- Name of manufacturer or his registered trademark or both.

7.1.9 Laying

Laying of pipe shall conform to Clause 7.2

7.1.10 Jointing

Jointing of RCC pipes shall be done as per the requirements of following Specifications and as per the relevant IS Code. The type of joints shall be as specified in the Contract / Drawing. After jointing extraneous material if any, shall be removed from the inside of the pipe and newly made joints shall be thoroughly cured. In case, rubber sealing rings are used for jointing, these shall conform to IS: 5382.

7.1.10.1 **Spigot and Socket Joint (Rigid)**

The spigot of each pipe shall be slipped home well into the socket of the pipe previously laid and adjusted in the correct position. The opening of the joint shall be filled with stiff mixture of cement mortar in the proportion of 1:1, which shall be rammed with caulking tool.

7.1.10.2 **Collar Joint (Rigid)**

After laying the RCC pipes at proper alignment and gradient their abutting faces shall be coated with hot bitumen in liquid condition by means of a brush. The wedge-shaped groove in the end of the pipe shall then be filled with a tarred gasket in one length for each joint. The collar shall then be slipped over the end

of the pipe and the next pipe butted well against the tarred gasket by suitable appliances approved by Engineer-in-charge so as to thoroughly compress the tarred gasket into the grooves, care being taken that the concentricity of the pipes and levels are not disturbed during this operation. The collar shall then be placed symmetrically over the end of the two pipes and the space between the inside of the collar and the outside of the pipe filled with a mixture of cement and sand in the proportion of 1:1, tempered with just sufficient water to have a consistency of the semi dry conditions, well packed and thoroughly rammed with caulking tools. The joints shall be finished off with a filled sloping at 45o to the side of the pipe. The finished joints shall be protected and cured thoroughly as directed by Engineer-in-charge. Any plastic solution or cement mortar that may have been squeezed into the inside of the pipe shall be removed so as to leave the inside of the pipe perfectly clean.

7.1.10.3 Spigot and Socket Joint (Semi-flexible)

This joint is composed of specially shaped spigot and socket ends on the RCC pipes. A rubber ring, shall be lubricated and then placed on the spigot which is forced into the socket of the pipe previously laid. This compresses the rubber ring as it rolls into the annular space formed between the two surfaces of the spigot and socket, stiff mixture of cement and mortar in the proportion of 1:1, shall then be filled into the remaining annular space and rammed with a caulking tool.

7.1.10.4 Collar Joint (Semi-flexible)

This joint is made up of a loose collar which covers two specially shaped pipe ends. Each end shall be fitted with a rubber ring, which when compressed between the spigot and collar, seal the joint. Stiff mixture of cement mortar in the proportion of 1:1, shall then be filled into the remaining annular space and rammed with a caulking tool.

7.1.10.5 Spigot and Socket Joint (Flexible)

The RCC pipe with the rubber ring accurately positioned on the spigot shall be pushed well home into the socket of the previously laid pipes. The manufacturer's instructions shall be used, and the manufacturer's instructions shall be deemed to form a part of this Specifications. The rubber rings shall be lubricated before making the joint and the lubricant shall be soft soap water or an approved lubricant supplied by the manufacturer.

7.1.10.6 Flush Joint (Internal)

This joint shall be generally used for culvert pipe of 60 cm. diameter and over. The ends of the pipes are specially shaped to form a self-centering joint with an internal jointing spaces 1.3 cm wide. The finished joint is flush with both inside and outside with the pipe wall. The jointing space is filled with cement mortar in the proportion of 1:1, mixed sufficiently dry to remain in position when forced with a trowel or rammer.

7.1.10.7 Flush Joint (External)

This joint is suitable for pipes which are too small for jointing from inside. This joint is composed of specially shaped pipe ends. Each end shall be butted against the other and adjusted in correct position. The jointing space shall then be filled with cement mortar in the proportion of 1:1, sufficiently dried and finished

off flush. Great care shall be taken to ensure that the projecting ends are not damaged as no repairs can be readily affected from inside the pipe.

7.1.11 Cleaning of pipes

As soon as a stretch of RCC pipes has been laid complete from manhole to manhole or for a stretch as directed by Engineer-in-charge, Contractor shall run through the pipes both backwards and forwards a double disc or solid or closed cylinder 75 mm less in diameter than the internal diameter of pipes. The open end of an incomplete stretch of pipe line shall be securely closed as may be directed by Engineer-in-charge to prevent entry of mud or slit etc.

If as a result of the removal of any obstruction, Engineer-in-charge considers that damages may have been caused to the pipe lines, he shall be entitled to order the stretch to be tested immediately. Should such test prove unsatisfactory Contractor shall amend the work and carry out such further tests as are required by Engineer- in-charge.

It shall also be ascertained by Contractor that each stretch from manhole to manhole or the stretch as directed by Engineer-in-charge is absolutely clear and without any obstruction by means of visual examination of the interior of the pipeline suitably enlightened by projected sunlight or otherwise.

a) As soon as a stretch of RCC pipes has been laid complete from manhole to manhole or for a stretch as directed by Engineer-in-charge, Contractor shall run through the pipes both backwards and forwards a double disc or solid or closed cylinder 75 mm less in diameter than the internal diameter of pipes. The open end of an incomplete stretch of pipe line shall be securely closed as may be directed by Engineer-in-charge to prevent entry of mud or slit etc.
b) If as a result of the removal of any obstruction, Engineer-in-charge considers that damages may have been caused to the pipe lines, he shall be entitled to order the stretch to be tested immediately. Should such test prove unsatisfactory Contractor shall amend the work and carry out such further tests as are required by Engineer- in-charge.
c) It shall also be ascertained by Contractor that each stretch from manhole to manhole or the stretch as directed by Engineer-in-charge is absolutely clear and without any obstruction by means of visual examination of the interior of the pipeline suitably enlightened by projected sunlight or otherwise.

7.1.12 Testing at work site

After laying and jointing of RCC pipes is completed the pipe line shall be tested at work site as per the following Specifications and as directed by Engineer-in-charge. All equipment for testing at work site shall be supplied and erected by the Contractor and shall be rectified by him / her to the full satisfaction of Engineer-in- charge. Water used for test shall be removed from pipes and not released to the excavated trenches.

After the joints have thoroughly set and have been checked by Engineer-in-charge and before backfilling the trenches, the entire section of the sewer (or storm water drain) shall be proved by Contractor to be water tight by filling in

pipes with water to the level of 1.50 m. above the top of the highest pipe in the stretch and heading the water up for the period of one hour. The apparatus used for the purpose of testing shall be approved by Engineer-in-charge. Contractor if required by Engineer- in-charge shall dewater the excavated pit and keep it dry during the period of testing. The loss of water over a period of 30 minutes should be measured by adding water from a measuring vessel at regular 10 minutes intervals and noting the quantity required to maintain the original water level. For the approval of this test the average quantity added should not exceed 1 litre / hour / 100 linear metres / 10 mm for nominal internal diameter. Any leakage including excessive sweating which causes a drop in the test water level will be visible and the defective part of the work should be removed and made good.

In case of pressure pipeline, the completed stretch of pipeline shall be tested for site test pressure of 0.15g/sq.cm. The site test pressure should not be less than the maximum operating pressure plus the calculated surge pressure, but in no case should it exceed the hydrostatic test pressure, as specified in IS: 458.

7.1.13 Measurement

All RCC pipes shall be measured according to the work and/or BOQ actually done and no allowance will be made for any waste in cutting to the exact length required. The measurement for pipes shall be in running metres nearest to a cm. of length along the centre line of pipe as actually laid at work sites.

7.1.14 Rate

The rate for providing, laying and jointing of RCC pipes shall be deemed to include the cost of collars / rubber rings, jointing material, testing and the extra excavation required for ordinary bedding of pipes and also for collars and pipe sockets if any and/or as specified in the BOQ.

7.2 Laying of Pipes and Fittings / Specials

7.2.1 Scope

This Specification covers the requirements for laying of pipes and fittings / specials below ground for water supply / sewerage / storm water drainage works.

7.2.2 Applicable Codes

The laying of pipes and fittings / specials shall comply with all currently applicable statutes, regulations, standards and Codes. In particular, the following standards, unless otherwise specified herein, shall be referred. In all cases, the latest revision of the standards / Codes shall be referred to. If requirements of this Specification conflict with the requirements of the standards / Codes, this Specification shall govern.

7.2.3 Codes of practice

IS: 783	Code of Practice for Laying of Concrete Pipes.
IS: 311	Code of Practice for Laying of Cast Iron Pipes.
IS: 376	Safety Code for Excavation Work.
IS: 127	Code of Practice for Laying of Glazed Stoneware Pipes.
IS: 5822	Code of Practice for Laying of Welded Steel Pipes for Water Supply.
IS: 6530	Code of Practice for Laying of Asbestos Cement Pressure Pipes.

7.2.4 Carting and Handling

Pipes and fittings / specials shall be transported from the factory to the work sites, at places along the alignment of pipe line as directed by Engineer-in-charge.

Contractor shall be responsible for the safety of pipes and fittings / specials in transit, loading / unloading. Every care shall be exercised in handling pipes and fittings / specials to avoid damage. While unloading, the pipes and fittings / specials shall not be thrown down from the truck on to hard surfaces. They should be unloaded on timber with steadying ropes or by any other approved means

Padding shall be provided between coated pipes, fittings / specials and timber skids to avoid damage to the coating. Suitable gaps between pipes should be left at intervals in order to permit access from one side to the other. In case of spigot socket pipes while unloading, as far as possible pipes shall be unloaded on one side of the trench only. The pipes shall be checked for any visible damage (such as broken edges, cracking or splaying of pipe) while unloading and shall be sorted out for reclamation. Any pipe which shows sufficient damage to preclude it from being used shall be discarded. Dragging of pipes and fittings / specials along concrete and similar pavement with hard surfaces shall be prohibited.

Wherever a section of pipe, or a fitting is to be lifted or moved, it shall be handled carefully with belt slings. The belts shall be constructed so that no metal bears against the pipe and so that the bearing is uniform. The width of the belts shall be adequate to prevent any damage to the pipe coating. The pipe section may at no time be dropped but shall be lowered carefully into position and may not be slided along the ground. If it is to be rolled, it may be done only on slides or ground specially prepared so as to prevent any damage to the coating.

All State and local laws be observed during transportation. The Contractor shall secure permits and licenses and provide all signals, guards and lights that may be required. Upon delivery the pipe sections and fittings shall be placed on specially prepared ground to protect them from distortion and damage. The ground shall be prepared so that they will rest evenly and will have uniform bearing throughout their lengths. Valve and sluice gates shall be placed on blockings.

7.2.5 Storage

Each stack of pipes shall contain only pipes of same class and size, with consignment or batch number marked on it with particulars of suppliers wherever possible. Storage shall be done on firm level and clean ground and wedges shall be provided at the bottom layer to keep the stack stable. The stack shall be in pyramid shape or the pipes laid lengthwise and crosswise in alternate layers. The pyramid stack shall be made for smaller diameter pipes for conserving space in storing them. The height of the stack shall not exceed 1.5m.

Fittings / specials shall be stacked under cover and separated from pipes. Valves and sluice gates shall be placed on blockings.

Rubber rings shall be stored in a clean, cool store away from windows, boiler, electrical equipment and petrol, oils or other chemicals. Particularly in the field where the rubber rings are being used it is desirable that they should not be left out on the ground in the sun or overnight under heavy frost or snow conditions.

7.2.6 Laying

7.2.6.1 Excavation

1. Before excavating the trench, the alignment of pipeline shall be approved by Engineer-in-charge. The excavation of trenches and pits for manholes / chambers shall be carried out in accordance with the Specification and shall be done such that it does not get far ahead of the laying operation as approved by Engineer-in-charge.
2. To protect persons from injury and to avoid damage to property, adequate barricades, construction signs, red lanterns and guards as required shall be placed and maintained during the progress of the construction work until it is safe for the traffic to use the roadways. The Contractor shall provide sign boards
3. at salient points in streets and keep men to guide the traffic at his own cost. The relevant Indian Standards and the rules and regulations of local authorities in regard to safety provisions shall be observed.
4. Trial pits may be dug by the Contractor, without being directed to do so, along the lines of the trenches as shown on the drawings in advance of the excavations for the purpose of satisfying himself as to the location of underground obstructions or conditions. The Contractor shall proceed with caution, in any excavation and shall use every means to determine the exact location of underground structures, pipelines, conduits etc., prior to excavation in the immediate vicinity thereof. The Contractor shall be solely responsible for the cost of protection or repair or replacement of any structure, pipeline, conduit etc., above or below ground which may be broken or otherwise damaged by his operations.
5. Suitable fencing shall be provided along the sides of trenches and pits. The posts of fencing shall be of timber securely fixed in the ground not more than 3 m apart and they shall not be less than 75 mm in diameter or less than 1.2 m above the surface of the ground. There shall be two rails, one near the top of the posts and the other about 50 mm above the ground and each shall be of 50 mm to 70 mm in diameter and sufficiently long to run from post to post to which it shall be bound with strong rope. The method of projecting rails beyond the posts and tying them together where they meet will not be allowed on any account. All along the edges of the excavated trenches a bank of earth about 1.2 m high shall be formed where required by Engineer-in-charge for further protection.
6. The lighting, barricading, guarding of the trenches and the maintenance of watchman shall be done by the Contractor at his cost. At every 30 meters interval and at every change in the gradient, sight rails shall be provided and fixed by the Contractor at his own cost. The sight rails and boning rods for checking the excavation and inverts of the pipes shall be of the quality approved by the Engineer-in-charge. In all streets in the City/Town at every 15 meters interval, blank board shall be provided by

the Contractor at his own cost, to facilitate crossing of the trench by the Public residing on the either side.

7. The road metal and also the rubble packing shall first be stripped off for the whole width of the trench / pit and separately deposited in such place or places as may be determined by Engineer-in-charge.
8. During excavation, large stones and rubble shall be separated and removed from the excavated soil and stacked separately. The material from excavation shall be deposited on either side of the trench leaving adequate clear distance from the edges of the trench and pit or as may be necessary to prevent the sides of the trench / pit to slip or fall or at such a distance and in such a manner so as to avoid covering fire hydrants, sluice values, manhole covers, etc. and so as to avoid abutting the wall or structure or causing inconvenience to the public and other service organization or otherwise as Engineer-in-charge may direct.
9. Contractor shall take into account additional excavation if any as Engineer-in- charge may require in order to locate the position of water pipes, drains, sewers, etc. or any other works which may be met with, in or about the excavation of trenches / pits while quoting the rates for excavation. Such service lines if met with during excavation shall be properly maintained by Contractor, by means of shoring, strutting, planking over, padding or otherwise as Engineer-in-charge may direct, and shall be protected by Contractor from damage during the progress of the work.
10. Wherever extra width of excavation shall be necessary for shoring and strutting, of the trenches on account of the nature of the soil, such extra width required to accommodate the shoring boards shall not be paid for separately and the rates quoted for trench work are deemed to be inclusive of all such incidental work.
11. All precautions shall be taken during excavation and laying operations to guard against possible damage to any existing structures/pipelines of water, gas, sewage etc.
12. If the work for which the excavation has been made is not complete by the expected date of the setting in of monsoon which is First week of June or the setting in of rain whichever is earlier, or before the day fixed by Engineer-in- charge for filling in any excavation on account of any festival or special occasion, Contractor shall backfill such excavation and consolidate the filling.
13. Utmost care shall be taken to see that the width of the trench at the top of pipe is not more than [External diameter of pipe in mm + 600 mm] + [400 mm for every 1500 mm Depth of cutting] or as specified in the Cross Section Drawing (in case there is any difference, the latter shall prevail). In case additional width is required it shall be provided only in the top portion from the ground level upto 300 mm above the crown of pipe. If any extra width is provided in the area below this portion, Contractor shall have to provide remedial measures in the form of lime concrete or rubble masonry or otherwise at the discretion and to the satisfaction of Engineer-in-charge. If rock is met with, it shall be removed to 15 cm below the bottom of pipes and fittings / specials and the space resulting shall be refilled with lean cement concrete of adequate depth, properly consolidated to give the curved seating. The bottom of the trench shall

be properly trimmed to permit even bedding of the pipeline. Bottom of trenches / pits shall be saturated with water and well rammed wherever Engineer-in-charge may consider it necessary to do so. For laying of pipes larger than 1200 mm in diameter, in earth and moorum, the curvature of the bottom of the trench should match the curvature of the pipe as far as possible, subtending an angle of 120 ºs at the centre of the pipe.

14. Wherever a socket or collar of pipe or fitting / special occurs a grip is to be cut in the bottom of the trench or concrete bed to a depth of at least 75 mm below the bed of the pipe so that the pipe may have a fair bearing on its shaft and does not rest upon its socket. Such grip shall be of sufficient size in every respect to admit the hand, all around the socket in order to make the joint and the grip shall be maintained clear until the joint has been approved by Engineer-in- charge.
15. When welding is to be carried out with the pipes and specials in the trench, additional excavation of not more than 60 cm in depth and 90 cm in length shall be made at joints in order to facilitate welding.
16. The excess excavated material shall be carried away from site of works to a place upto to a distance as directed by Engineer-in-charge. This shall be done immediately so as not to cause any inconvenience to the public or traffic. If the instructions from Engineer-in-charge are not implemented within seven days from the date of instructions to cart the materials and to clear the site, the same shall be carried out by Engineer-in-charge at Contractor's risk and cost and any claim or dispute shall not be entertained in this respect.
17. Refilling of trenches, where the excavation is in rock shall be with the surplus soft soil from pits located within 200meters from the reach in question.
18. It is to be distinctly understood that no extra payment shall be made for the excavation from borrow pits located within 200 metres for obtaining earth for refilling, any instructions of the Engineer-in-charge to bring earth from beyond 200 metres for refilling shall be detailed in writing and a separate extra payment shall be made for the additional conveyance. No payment shall be made for disposal of soil for excavation, surplus to or unsuitable for filling.

7.2.7 Work included in Excavation

Unless otherwise directed on the project Specifications, all of the following items are included in the excavation:

1. Removing all surface obstructions including shrubs, jungle etc.,
2. Making all necessary excavations true to line and grade,
3. Furnishing and installing all shoring and bracing as necessary or as directed,
4. Pumping and bailing out water to keep trenches free of water during pipe laying and jointing and thereafter until joints mature,
5. Providing for uninterrupted surface water flow during work in progress,
6. Providing for disposing off water flows from storm, drains, nallas or other sources, suitably,
7. Protecting all pipes, conduits, culverts, railway tracks, utility poles, wire fences, buildings, and other public and private property adjacent to or in the line of work,

8. Removing all shoring and bracing which is not ordered to be left in place or not required by the project plans or Specifications to remain in place,
9. Hauling away and disposing of excavated materials not necessary or else unsuitable for back filling purposes. The extra excavated soil will have to be properly dressed in soil banks along with the trench as directed,
10. Back filling the trenches as directed or as per Specifications,
11. Restoring all property injured or disturbed by these construction activities to the condition as near its original condition as possible,
12. Restoring the surfaces and repairing of all roads, streets, alleys, walks, drives, working spaces, and rights of way to a condition as good as prior to excavation.

7.2.8 Change of Trench Location

In case the Engineer-in-charge orders that the location of trench be moved a reasonable distance, on account of the presence of an obstruction or due to such other cause or if a changed location is authorized at the Contractor's request, the Contractor shall not be entitled to extra compensation or to a claim for damage. If however such change is made at the orders of the Engineer-in-charge, which involves abandonment of excavation together with the necessary back fill, will be measured, classified and paid for in the same manner as for other trench excavation and back fill of the same character. In case the trench is abandoned in favour of new location at the Contractor's request, after its approval, the abandoned excavation and back fill shall be at Contractor's expense.

7.2.9 Minimum earth cover

If a profile is not furnished for a pipeline, the main will be constructed with a minimum earth cover of 1000 mm from the top of the pipeline, unless otherwise indicated on plans and ordered by the Engineer-in-charge.

7.2.10 Dewatering

During the excavation, if subsoil water is met with, Contractor shall provide necessary equipment and labourers for dewatering the trenches / pits by bailing out water or water mixed with clay. If pumping out subsoil water is found to be necessary, Contractor shall provide sufficient number of pumps for the same. In both the above cases the excavation shall be done to the required level and the pipes shall be laid to proper alignment and gradient. Contractor shall also make necessary arrangement for the disposal of drained water to nearby storm water drain or in a pit if allowed by Engineer-in-charge. In no case the water shall be allowed to spread over the adjoining area. Before discharging this water into public sewer / drain, Contractor shall take necessary permission from the local authorities.

The Contractor shall be responsible for the adequate pumping, drainage and bailing out of water from the excavation. Failure to make such provisions which results in unsuitable subgrade conditions, and which will require any special foundations as directed by the Engineer-in-charge, such foundations shall be placed at the entire cost of the Contractor and will not be measured or paid for as separate pay items. If the Contractor selects to undercut the trench and use

gravel or tile bailing, drainage of well pointing, the additional work will be considered as incidental work and additional compensation will not be allowed

7.2.11 Special foundation in poor soil

Where the bottom of the trench at subgrade is found to consist of material which is unstable to such a degree that in the opinion of Engineer-in-charge, it cannot be removed and replaced with approved material thoroughly compacted in place to support the pipe properly, a suitable foundation for the pipes, consisting of piling, timbers or other materials, in accordance with relevant Drawings and as instructed by Engineer-in-charge shall be constructed.

During the progress of the work, should the foundation for the pipeline be in soft, yielding or spongy materials which are unsuitable for the subgrade of the pipeline and which is not the result of the Contractor's negligence, to make proper provisions for adequate drainage of the excavation, the Contractor shall remove such unsuitable subgrade materials to the depth directed by the Engineer-in-charge. The Contractor shall fill the excavated depth in the manner hereinafter described or as directed by the Engineer-in-charge.

The Contract unit for foundation shall be one cubic metre. The foundations will be measured for payment complete in place. The contract unit price shall be the total compensation for furnishing all labour, tools, materials, equipment and incidentals necessary to complete the work, including all excavation and disposal of surplus material.

7.2.12 Concrete Foundations

The space resulting from removal of unsuitable materials shall be filled with a concrete foundation and the concrete shall conform to relevant provisions of Indian Specifications.

7.2.13 Bedding

The bedding for pipe shall be provided as specified in the Drawings or as per direction of Engineer-in-charge.

7.2.14 Concrete cushion, embedment and encasement

Concrete embedment and encasement wherever required, shall be constructed as per the details given in approved Drawings or as directed by the Engineer-in-charge. Where concrete bedding is to be placed beneath the pipeline, the sub-grade shall be prepared to dimensions as shown in the Drawings. The bottom of the trench may be sloped on the sides or kerbed, but the thickness of concrete shall be as specified in the Drawings or as directed by the Engineer-in-charge. Dry mix will not be permitted.

For earth, granular material or concrete embedment, each pipe section shall have uniform bearing on the subgrade for the full length of the pipe barrel, suitable excavation shall be made to receive the pipe, bell or collar and allow adequate room for proper workmanship in making the joint. Adjustment to line and grade shall be made by scraping away or filling in with gravel or concrete and not by wedging or blocking up the bell. Pipe sockets and barrels shall be clean and free from dirt at the time of jointing.

The concrete for bedding portion will be mixed moist or damp to give a slump of not more than 25 mm and for sides and top portions of encasement, if specified, will be mixed to obtain a slump between 25 mm and 80 mm. All water in the trench must be disposed off prior to placing of concrete. There should be no cleavage line between the bedding concrete and the side embedment concrete. Clear out space shall be left for jointing and lowering pipe in place and bringing to grade by tamping under pipe or removing excess concrete under pipe. After the joint is made, the remainder of the concrete embedment may then be poured and thoroughly tamped to make bond with original concrete. Care must be exercised in tamping to prevent lifting of the pipe out of alignment or grade. Back filling shall be done in a careful manner and such time after the concrete cushion, embedment or encasement is placed, as not to damage the concrete in any way.

All pipes shall be so laid that the contact in the joint between the two lengths of pipe shall be uniform throughout the circumference of the joint. Where curves in the alignment are indicated on the Drawing, and the curves are flat, standard pipe will be used with the outside edge of the joint pulled away from the seat to make a smooth joint. Where curves are sharp, standard or specially made bends will be used. Openings at end of day's work openings in tees, deep cut connections, shall be capped and sealed.

7.2.15 Laying of pipes and fittings / specials

All precautions shall be taken during excavation and laying operations to guard against possible damage to any existing structure / pipe line of water, gas, sewage, etc. After excavation of trenches, pipes shall not be lowered unless the dimensions of trenches and bedding work for pipes at the bottom of the trenches are approved and measured by Engineer-in-charge. Pipes and fittings / specials shall be carefully lowered in the trenches.

The pipes and specials shall be stacked along the alignment in advance with utmost care during the transit so that they are not damaged. Any damage due to these reasons shall be Contractor's liability. The pipe shall be lowered and laid only after the trenches are finally ready and levels duly checked by the Engineer-in-charge. It shall be seen that no damaged pipe is lowered in the trench. Every precaution shall be taken to prevent foreign materials from entering the pipes when they are being placed in the line. Normally the socket ends shall face the upstream. When any portion of the excavation shall have been carried down to the necessary depth, the Contractors shall obtain permission from the Engineer-in-charge before commencing the laying of pipes or concrete or the construction of masonry.

Special arrangements such as cranes, tripods with chain pulley block for lowering the pipes and fittings / specials shall be made by Contractor. In no case pipes and fittings / specials shall be dropped. Slings of canvas or equally non-abrasive material of suitable width or special attachment to fit the ends of pipes and fittings / specials shall be used to lift and lower the coated pipes and fittings / specials. The pipes and fittings / specials shall be inspected for defects and be rung with a light hammer preferably while suspended to detect crack, wherever applicable. If doubt persists, further confirmation shall be done by pouring a little paraffin on the inside of the pipe at the suspected spot. No sign of paraffin should appear on the outside surface. Pipes and fittings / specials damaged during lowering or aligning shall be rejected by Engineer-in-charge.

All the pipes are to be laid perfectly true both in alignment and to gradient specified. Pipes in a trench shall be laid and fitted previous to the jointing being commenced. In case of spigot and socket pipe the socket end of the pipe shall face upstream, except when the pipe line runs uphill in which case the socket ends should face the upgrade of a slope. After placing a pipe in the trench, the spigot end shall be centered in the socket and the pipe forced home and aligned to required gradient. The pipes shall be secured in place with approved backfill material tamped under it except at the socket. Pipes and fittings / specials which do not allow a sufficient and uniform space for joints shall be removed and replaced with pipes and fittings / specials of proper dimensions to ensure such uniform space. Precaution shall be taken to prevent dirt from entering the jointing space. At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by Engineer-in-charge. during the period that plug is on, the Contractor shall take proper precautions against floatation of the pipe owing to entry of water into the trench. Wherever it is necessary to deflect pipe from a straight line, either in the vertical or horizontal plane, to avoid obstructions or where long radius curves are permitted, the deflection allowed at joints shall not exceed 2½o. In the case of pipes, with joint to be made with loose collars, the collars shall be slipped on before the next pipe is laid. The pipes shall be laid such that the marking on pipes appears at the top of the pipes. Properly fitted temporary wooden stoppers shall be provided to close the ends of all incomplete pipe lines. The stoppers are only to be removed when pipes are being laid and jointed. Pipe laying and jointing shall be started and completed only section wise as per the instruction of the Engineer-in-charge. During the progress of pipe laying the open ends of pipe shall be closed and water tight. Sight rails shall be provided at all change of direction or gradients at distance of @ 30 m along straight lengths. All the invert levels shall be confirmed from the sight rails with the help of proper boning rods as per the standard practice. The pipe shall be jointed with cement mortar 1:1 and proper caulking shall be done. After a particular section of the pipe is laid and jointed hydraulic testing shall be done section wise.

Just prior to placing each pipe section in the line, damaged coating shall be repaired and the interior shall be cleaned off all foreign materials. Cleaning shall be accomplished by brushing, blowing with compressed air and washing with water or as specified by the Engineer-in-charge.

The item for laying of pipe line also includes labour work for lowering, laying and jointing various pipes including jointing with specials, levelling, etc. The Contractors shall transport pipes and specials from stores, for their various sections in such quantities as may be required for laying. Ordinarily no surplus stock shall remain on completion of any section. In case however, such pipe etc. become surplus in any sections, the Contractor shall remove the same to the next section for use in the work. It is likely that on completion of the whole work, some pipes and specials etc. may become surplus at the site and the Contractors shall arrange to hand over the same in good condition to the Engineer-in-charge at the Owner's store as may be directed if required by Owner. The Contractor shall supply a list of stock so returned to the Engineer-in-charge. No extra payment shall be made to the Contractors for these works. The rates for laying the pipes shall cover the cost of loading, transporting and unloading as may be required. The fortnight report for pipes collected and laid should be sent to the Engineer-in-charge.

The cutting of pipe for inserting valves, fittings or specials shall be done in a neat and workman like manner without damage to the pipe so as to leave a smooth end at right angles to the axis of the pipe. For this purpose, pipe cutting machine shall be used.

7.2.16 Jointing

Pipes shall be laid to the lines and grades given in the plans, with the ends abutting to form a even joint without shoulders or unevenness of any kind along the invert of the pipes. No joint shall be made under water. The ends of the pipes shall be dry and kept clean before and during laying and jointing operations.

All joint work shall be done in an approved manner by skilled workmen so that the completed pipeline shall have a continuous, smooth and uniform interior surface. Extruded joint material shall be removed from the interior of the pipe. In cold weather protective measures must be taken to ensure a satisfactory joint.

Jointing for pipes and fittings / specials shall be done in accordance with the relevant Specifications depending on type of pipes being used.

7.2.17 Valve Rooms, Manholes, Head Walls, Thrust Blocks, Anchor Blocks, Saddle supports etc.

The Contractor shall build manholes, inlet manholes, inlets, junction chambers, headwalls, culverts, anchor blocks, thrust blocks and such other miscellaneous structures that may be required at the locations instructed by the Engineer-in-charge and of such forms, dimensions and materials as are shown in the approved standard details or as may be specified or directed. These structures shall also include the installation of such specials and connections to pipes and other structures as may be required to complete the constructions as shown in the Approved Drawings.

7.2.18 Closure sections and connections to structures

Closure sections shall be constructed where required by the Contractor's operations. Connections to pipe specials shall be made as approved by the Engineer-in-charge. Lining and coating of the pipe lines, which must be cut to provide for closure pieces or to permit the proper location of valves structure shall be repaired by the Contractor. No separate payment will be made for closure pieces installed, but the same will be measured as it is a pipe in place and along the pipeline.

The cutting of pipe for inserting valves, fittings or specials shall be done in a neat and workman like manner without damage to the pipe so as to leave a smooth end at right angles to the axis of the pipe. For this purpose, pipe cutting machine shall be used.

7.2.19 Temporary stoppages of work

At times when pipe laying is not in progress, or at the end of the day's work, the open ends of pipe shall be closed by a watertight plug or other means approved by Engineer-in-charge. During the period that plug is on, the Contractor shall take proper precautions against floatation of the pipe owing to entry of water into the trench.

7.2.20 Testing and commissioning

Testing and Commissioning of pipes shall be done in accordance with the relevant Specifications.

7.2.21 Water Tightness test

All hydraulic structures, either water supply or drainage etc., such as sewer lines, joints etc., or any other liquid containers shall have to be tested for water tightness. The Contractor shall give all such hydraulic tests by making his own arrangements for water filling and disposal of water after the test and shall repeat this test, if necessary, until the requisite test results are obtained without any claim for extra cost or compensation. The water tightness test shall be conducted as specified in IS: 4127- 1967. The tendered rates for hydraulic structures shall include all costs incurred by the Contractor for water tightness test. If any such hydraulic structure or fixture is found to be unsatisfactory at the time of giving this test the Contractor shall either repair or demolish and construct the same as directed such that the structure is made absolutely water tight and declared as satisfactory by the Engineer-in-charge. The decision of the Engineer-in-charge will be taken as final. The Contractor may use at the time of construction, for increasing the water tightness, approved proprietary chemicals only with the express permission of the Engineer-in-charge to serve the purpose of the Contractor to facilitate such type of work for his own convenience and advantage. But in all such cases, the Contractor will not be entitled to any extra rate. The Contractor shall see that every effort is made to make structures and fixtures water tight, by resorting to such chemicals and making efficient use of proportion and grading of materials etc., as provided originally in the Specifications.

7.2.22 Backfilling

Trenches shall be backfilled with approved selected excavated material only after the successful testing of the pipe line. The tamping around the pipe shall be done by hand or other hand operated mechanical means. The water content of the soil shall be as near to the optimum moisture content as possible. Filling of the trench shall be carried out simultaneously on both sides of the pipe in such a manner that unequal pressure does not occur. Back filling shall be consolidated by watering, ramming, care being taken to avoid damage to the pipe line. In case of mild steel pipes / specials, the spiders provided during assembly and welding shall be retained until the trench is refilled and consolidated. Where timbers are placed under the pipe line to aid alignment, these timbers shall be removed before backfilling.

7.2.23 Reinstatement of road / footpath

Reinstatement of road / footpath shall be done as per the requirements of local authorities and the relevant Specifications after the completion of work.

7.2.24 Clearing of site

All surplus materials, and all tools and temporary structures shall be removed from the site as directed by Engineer-in-charge and the construction site left clean to the satisfaction of Engineer-in-charge.

7.2.25 Disinfection of water mains

The mains intended for potable water supplies should be disinfected before commissioning them for use.

The mains shall be chlorinated with a liquid chlorine solution (that is liquid chlorine gas and water mixture). The disinfection shall be considered to have been achieved if a chlorine residual of not less than 10 ppm remains in the water after 24 hours standing in the pipe. If this requirement is met with, the main should be thoroughly flushed with clean water.

If the treatment specified above is not possible, enough chlorinate lime, calcium or sodium hypochlorite should be introduced to produce the required concentration of chlorine in the solution. The solution should then be allowed to stand for not less than 24 hours, after which it should be tested for residual chlorine, which should not be less than 10 ppm. If found satisfactory, the mains should be thoroughly flushed with clean water.

7.2.26 Measurement

The measurements for excavation in trenches shall be done in following manner and will be paid accordingly.

Length	As per actual length of pipe and fittings / specials laid at work site.
Width & cross Section	As per Approved Drawing
Depth	Average depth of trench from ground level to invert of pipe plus thickness of bedding

Excavation of asphalt road and reinstatement of road shall be measured on per square metre basis and the length and width at top of trench shall be considered same as those mentioned for excavation of trench. Rate of this item, if any to be paid as per BOQ.

The measurement for removal of excess excavated material upto a specified distance shall be as per the relevant item(s) in the schedule of Quantities and Rates and shall be measured on cubic metre basis. In case of soil 30% deduction shall be done to take account for voids where as it will be 40% in case of rubble.

Measurement for pipes and fittings / specials shall be in accordance with the relevant clause(s) of Specification and IS Code for particular types of pipes.

7.2.27 Notes

Fencing provided along the sides of trenches and pits shall not be paid for separately and Contractor shall take into account the costs of such works and quote accordingly.

In case of the metal packing or dressed stones not being deposited as specified or being mixed up with excavated materials and not available for the reinstatement of road / pavement, the cost of the new metal packing or dressed stones required shall be without any extra charges to Contractor by Engineer-in-charge.

Service lines if damaged during excavation shall be made good either by Contractor or by other agency as Engineer-in-charge may decide and the cost of the same shall be borne by the Contractor wholly in either case.

Contractor shall not be paid any additional compensation for excess excavation over what is specified as well as for any remedial measures that are specified.

The excess excavated material shall be carried away from site of works as specified, failing which in view of public safety and traffic convenience Engineer-in-charge may carry out the work by any other agency at Contractor's risk and cost.

8. SUPPLY OF DUCTILE IRON, HDPE PIPES, SPECIALS, VALVES AND LAYING OF PIPES FOR WATER SUPPLY

8.1 General

8.1.1 Standards

Except as otherwise specified in this technical specification, the Indian/International Standards and Codes of Practice in their latest version shall be adhered to for the design, manufacturing, inspection, factory testing, packing, handling and transportation of product. Should any product be offered conforming to other standards, the equipment or products shall be equal to or superior to those specified and the documentary confirmation shall be submitted for the prior approval of the Engineer-in-charge.

This specification requires a reference to the following standard specifications

IS: 4985 Unplasticized PVC pipes for potable water supplies
IS: 10151 PVC and its copolymers for its safe use in contact with foodstuffs,
pharmaceuticals, and
drinking water IS: 10500 Drinking water specification
IS: 12235 Methods of test for unplasticized PVC pipes for potable water supplies
IS: 4669 Methods of test for PVC resin
IS: 12818 Unplasticized PVC screen and casing pipes for bore/tube well IS: 3400 Methods of test for vulcanised rubber (part-1 to 22)
IS: 1387 General requirements for the supply of metallurgical material IS: 210 Grey iron casting
IS: 1536 Centrifugally cast (spun) iron pressure pipe for water, gas and sewage
IS: 1537 Vertically cast iron pressure pipe for water, gas and sewage IS: 1538 Cast iron fittings for pressure pipes for water, gas and sewage
IS: 5531 CI specials for Asbestos cement pressure pipes for water gas & sewage
IS: 1363 Hexagon head bolts, screws and nuts of product grade A and B (part:1-5)
IS: 1367 Technical supply conditions for threaded steel fasteners IS: 780 Sluice valve for water works purposes
IS: 2906 Specifications for sluice valves for water works purposes IS: 318 Leaded tin bronze ingots and casting
IS: 8543 Methods of testing plastics: Determination of density of solid plastics
IS: 7181 Horizontally cast iron double flanged pipes for water, gas and sewage.

IS: 8794	CI detachable joints for use with Asbestos cement pressure pipes IS: 5382 Rubber sealing rings for gas mains, water mains and sewers
IS: 5531	Cast iron specials for asbestos cement pressure pipes for water, gas and sewage
IS: 779	Water meters
IS: 3624	Pressure and vacuum gauges IS: 341 Black japan, types A, B and C
IS: 9862	Ready mixed paint, brushing, bituminous, black, lead free, acid, alkali, water and chlorine resisting
IS: 1239	Mild steel tubes, tubular and other wrought steel fittings
IS: 7328	High density polyethylene materials for moulding and extrusion
IS: 4984	Specification for high density polyethylene pipes for potable water supplies; sewage and industrial effluents
IS: 554	Dimensions for pipe threads where pressure tight joints are required on the threads
IS: 1592	Asbestos cement pressure pipes - Specifications
IS: 778	Specifications for copper alloy gate, globe and check valves for water works purposes
IS: 12820	Dimensional requirements for rubber gaskets for mechanical joints and push on joint for use with cast iron pies and fittings for carrying water, gas and sewage.
IS: 9523	Specification for DI fittings for pressure pipes for water, gas, and sewage.
ISO: 2045	Single socket for uPVC and uPVC pressure pipes with elastic sealing ring type joints - Minimum depth of engagement
ISO: 2507	PVC pipes and fittings- Vicat softening temperature - Test method and specification
ISO: 3603	Fittings for PVC pipe with elastic sealing ring joints pressure test for leakproofness
ISO: 1167	Thermoplastics pipes for the transport of fluids - Resistance to internal pressure - Test method and basic specification
ISO 3451-5	Determination of Ash: Part-5 - Poly vinyl chloride
ASTM: D 2152	Standard test method for ^{0} of fusion of extruded PVC pipe and moulded fittings by Acetone immersion
MTNL	Mahanagar Telephone Nigam Limited; Technical specifications for cable ducts.
BS: 4772	Specification for DI fittings
IS: 7634- Parts 1-3	Code of practice for plastic pipe works for potable water supplies
IS: 8329	Centrifugally cast (spun) ductile iron pressure pipes for water, gas and sewage.
IS: 12288	Code of practice for use and laying of ductile iron pipes
CPHEEO	Manual on Water Supply and Treatment, III edition, Ministry of Urban Development, New Delhi- May 1999.

8.2 Ductile Iron Pipes

8.2.1 Ductile Iron Pipes:

The pipes will be centrifugally cast (spun) Ductile Iron pipes for Water and Sewage confirming to the IS 8329: 2000. The pipes used will be either with push on joints (Rubber Gasket Joints) or Flanged joints. The class of pipe to be used shall be of the class K-9.

The pipes shall be coated with bitumen as per appendix C and have factory provided cement mortar lining in the inside as per the provisions of Appendix B of the IS 8329: 2000.

The pipes will be supplied in standard length of 4.00, 5.00, 5.50 and 6.00 meters length with suitably rounded or chamfered ends. Each pipe of the push on joint variety will also be supplied with a rubber EPDM/(SBR) gasket. Any change in the stipulated lengths will be approved by the Engineer-in-charge. The gaskets will confirm to the IS 5382:1985.

The gaskets should also be supplied by the manufacturer of the pipes. They should preferably be manufactured by the manufacturer of the pipes. In case they are not, it will be the responsibility of the manufacturer of the pipes to have them manufactured from a suitable manufacturer under its own supervision and have it tested at his/sub-Contractors premises as per the contract. The pipe manufacturer will however be responsible for the compatibility and quality of the products.

The flanged joints will confirm to the Clause 6.2 of IS 8329. The pipe supply will also include one rubber gaskets for each flange.

8.2.2 Inspection and Testing:

The pipes will be subjected to following tests for acceptance:

- Visual and dimensional check as per Clause 13 and 15 of IS 8329
- Mechanical Test as per Clause 10 of IS 8329
- Hydrostatic Test as per Clause 11 of IS 8329
- The test reports for the rubber gaskets shall be as per acceptance tests of the IS 5832 and will be in accordance to Clause 3.8

The sampling shall be as per the provisions of the IS 8329

8.2.3 Marking

- All pipes will be marked as per Clause 18 of IS 8329 and show as below:
- Manufacturer name/ stamp
- Nominal diameter
- Class reference
- A white ring line showing length of insertion at spigot end

8.2.4 Packing and Transport:

The pipes should be preferably transported by road from the factory and stored as per the manufacturer specifications to protect damage.

8.3 Specials for Ductile Iron Pipes

8.3.1 General

This section covers the general requirements for Ductile Iron (DI) fittings suitable for Tyton joints to be used with Ductile Iron pipes with flanged and Tyton jointing system.

8.3.2 Types of specials

The following types of DI fittings shall be manufactured and tested in accordance with IS: 9523 or BS: 4772.

- flanged socket
- flanged spigot
- double socket bends (900, 450, 22 1/2 0, 11 1/4 0)
- double socket branch flanged tee
- all socket tee
- double socket taper
- All the fittings shall be of class K-12.

8.3.3 Supply

All the DI fittings shall be supplied with one rubber ring for each socket. The rubber ring shall conform to IS: 12820 and IS: 5382 as described in the preceding chapter and/or BOQ. Flanged fittings shall be supplied with one rubber gasket per flange and the required number of nuts and bolts.

8.3.4 Lubricant for ductile iron pipes and specials

8.3.4.1 General

This section covers the requirements for lubricant for the assembly of Ductile Iron pipes and specials suitable for Tyton push-in rubber ring joints

8.3.4.2 Specification

The lubricant has to have the following characteristics:

- must have a paste like consistency and be ready for use
- has to adhere to wet and dry surfaces of DI pipes and rubber rings
- to be applied in hot and cold weather; ambient temperature 0 - 50 °C, temperature of exposed pipes up to 70 °C
- must be non-toxic
- must be water soluble
- must not affect the properties of the drinking water carried in the pipes
- must not have an objectionable odour
- has to inhibit bacterial growth
- must not be harmful to the skin
- must have a shelf live not less than 2 years

Acceptance tests

- They shall be conducted in line with the provisions of the IS 9523

8.3.5 Packing

All the DI fittings shall be properly packed with jute cloth. Rubber rings shall be packed in polyethylene bags. Rubber rings in PE bags and nuts, bolts etc. shall be supplied in separate jute bags.

The fittings should also be supplied by the manufacturer of the pipes. They should preferably be manufactured by the manufacturer of the pipes. In case they are not, it will be the responsibility of the manufacturer of the pipes to have them manufactured from a suitable manufacturer under its own supervision and have it tested at his/sub-Contractors premises as per the contract. The pipe manufacturer will however be responsible for the compatibility and quality of the products.

8.4 HDPE Pipes

8.4.1 Scope

This Specification covers the requirements for manufacturing, testing, supplying, laying, jointing and testing at works and site of HDPE pipes used for water supply, sewers.

8.4.2 Applicable Codes

The manufacturing, testing, supplying, jointing and testing at work sites of HDPE pipes shall comply with all currently applicable statutes, regulations, standards and Codes. In particular, the following standards, unless otherwise specified herein, shall be referred. In all cases, the latest revision of the Codes shall be referred to. If requirements of this Specification conflict with the requirements of the standards / Codes, this Specification shall govern.

IS: 4984	Specifications for High Density Polyethylene Pipes for Water Supply (Including Fittings)
IS: 2530	Methods of test for polyethylene moulding materials and polyethylene compounds
IS: 7328	High density polyethylene materials for moulding and extrusion ***(first revision)***
IS: 9845	Method of analysis for the determination of specific and/or overall migration of constituents of plastics materials and articles &ended to come into contact with foodstuffs (**first revision**)
IS: 10141	Positive list of constituents of polyethylene h contact with foodstuffs, pharmaceuticals and drinking water
IS: 10146	Polyethylene for its safe use in contact with foodstuffs, pharmaceuticals and drinking water

Others I.S. Codes not specifically mentioned here but pertaining to the use of HDPE pipes form part of these Specifications.

8.4.3 HDPE Pipes:

The pipes will be High Density Polyethylene Pipes for Water and Sewage confirming to the IS 4984 and IS 14333 respectively. The pipes used will be joined by electro- fusion welding using either with automatic or semi-automatic electrofusion machines. The class of pipe to be used shall be as specified in the BOQ of this RFP.

Contractor will supply all size HDPE pipe, fittings and other materials as per BOQ necessary to complete the laying of pipelines. The Contractor is to procure all bought out items from approved vendors and accordingly keep Engineer-in-charge informed. The inspection of bought out items would be carried out by Engineer-in-charge or as instruction by Engineer-in-charge. The Contractor shall provide the skilled labour, tools, material and equipment necessary for the proper execution of the Work. This will include but not be limited to list of specialized items furnished herewith.

8.4.4 Jointing:

The Contractor must have dedicated bar coded electro- fusion (Automatically/ Semi- automatically Readable) machine with power generator (at any point of time minimum 2 nos.), Pipe Cutters (like circular guillotine), End Scrapers, Pipe Straightened, approved Top loading clamp for fusing saddle tapping tee, clamps of all sizes for Electro-fusion fittings, re-rounding tools and test ends etc. for pipes. Contractor has to arrange his own all equipment(s) for HDPE fusion equipment at the site whenever required.

In case there is non-availability of approved equipment(s), tools and tackles during the work at site, suitable penalties, as per special terms and condition of the contract, will be levied and deducted from the running bills.

The procedure for jointing of HDPE pipe and fittings must be done by only Bar coded electrofusion machine (Automatically/ Semi-automatically Readable) that can read the bar code of the fittings automatically shall be used for jointing of HDPE pipe / fittings. Manual feeding electro-fusion machines are not acceptable for jointing purpose.

The Contractor has to submit the certificate of calibration of Fusion machine at the time of start of work and at fixed intervals as per the instruction of Engineer-in- charge. Contractor shall ensure that the machines are always available at site, no stoppage of work due to the non-availability of machines.

The Contractor shall flush the Pipeline with air to remove dust, water, mud etc. before fusing the joints.

Before jointing, the Contractor shall place packing sand under the pipes and/or on both sides of the joint to keep the pipes in line and at the correct alignment during the jointing process. Alignment clamps with the correct size shells should be used to align the pipe during the electro-fusion cycle.

The Contractor shall ensure that polyethylene pipe is only cut with an approved HDPE pipe cutting tool. Before fusion is attempted the Contractor shall remove the oxidized surface of the pipe to be inserted into the electro-fusion coupling. The tool must remove a layer of 0.1 mm to 0.4 mm from the outer surface of the polyethylene pipe. It may also be noted that no fusion will be allowed without clamping device and only the approved cutting tools (Hack Saw shall not be allowed for cutting the Pipe) shall be used.

The Contractor has to supply all the consumables required for carrying fusion of the joints (like cloth/ paper napkin, acetone etc.). If, upon inspection, the EIC determines a joint is defective, Contractor shall remove the joint by an approved

method. The cost of this work shall be borne by the Contractor. For electro-fusion jointing, the Contractor must bring own tools, tackles and equipment(s).

Contractor shall arrange generator for power supply for fusion machine. Taking power connection from nearby construction power source, connections without written permission from concerned authorities or residential premises is strictly not permitted.

Only, Approved Jointers shall carry out fusion of all joints. Contractors shall provide the list of jointers to be used on the job and make arrangements for qualification Testing of the jointers in presence of Engineer-in-charge / Engineer-in-charge's representative. All approved Jointers shall bear Identity cards signed by Engineer- in-charge / Engineer-in-charge's representative.

8.4.5 Grade of Materials

Pipes shall be classified according to the grade of materials as given in Table below:

Sl. No.	**Material Grade**	**MRS of Material in MPa, at 20ºC, 50 Years**	**Maximum Allowable Hydrostatic Design Stress (σ), MPa**	
			At **20ºC**	**At 30ºC**
(1)	(2)	(3)	(4)	(5)
i)	PE 63	6.3	5.0	4.0
ii)	PE 80	8.0	6.3	5.0
iii)	PE 100	10.0	8.0	6.3

Note: The pipes are recommended for maximum water temperature of +45ºC. the pipes may also be used up to the ambient temperature -40ºC. As the creep rupture strength of the pipe varies with the change in water temperature, the maximum working pressure, therefore should be modified by applying the pressure coefficient as given in Fig. 1 of IS 4984.

The maximum allowable hydrostatic design stress (σ) of a pipe is obtained by applying the design coefficient of 1.25 (Min) to the MRS value of the material, taking into consideration the temperature at which the pipe is designed.

The material grading shall be given by the raw material supplier and in case of master batch, by the pipe manufacturer.

8.4.6 Pressure Rating

Pipes shall be classified by pressure rating (PN) corresponding to the maximum permissible working pressure at 30ºC, as follows:

Pressure Rating of Pipe	**Maximum Permissible Working Pressure**
PN 2.5	0.25 MPa
PN 4	0.40 MPa
PN 6	0.60 MPa
PN 10	1.00 MPa
PN 12.5	1.25 MPa
PN 16	1.60 MPa

8.4.7 Nominal Diameter (DN)

The nominal diameter of pipes covered as per IS Specifications are:

16, 20, 25, 32, 40, 50, 63, 75, 90, 110, 125, 140, 160, 180, 200, 225, 250, 280, 315,

355, 400, 450, 500, 560, 630, 710, 800, 900 and 1000 mm.

8.4.8 Marking

All pipes will be marked as per Clause 10 of IS 4984 and show as below:

- Manufacturer name/ Trade-mark
- Designation of pipe
- All pipes shall be designated according to the grade of material as per Clause
- 16.10.5 followed by pressure rating as per Clause 16.10.6 and nominal diameter as per Clause 16.10.67 For PE 63 PN 10 DN 200, indicates a pipe pertaining to material grade 63, pressure rating 1.0 MPa and outside nominal diameter 200mm.
- Lot number/ Batch number

8.5 Valves

8.5.1 General

All the valves must be Electrically Operated & SCADA Compatible for this Atal Puram Township Project.

The sluice valve will confirm to IS: 780/ IS: 2906.

The material to be supplied under this sub-section shall include but not be limited to the following:

All necessary fittings including bolts, nuts, gaskets, backing rings, counter flanges, jointing material, strainers etc. as required.

8.5.2 Sluice Valves

8.5.2.1 Scope

This section covers the requirements for non-rising stem type sluice valve from 50 mm to 600 mm size. The valves will be used for water supply on line installations in upright positions, up to 450 C working temperature, with double flange and cap or hand wheel, for manual operation.

8.5.2.2 Nominal pressure and dimensions

The working pressure of the valves shall be 16 kg/cm2 (1.6 Mpa) or as specified in the BOQ.

The dimension and mass of the sluice valves shall be in accordance with IS: 780 for sizes from 50 to 300 mm and IS: 2906 for sizes 350 to 1200 mm.

The flanges and their dimensions of drilling shall be in accordance with IS: 1538 (Part-I to XXII).

8.5.2.3 Material

The material for different components parts of sluice valve shall conform to requirements given below:

S No.	Component	Material	Ref. to IS	Grade / designation
1	Body, bonnet, wedge, stuffing box, gland, thrust plate, hand wheel cap. etc.	Grey cast iron	210	FG 200
2	Stem	Stainless steel	6603	AISI 431, AISI 410
3	Wedge nut	Leaded tin bronze	318	LTB 2
4	Body seat ring, wedge facing ring	Leaded tin bronze	318	LTB 2
5	Bolt	Carbon steel	1363	Class 4.6
6	Nut	Carbon steel	1363	Class 4
7	Bonnet gasket	Compressed fibre board	2712	C
8	Gland packing	Asbestos	4687	nil

8.5.2.4 Coating

All sluice valves shall be coated by dipping in a bath of tar base composition as given in Clause 7 of IS: 780 for sizes from 50 mm to 300 mm and Clause 8 of IS: 2906 for sizes from 350 mm to 1200.

All components susceptible to corrosion attack shall be coated internally and externally. Protective coating shall always be applied to the individual components before they are assembled, following shot blasting to give good adhesion.

8.5.2.5 Marking, testing and inspection

The standard marking and packing of the valves shall be done as per Clause 10 and 11 of IS: 780. The direction of rotation for OPEN, CLOSE position shall be marked on the hand wheel and on the bonnet of the valve.

Testing of sluice valve shall be done for close end in accordance with IS: 780 for sizes from 50 mm to 300 mm and IS: 2906 for sizes from 350 mm to 600.

All the valves shall be inspected for flaw detection test in accordance with IS: 780. for sizes from 50 mm to 300 mm and IS: 2906 for sizes from 350 mm to 1200.

The design, construction material, manufacture, inspection, performance, and testing shall comply with all applicable Indian Standards and Codes. Nothing in the specification will be construed to relieve the supplier of this responsibility.

8.5.3 Air valves

8.5.3.1 Scope and general design feature

This section covers the requirements of automatic double ball air valves to be used for evacuation of accumulation of air in water mains under pressure, for the exhaust of air when such mains are being charged with water and for inlet of air when they are emptied of water.

The design shall be such that higher the rate of flow the greater the resultant down thrust keeping the ball 'glued' to its seat until the last drop of air is expelled from the pipe system.

The valves shall have an integrated sluice valve. If required, they shall be installed on a flange welded on the MS pipe / special. The possible air velocity (inflow and outflow) must be at least 10 m/s. The working pressure of the air valves shall be 16 kg/cm2 (1.6 Mpa).

8.5.3.2 Construction feature

The flow of air should be as unobstructed as possible. The low pressure orifice shall

be in the same axis as the main discharge/incoming air flow and must have a diameter sufficiently large.

The cone angle in the low pressure (large orifice) chamber should be carefully calculated and there should be adequate height to allow for free movement of the vulcanite ball in the low chamber. The annulus around the low pressure vulcanite covered ball is to be generously proportioned for discharge of air under various differential pressure.

The orifice shall be carefully profiled to allow the requisite flow of air under varying differential pressure. It shall be in moulded synthetic rubber such that even after extended contact the vulcanite covered ball does not stick to it when the line pressure becomes zero.

In the high pressure chamber, the orifice shall be in profiled in such a manner that the rubber covered ball is not damaged even after extended contact. There should be machined guide in the chamber which ensures that the ball travels vertically and makes contact with the nipple and seals off the orifice without fail.

8.5.3.3 Material

The material for different components parts of the air valve shall conform to requirements given below:

S No.	Component	Specifications
1	Body	Cast Iron conforming to IS: 210 GR FG 200
2	High Pressure Cover	Cast Iron confirming to IS 210 GR FG 200
3	Low Pressure Cover	Cast Iron confirming to IS 210 GR FG 200
4	Cowl	Cast iron confirming to !S 210 GR FG
5	High Pressure Orifice Plug	Stain less steel conforming to AISI 410
6	Low pressure ball	Vulcanite covered seasoned timber
7	High pressure ball	Rubber covered seasoned timber
8	Lower pressure seat ring	Dexine (Nitrile rubber)
9	Isolating sluice valve	Conforming to IS: 780 - 1984
10	Spindle for sluice valve	Stainless steel conforming to AISI 410
11	Bolts and nuts	Mild steel

The body and seat of the valve shall withstand a working pressure of 10 kg/cm2 for at least 15 minutes.

TECHNICAL SPECIFICATION FOR POWER INFRASTRUCTURE AND SMART STREET LIGHTING

(SCHEDULES)

TABLE OF CONTENTS

1 POWER INFRASTRUCTURE

Power Supply in the proposed Atal Puram township is to make quality and reliable power available for 24/7 supply with Smart Grid & Smart Metering with energy efficient transmission and automation in distribution. The power supply system will be with underground cables.

The following aspects needs to be considered while carrying out the design & execution of the Atal Puram township-

a) Maintaining high availability and as well reliability in the system
b) More redundancy (n-1 design criteria will be followed)
c) Ensuring Personal & System Safety
d) Space optimization
e) Operational and maintenance ease
f) Control and monitoring
g) Economic
h) Obtain the fault level at each buses within permissible limits
i) Voltage drop and AT & C losses within permissible limit.
j) Ensuring Zero % theft.
k) Application of state-of-the-art technology
l) Service proven design
m) Use of interchangeable, modular components
n) Environment friendly
o) Adherence to operational performance requirements

The power distribution system will be developed based on Smart Grid concept. All 33 kV and 11 kV feeders of substations and supply point of the plot will be metered and proper energy management system will be established.

1.1 Scope of Work

This specification is intended to cover the *design, detailed Engineering, construction/ manufacture, procurement of electrical equipment's, assembly, testing at manufacturer's works, supply in properly packed condition for transport to site, transportation, Erection, site testing and commissioning,* including preliminary acceptance test, performance guarantee and post commissioning services and

insurance during transit, storage, erection and commissioning till end of defect liabilities period with all accessories for efficient and ease of operation of township, Agra.

The Scope includes but not limited to Supply, Installation, testing & commissioning (SITC) of 3 nos. of 33/11kV Distribution substations including Lighting, earthing & cabling system, Ring Main units (RMUs) for power supply at each plot, RCC trench & associated manholes for underground cabling system, Compact Substation (CSS) for power supply of Street lighting & miscellaneous loads, 33kV & 11kV power cables.

The scope also include all civil works (Design, Supply, construction and handling over) required for all electrical equipments i.e. civil works for 33/11kV substation such as building, Transformer foundations and cable trench, boundary wall, fencing works, gate, internal road, drains, control room etc., foundation for RMUs (at each plot) & CSS, all civil works for RCC trench & associated manholes for underground cabling system for Atal Puram township.

The scope shall also include supply of mandatory spares and special Tools as specified.

- Cable shall be laid in groups with uniform spacing arrangement in trays to sustain the loads.
- Manhole chambers for RCC trench should have sufficient space inside for cable laying, bending (20D) and jointing as well as for future maintenance as given in drawing.

In addition to the standards provided in the Technical specification, Contractor shall also observe the latest editions of the following standards, specification or requirements. In case of any conflict, technical advice from EIC shall be obtained.

The BIDDER shall be responsible for complete satisfactory working of system with guaranteed parameters. All the major equipment shall be installed tested and commissioned under supervision of representative of original manufacturer of respective equipment in the presence of commissioning agent appointed by the employer.

The scope includes but not limited to SITC of following items-

SL No	Description	Quantity	Remarks
Power Transformers	33/ 11kV, 10MVA, Oil type, two winding, 3 Phase, Dyn11, 50Hz, ONAN/ ONAF Transformer with 8.35% impedance on 10 MVA with OLTC.	6 nos.(4 Nos in EPC Package)	2 at ESS-2 and 1 Nos at ESS-1&3
33kV Switchgears	Indoor type, GIS (Refer SLD for more detail).	3 nos.	1 at each S/S
11kV Switchgears	Indoor type, GIS (Refer SLD for more detail).	3 nos.	1 at each S/S
Distribution Transformer	11/ 0.433kV, 250kVA, Dry type, two winding, 3 phase, Dyn11, 50Hz, AN, off circuit tap changer with +/-5% in steps of 2.5% on HV side for station transformer & 4% impedance with losses as per CBIP.	6 nos.	2 at each substation
Lighting Transformer	415/415V, 50kVA, Dry type, two winding, 3 phase, Dyn11, 50Hz, off circuit tap changer +/-5% with 4% impedance.	3 nos.	1 at each substation
11kV RMUs	3 way RMUs(2 nos. incomer Load break switch & 1 nos. of outgoing VCB) with FPI (Fault passage indicator) and FRTU (Field remote terminal unit) for SCADA integration.	14 nos.	
11kV RMUs	4 way RMUs(2 nos. incomer Load break switch & 2 nos. of outgoing VCB) with FPI (Fault passage indicator) and FRTU (Field remote terminal unit) for SCADA integration.	24 nos.	
11kV RMUs	5 way RMUs(2 nos. incomer Load break switch & 3 nos. of outgoing VCB) with FPI (Fault passage indicator) and FRTU (Field remote terminal unit) for SCADA integration.	51 nos.	
Smart Meter	3-Phase, 4wire, HT, CT Operated, TOD Smart Meter.	89 nos.	
33kV Cables	33KV(E), 3C X 300 sq.mm, armoured , XLPE insulated, stranded Aluminium conductor, screened by extruded semi-conducting compound for the conductor followed with copper tape and inner and outer extruded PVC sheath compound Type-ST2.	11.54 KM	2nos 33kV incoming line for ESS-2 and One 33kV incoming line for ESS-1 and ESS-3.

SL No	Description	Quantity	Remarks
11kV Cables	11KV(E), 3C X 300 sq.mm, armoured , XLPE insulated, stranded Aluminium conductor, screened by extruded semi-conducting compound for the conductor followed with copper tape and inner and outer extruded PVC sheath compound Type-ST2.	41.52 KM	2nos 11kV Interconnected double run line for ESS-2 and 1no 11kV Interconnected double run line for ESS-1 & 3.
33kV Cable termination kits & joints	Cable Termination kits & straight joints for 33KV (E), 3C X 300 sq.mm cables.	1 Lot	
11kV Cable termination kits & joints	Cable Termination kits & straight joints for 11KV (E), 3C X 300 sq.mm cables.	1 Lot	
Compact substation (CSS)	11/ 0.433kV CSS, having 11kV, HT Panel with 2 incomers LBS and 1 outgoing self-powered VCBs with 250kVA, dry type, two winding, 3 phase, Dyn11, 50Hz, AN, Transformer, LT panel, APFC, FPI & FRTU.	3	1 at each substation
Common service trench(CST)	Construction of RCC trench- & associated manholes for underground cabling system and laying of 33kV, 11kV, LT (Street lighting), C&I cables inside RCC trench. including excavation and backfilling with soil including warning tape over the trench, etc.	1 Lot	
Earthing & Lightning protection System	Equipment & safety earthing of all equipment's in 33/11kV substations, RMUs & CSS.	1 lot	
Lighting system	Lighting system including internal wiring & conducting, indoor & outdoor fixtures, including flood lights, emergency & exit light fixtures, switch, power sockets & plugs, Lighting mast, LDBs, PDBs etc. for 33/11kV substations.	1 lot	
Auxiliary systems for 33/11kV Substations	Electrical Auxiliaries (ACDB, DCDB, UPS, Lead Acid Plante type Batteries (1) x 100% rated battery associated with 2 x 100% float cum boost chargers for DC system, exhaust fans_corrission proof, welding sockets,	3 lot	1 at each substation

SL No	Description	Quantity	Remarks
	Mechanical Auxiliaries (HVAC, Fire Hydrant, Fire Detection & Alarm, Overhead Crane, Nitrogen Injection fire prevention method system for power transformers etc.), Control Cables & terminations etc.		
DG Sets:	Diesel Generator sets with AMF panel for Emergency power Backup for 33/11 kV Substations	3 nos.	1 at each substation
Cabling System	Cabling system including cable trench trays & supports, terminations, joints etc. for 33/11kV substations.	1 lot	
Civil works	Civil works for 33/11kV substation such as building, Transformer foundations and cable trench, boundary wall, fencing works, gate, internal road, drains, control room etc., foundation for RMUs (at each plot) & CSS.	1 lot	
SCADA & Smart Grid System	Smart grid system includes ADMS, AMI, SCADA, , Demand response, costumer portal, Automation of the substations.	1 lot	

Detailed Technical specification of each equipment's needs to be referred in respective equipment technical specifications.

1.2 Terminal Points

1.2.1 ..... At 33kV Incomer-

Terminal point for 33kV incomer shall be outgoings of the UPTCL 33kV GIS switchgears placed in 132/33kV GIS substation. The 33kV cable originating from outgoing of the UPTCL 33kV GIS switchgear. 132/33kV Substation which includes- 40 MVA Power transformers, 132kV GIS, 33kV GIS 132kV cables, 132kV Transmission lines and any facility required for 132kV GIS substation shall not be in bidder's scope. Any work required for arrangement of 33kV incoming substation from UPTCL 33kV GIS substation is in bidders scope.

1.2.2 ..... At Consumer Plot-

Terminal point for 33kV & 11kV distribution shall be up-to Smart meter placed at the outgoing of the 33kV & 11kV RMUs placed at HT consumer plots and Feeder pillar

placed at LT consumer polts . Cable beyond the Smart meter at RMU and Feeder pillar shall be in consumers' (plot owner's) scope. All 33kV, 11kV, LT, control cables & its terminations & joints, RMUs, FRTUs, in-built DC system, Smart meter & all arrangement required Smart grid & SCADA communication as per specifications shall be in bidder's scope.

1.2.3 ..... Exclusion List

i.) 132/33kV Substation Augmentation, Power Transformers & its U/G cabling for incomer.

ii.) LT Smart meters inside consumer's plot.

iii.) The following exclusions and provisions apply to the substation locations under the EPC package:

a. **Transformer Configuration:**

i. ESS-2 will proceed with **2 nos. of power transformers** as planned.

ii. ESS-1 and ESS-3 will each have **1x10 MVA transformer** instead of the originally planned 2x10 MVA transformers.

b. **Exclusions from EPC Scope:**

i. One transformer at ESS-1 and ESS-3.

ii. One 33kV incoming line each for ESS-1 and ESS-3.

iii. One line of 33kV and 11kV interconnections between ESS-1 and ESS-3.

c. **Future Infrastructure Provision:**

i. Adequate space for future infrastructure, such as trenches and substation expansions, must be incorporated into the design.

1.3 Codes And Standards

i.) All equipment, system and services covered under this specification shall comply with all currently applicable statutes, regulations and safety codes of the country. Nothing in this specification shall be construed to relieve the Bidder of this responsibility.

ii.) The standards not indicated in the specification are also acceptable after approval, if they are established to be equal or superior to the standards indicated in the specification.

iii.) The metric units/SI units shall be used in all data/drawings to be submitted against this package.

iv.) The Bidder shall furnish the English translations of all standards to which the equipment and systems offered are conforming to, as and when required by the Owner.

v.) The work shall be performed in conformity with these specifications standards and Codes of Practice specified or referred in the tender. In case of any conflict the stipulations under these specifications shall govern.

vi.) In addition, work shall also conform to the requirements of latest editions/ amendments of the following:

The Indian Electricity Act and Rules framed there under

a) Fire Insurance Regulations
b) Regulations laid down by the Chief Electrical Inspectorate
c) Regulations laid down by the Factory Inspectorate
d) Applicable Codes of Practice of the Bureau of Indian Standards
e) Any other regulations laid down by the Central, State or Local Authorities from time to time and during the execution of this contract.

1.4 Planning And Design Criteria

1.4.1 ..... General Design Criteria

The design concept of electrical system is based on providing safe, reliable & stable power and efficient performance of electrical system.

a) The design standard described herein is generally in compliance with the latest Indian Standards, IEC and Code of Practices of India.
b) All electrical installations shall confirm to the latest CEA (Central Electricity Authority) guidelines 2021
c) Latest National and International Standards shall be used for each electrical equipment design in Atal Puram township.

1.4.2 ..... Design Ambient

The electrical equipment shall be designed with due consideration to the following ambient conditions:

a) Design ambient temperature : 50°C.
b) Minimum ambient temperature : 9.8°C.
c) Maximum ambient temperature : 43.1°C.
d) Equipment design temperature range : 5°C to 45°C.
e) Max. Ambient relative humidity : 95% RH
f) Seismic Zone : Between Zone II & III

1.4.3 ..... Voltage Levels

Following voltage levels shall be used:

a) 33 kV- Transmission from UPTCL 132/33kV GIS source substations to 33kV GIS substation of Atal Puram township.
b) 33 kV- Consumer having load more than 4 MVA as per DVNNL regulation.
c) 11kV- Consumer having load up-to 4 MVA as per DVVNL regulation.
d) 415 V/230V- LV supply for LV auxiliary loads at substations & CSS to feeder pillar, UPS & street lighting and residential loads which is less than 56KVA.
e) 24 V DC –DC voltage for RMUs & control and instrumentation.

TABLE 1-1: VOLTAGE LEVELS

Item	Voltage	Neutral Earthing
33 & 11kV	33 & 11 kV ±10%, 50 Hz ±3%, 3-phase	Solidly earthed
LV Power Distribution System	415V ±10%, 50 Hz ±3%, 3Ph, 4W system 230 V ±10%, 50 Hz ±3%, 1Ph, 2W system	Solidly earthed
Uninterrupted Power Supply (UPS)	240 ±1% V safe AC, 50 Hz, 2W system.	Solidly earthed
DC System	a)110 V (+)10% to (-)15% DC b) 24 V (+)10% to (-)15% DC	Ungrounded

1.4.4 ..... Basic Insulation Level

Unless stated otherwise in the individual equipment/system specification, the insulation levels shall be as given below:

TABLE 1-2: BASIC INSULATION LEVEL

Nominal System Voltage	Highest System Voltage	Rated 1 min power freq. Withstand voltage (KVRMS)	Rated Lightning Impulse Withstand Voltage (KVPEAK)
33 kV	36 kV	70 kVrms	170 kVpeak
11 kV	12kV	28 kVrms	75 kVpeak
415 V	1.1 kV	3 kVrms	-

1.4.5 ..... Fault Levels

Different equipment shall be designed for the following through fault withstand capabilities fault levels as mentioned below: -

TABLE 1-3: FAULT LEVEL

System	Fault Level	Duration
33 kV	26.2kA	1 second
11 kV	18.3kA	1 second
415V	50kA	1 second
110V DC	15 kA	1 second

1.5 Assessment of Power Demand for Atal Puram Township.

Power demand is arrived for various categories of consumers as detailed below as per ECBC.

TABLE 1-4: POWER DEMAND FOR STANDARDS

Classification	Standards Watt/Sq.m (Energy conversation building code)	Diversity Factor	Connected Load (MW)
Commercial	68.9	0.75	16.22
Residential	27.5	0.50	17.21
Residential - EWS/LIG & Hostel	11.4	0.50	1.05
Roads, open space, etc.	2.7	0.50	0.53
Public / Semi Public / Services etc.	64.6	0.75	31.75
Utilities	64.6	0.75	2.12
Total			**68.88**

TABLE 1-5: ASSESSMENT OF POWER DEMAND FOR ATAL PURAM

CLASSIFICATION	TOTAL POWER DEMAND (MW)	Total Power Demand (MVA) 0.95 PF.
Commercial	12.17	12.81
Residential	8.60	9.06
Residential - EWS/LIG & Hostel	0.52	0.55
Roads, open space, etc.	0.27	0.28
Public / Semi Public / Services etc.	23.81	25.06
Utilities	1.59	1.68
Total	**46.96**	**49.43**
Ultimate Power Demand Load (MW) at 11kV level		**49.43 MVA**
Ultimate Power Demand Load (MW) after considering 0.7 overall diversity factor at 220kV or 132kV level		**34.60**

Note: Total Power Demand Load (MW) after considering 0.7 overall diversity factor and Total Power Demand Load (MVA) @ 0.95 power factor.

1.6 RCC Trench(Common Service Trench)

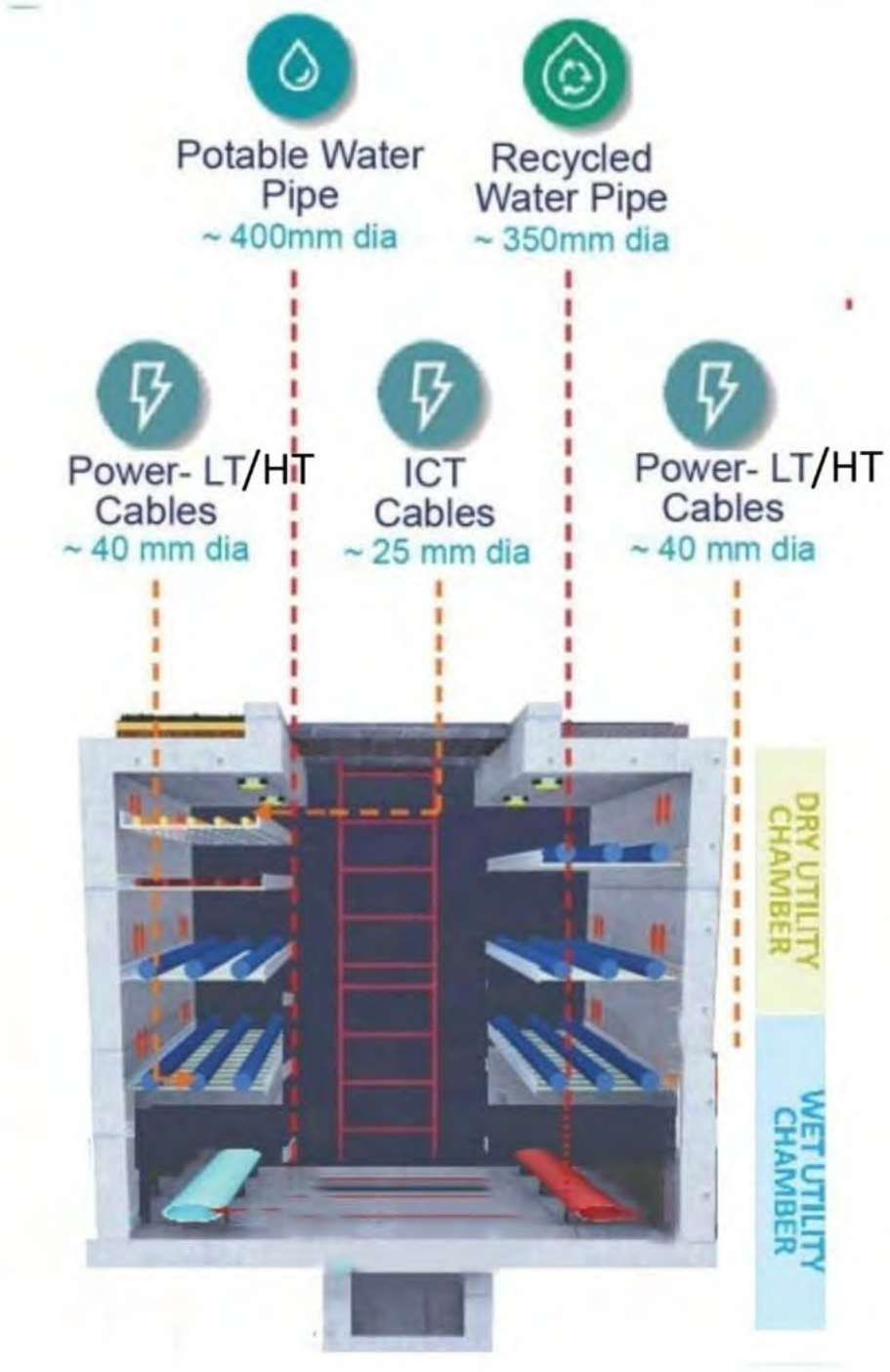
To facilitate plug and play connectivity, ease of maintenance and future access for power network cables without service disruptions to road users, it is proposed to provide standardized cable trenches & common service tunnels.

An integrated common service tunnel (CST) is proposed within the right of way under industrial sub-arterial road wherever found necessary. By providing the utilities along the road's carriageway the maintenance or upgradation of works would have minimal impact on traffic flow, with low maintenance cost. This would also help developments connect to the services without affecting the roads and traffic. The schematic design of utilities different for all the hierarchy of roads and for each type of road the placement of underground utilities is varying with respect to the requirements. The common service tunnel has been proposed in

major roads to optimize the operation and maintenance of services The advantages of CST are as follows,

- Reduction of maintenance manholes,
- One-time relocation,
- Less excavation and repair compared to separate cable ducts for each service.
- Allow rapid access to all utilities without having to dig access trenches and one of the greatest advantages is public safety.
- Stacking of most services in a single corridor

All the power cables including the cables from transmission stations to further distribution stations & to the consumers is proposed to be laid underground either in trench or in pipes/ducts according to the number of cables drawn. Underground power lines, whether in common or separate channels, prevent utility cables from blocking roads, thus speeding emergency access attire natural disasters such as earthquakes, hurricanes.



Typical (CST) Common Service trench cross section cable arrangement

1.7 Planning For Power Distribution

Space requirements of following external and Internal Electrical Infrastructure are shown in the below Table:

TABLE 1-6: SPACE REQUIREMENT FOR POWER DISTRIBUTION

DESCRIPTION	AREA	REMARKS
33/11kV Substation-1	0.7 Acre	
33/11kV Substation-2	0.7 Acre	
33/11kV Substation-3	0.85 Acres	Area considered is more since it is having central control room having Smart Grid & SCADA system
11kV Individual substations in the ring including DC system, FRTU	10 sqmtr. per substation	Planned in each HT Consumers plot
Compact substations for common areas, Street lighting etc.	25 sqmtr. per substation	Planned in Residential LT consumers and outdoor green area

1.8 Design Guidelines & International Best Practice Parameters For Township Area

There are following design guidelines and international best practice parameters for power infrastructure which shall be followed in entire township to make this city smart, energy efficient, sustainable and user friendly. It is proposed that every consumer coming in this Atal Puram township shall bound to follow the same:

a) All building shall meet Green building standards (Green Township / Green Factory Norms).
b) Power automation system shall be considered including substation automation system from source end to consumer end including, SCADA, advanced metering infrastructure and self-healing system, power quality improvement, Outage management system, demand response for increasing and improving power reliability.
c) Smart meters shall be considered for 100% requirement including Receiving Station, Distribution network and Consumer points.

d) Lighting load shall be considered as per ECBC-2017 which is used for energy efficient building.

e) Use of Compact substations (CSS) consisting of HT panel, Transformer & LT panels as a combined unit, which shall be placed outdoor at appropriate place, with such arrangement, there shall be a reduction in cost involved in civil building, land cost and the electrical components purchased individually.

f) Use of Automatic power factor correction (APFC) panels to improve power factor to 0.95/ 0.98. This will reduce maximum power demand for the plant and demand charges of State Electricity Board.

g) It is the responsibility of the bidder to maintain the power quality parameters within the prescribed limits.

1.9 Design & Drawings

Following studies and design calculations shall be performed as per relevant IS/IEC/IEEE:

- System Short circuit analysis.
- System Stability studies.
- Relay Coordination and relay settings for entire plant.
- Load Flow studies.
- Transformer sizing calculations.
- Earthing & lightning protection design.
- LT service Transformer sizing calculations
- Fire Detection and alarm system Design.
- All (HT /LT / DC) Cable sizing calculations.
- DC System Sizing calculation.
- UPS Sizing calculations.
- Lighting calculations.
- Preparation of General arrangement drawings, Cabling, Lighting, Earthing and lightning protection layouts for Substation.
- Interconnection schedules, Cable schedules
- Block interlock diagram for LT & HT switchgears
- Preparation of communication system layout & architecture.
- Preparation of area illumination layout
- Installation and Operation & Maintenance manual

The drawings accompanying the tender document are indicative of the nature of work and issued for tendering purpose only. The purpose of these drawings is to enable the tenderer to make an offer in line with the requirements of the owner. However the contactor shall prepare drawings for all system based on tender drawings and Bill of materials and GTP and then submit the same for Employers Representative approval. Construction shall be carried out as per approved construction drawings/ specifications issued/ approved by the Employers Representative during the course of execution of work. Detailed construction drawings on the basis of which actual execution of work is to proceed will be furnished to the Bidder progressively based on the detailed construction program evolved after the award of work and also based on construction progress achieved by the Bidder.

Prospective tenderer shall be deemed to have studied the drawings enclosed with tender or displayed for scrutiny and fully understood the nature and magnitude of the work before submitting the bids.

After each job completion, Bidder shall prepare 'As-Built' drawings. Final certified 'As-Built' drawings shall be submitted by the Bidder to owner in bound volumes with one set of reproducible original sepia plus ten sets of prints.

Bidder shall submit equipment manufacturer's drawing for supply items like pushbutton stations, lighting transformers, marshalling boxes etc. for the review of Employers Representative in five sets of prints and the approval in writing of the Employers Representative shall be obtained before commencing manufacture. However, it is to be understood that the review of drawings shall not absolve the basic responsibility of Bidder to check total compliance to specifications included in tender document. Final drawings in bound volumes with one set of reproducible original sepia plus ten sets of prints shall be submitted by Bidder along with supply of materials at site.

1.10 Statutory Clearances

Any necessary statutory clearances & approval from CEIG/ electrical inspectorate, CEA, DVNNL, UPTCL required for 33/11kV Substations, RMUs, CSS, U/G cabling system, Smart Street lighting system & any other electrical works shall be in Bidder's scope.

The supervision of power infrastructure for this work shall be conducted by DVNNL

1.11 List of Appendix

S.NO.	TITLE	ANNEXURE NO.	REVISION NO.
1.	Technical Specifications for Power Transformer	VSPL/IPD/2324-066/DPR/E-010	Rev. A
2.	Technical Specifications for 33 & 11kV MV Switchgear	VSPL/IPD/2324-066/DPR/E-011	Rev. A
3.	Technical Specifications for 33 & 11kV RMU	VSPL/IPD/2324-066/DPR/E-012	Rev. A
4.	Technical Specifications for Compact Substation	VSPL/IPD/2324-066/DPR/E-013	Rev. A
5.	Technical Specifications for Power & Control Cables	VSPL/IPD/2324-066/DPR/E-014	Rev. A
6.	Technical Specifications for HDPE Pipe Conduit	VSPL/IPD/2324-066/DPR/E-015	Rev. A
7.	Technical Specifications for Earthing & Lightning protection system	VSPL/IPD/2324-066/DPR/E-016	Rev. A
8.	Technical Specifications for UPS	VSPL/IPD/2324-066/DPR/E-017	Rev. A
9.	Technical Specifications for DC System	VSPL/IPD/2324-066/DPR/E-018	Rev. A
10.	Technical Specifications for LT Panel, APFC & LDB	VSPL/IPD/2324-066/DPR/E-019	Rev. A
11.	Technical Specifications for LV Transformer	VSPL/IPD/2324-066/DPR/E-020	Rev. A
12.	Technical Specifications for Lighting & Small Power System	VSPL/IPD/2324-066/DPR/E-021	Rev. A
13.	Technical Specifications for Smart Meter	VSPL/IPD/2324-066/DPR/E-022	Rev. A
14.	Technical Specifications for Smart Grid & SCADA	VSPL/IPD/2324-066/DPR/E-023	Rev. A
15.	Plot wise power Demand Estimation & Transformer Sizing	VSPL/IPD/2324-066/DPR/E-024	Rev. A

1.12 Relevant Drawings Enclosed Along With Bid

S.NO.	DRAWING TITLE	DRAWING NO.	REVISION NO.
1.	Single Line Diagram for 33kV Switchboards	VSPL/IPD/2324-066/DPR/EL-001	Rev. A
2.	Single Line Diagram for 11kV Switchboards	VSPL/IPD/2324-066/DPR/EL-002	Rev. A
3.	GA Layout for 33/11kV Substation-1 & 3	VSPL/IPD/2324-066/DPR/EL-003	Rev. A
4.	Typical GA layouts for 33/11kV Substations (2)	VSPL/IPD/2324-066/DPR/EL-004	Rev. A
5.	33kV Cabling layout for Atal Puram Township	VSPL/IPD/2324-066/DPR/EL-005	Rev. A
6.	11kV Cabling layout for Atal Puram Township (2 SHEETS)	VSPL/IPD/2324-066/DPR/EL-006	Rev. A
7.	LV Cabling layout for Atal Puram Township	VSPL/IPD/2324-066/DPR/EL-007	Rev. A
8.	Cabling Layout for 33/11kV Substations	VSPL/IPD/2324-066/DPR/EL-008	Rev. A
9.	Earthing & Lightning Protection Layout for 33/11kV Substations (3 SHEETS)	VSPL/IPD/2324-066/DPR/EL-009	Rev. A
10.	Lighting Layout for 33/11kV Substation- 1 & 3 (3 SHEETS)	VSPL/IPD/2324-066/DPR/EL-010	Rev. A
11.	Typical Lighting Layout for 33/11kV Substations 2	VSPL/IPD/2324-066/DPR/EL-011	Rev. A
12.	Overall SLD for for Atal Puram Township Smart Street Lighting	VSPL/IPD/2324-066/DPR/EL-012	Rev. A
13.	Street Lighting Circuiting Layout for Atal Puram Township-Agra	VSPL/IPD/2324-066/DPR/EL-013	Rev. A
14.	Typical GA for lighting Poles	VSPL/IPD/2324-066/DPR/EL-014	Rev. A
15.	Typical SLD for 11kV 3Way,4Way and 5Way RMU	VSPL/IPD/2324-066/DPR/EL-015	Rev. A
16.	Typical SLD for Compact Substation	VSPL/IPD/2324-066/DPR/EL-016	Rev. A
17.	Typical SLD for Feeder Pillar (2 SHEETS)	VSPL/IPD/2324-066/DPR/EL-017	Rev. A

S.NO.	DRAWING TITLE	DRAWING NO.	REVISION NO.
18.	Typical GA layout for all Roads	VSPL/IPD/2324-066/DPR/EL-018	Rev. A
19.	Main Feeder Piller (MFP) & Feeder Piller Location Layout	VSPL/IPD/2324-066/DPR/EL-019	Rev. A
20.	Cabling & Trench Layout for Atal Puram Township-Agra	VSPL/IPD/2324-066/DPR/EL-020	Rev. A
21.	Typical Details of Manhole For Power Distribution	VSPL/IPD/2324-066/DPR/EL-021	Rev. A

1.13 Appendix (Power Infrastructure)

1.13.1 ..... Power Transformer

1.13.1.1 General

This specification is intended to cover the [design, Engineering, manufacture, assembly, testing at manufacturer's works, supply in properly packed condition for transport to site, erection, site testing and commissioning] of 33/11kV 10/12.5 MVA ONAN/ONAF Power Transformers complete in all respect including all accessories required for efficient and trouble-free operation of Atal Puram Township, Agra

1.13.1.2 Codes and Standards

All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) / IEC as given below except where modified and/or supplemented by this specification.

CODE		NAME OF STANDARD
IS 325	:	Three phase induction motors
IS 335	:	New insulating oil for transformers and switchgears
IS 354	:	Method of sampling and test for resins for paints
IS 1271	:	Classification of insulating materials for electrical machinery and apparatus in relation to their stability in service
IS 1866	:	Code of practice for electrical maintenance and supervision of mineral insulating oil in equipment
IS 2026	:	Power Transformers
IS 2071	:	Method of high voltage testing
IS 2099	:	Bushings for alternating voltages above 1000 V
IS 2147	:	Degree of protection
IS 2705	:	Current transformers
IS 3202	:	Code of practice for climate proofing of electrical equipment
IS 3347	:	Dimensions for porcelain transformer bushings for use in different polluted atmosphere
IS 3637	:	Gas operated relays
IS 3639	:	Specification for Fittings and accessories for power transformers
IS 5561	:	Electric power connectors

CODE		NAME OF STANDARD
IS 5578	:	Guide for marking of insulated conductor
IS 6600	:	Guide for loading of oil immersed transformers
IS 8468	:	On load tap changers
IS 10028	:	Code of practice for selection, installation and maintenance of transformers
IS 12063	:	Classification of degree of protection provided by enclosures of electrical equipment
IEC:137		Insulated bushings for alternating voltages above 1000V
IEC 60044-1	:	Current Transformer
IEC 60044-2	:	Voltage Transformer
IEC 60076 Part-7	:	Power transformers
IEEE C57.12.00	:	General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.12.70	:	Terminal Markings and Connections for Distribution and Power Transformers
IEEE C57.12.90	:	Test Code for Liquid-Immersed Distribution, Power, and Regulating Transformers
IEEE C57.19.00	:	General Requirements and Test Procedure for Apparatus Bushings
IEEE C57.19.01	:	Standard Performance Characteristics and Dimensions for Outdoor Apparatus Bushings
ANSI C57.91	:	Guide for Loading Mineral-Oil-Immersed Transformers
ASTM D1816	:	Test Method for Dielectric Breakdown Voltage of Insulating Oils of Petroleum Origin Using VDE Electrodes
C.B.I.P		C.B.I.P. publication Manual on transformers

Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

The electrical installation shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

1.13.1.3 Climatic Conditions

The electrical equipment shall be designed with due consideration to the following ambient conditions:

Design ambient temperature	:	45°C.
Minimum ambient temperature	:	9.8°C.
Maximum ambient temperature	:	43.1°C.
Equipment design temperature range	:	5°C to 45°C.
Max. Ambient relative humidity	:	87% RH
Seismic Zone	:	Zone II

1.13.1.4 Design Criteria

a) The Power transformers shall be installed in hot, humid and tropical atmosphere. All equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.

b) All Power Transformers shall be suited for uninterrupted operation under the following variations in voltage and frequency:

	Voltage Variation	:	±10%
	Frequency Variation	:	50Hz (+)3% to (-)5%
	Combined Variation of Voltage & Frequency	:	10% (absolute sum)

c) The transformer shall be capable of withstanding the short circuit stresses due to a terminal fault on one winding for minimum period of three (3) seconds.

d) The transformer shall be free from annoying hum or vibration. The design shall be such as not to cause any undesirable interference with radio or communication circuits.

e) Transformers shall accept without injurious heating, combined voltage and frequency variation which produce an over fluxing condition of 120% for one (1) minute.

f) Noise level of the transformer shall not exceed the values specified in NEMA TR-1.

1.13.1.5 Specific Requirements

1.13.1.5.1 Scope of work

The following power transformers along with their fittings and accessories shall be supplied by the bidder:

PARAMETER	RATINGS FOR 33/11KV POWER TRANSFORMER
Rating	10/12.5MVA
Quantity	Total 6 (six) nos., Two at each substation 2nos at ESS-2 and 1no at ESS-1 &3 in this EPC Package.
Ratio	33/11
Vector Group	Dyn11
HV	Delta
LV	Star
OLTC range	+10 to -10 in steps of 1.25%
Impedance on base MVA	8.35%
Type of cooling	ONAN/ ONAF
Type of earthing	
33 kV (HV)	-
11kV (HV)	Solidly Earthed

a) Power/Control cables from OLTC (On Load Tap Changer) /MB (Marshalling Box) /Cooler Control Panel to respective Transformers.
b) Civil works (if required) like transformer foundations with soak pits, Fire protection walls etc for all Transformers including concrete cable channel for all the Transformers.
c) Rail tracks for movement of transformers for maintenance.
d) Fabricated oil storage tank.

1.13.1.6 Construction Requirements

1.13.1.6.1 Tank

The Tank shall be of Bell Type and welded construction and fabricated from good commercial grade low carbon steel of adequate thickness. All seams shall be double welded. All welding shall be stress relieved. The core grounding shall be made available outside the tank by means of a disconnectable link for all transformers. The switching devices of the tap changer are to be fitted in a separate part of the transformer tank with its own oil conservator and protection.

The tank wall shall be reinforced by stiffener to ensure rigidity so that it can withstand without any deformation

- mechanical shock during transportation
- oil filling by vacuum.

All removable covers shall be provided with weatherproof, hot oil resistant, resilient gaskets. The design shall be such as to prevent any leakage of water into or oil from the tank.

Each transformer tank shall be provided with one set of bi-directional flanged wheels for rolling the transformer parallel to either centre line over rail gauge. Jacking pads, lifting eyes and pulling lugs shall be provided to facilitate movement of the transformer. All heavy removal parts shall be provided with eye bolt for ease of handling.

Transformer tank shall be completely insulated from its wheel so as to have transformer protection as envisaged. Tank shall be provided with necessary valves.

Manholes / hand holes of sufficient size shall be provided for access to leads, windings, bottom terminals of bushings and taps. Suitable guide shall be provided in the tank for positioning the core and coil assembly.

1.13.1.6.2 Core

The transformer shall be of core type. The core shall be constructed with high grade, non-aging, low loss, high permeability, grain oriented, cold-rolled silicon steel laminations free from scales and burrs, especially suitable for core materials.

The Core flux density shall be defined to limit the transformer inrush current.

The framework and the core bolts shall be efficiently insulated from the core so as to reduce the eddy currents to a minimum.

The core and its mechanical parts shall be designed to withstand forces produced during normal transportation, short-circuits and earthquakes. The core and winding assembly shall be fixed firmly both at tank bottom, sides and tank top at suitable number of points, to withstand severe impact during transport.

Adequate lifting lugs will be provided to enable the core and windings to be lifted.

1.13.1.6.3 Windings

The windings shall be manufactured from electrolytic copper with electrolytic grade and free from scales and burrs and fully insulated for rated voltage. All windings of transformers having voltage less than 66 kV shall have uniform insulation.

Insulating material shall be of proven design. Windings shall be so insulated that impulse and power frequency voltage stresses are minimum.

Coil assembly shall be suitably supported between adjacent sections by insulating spacers and barriers. Bracing and other insulation used in assembly of the winding shall be arranged to ensure a free circulation of the oil and to reduce the hot spot of the winding.

All leads from the windings to the terminal board and bushings shall be rigidly supported to prevent injury from vibration or short circuit stresses. Guide tube shall be used where practicable.

1.13.1.6.4 On-Load Tap Changer

The transformer, shall be equipped with motor driven On-load tap changer (OLTC) and shall be provided with remote control and monitoring.

The winding including the tapping arrangement shall be designed to maintain electromagnetic balance between HV and LV windings at all voltage ratios.

The on load tap changing will be affected by a 3-phase gang operated switch. Arrangement shall be such that switch can be operated at standing height from ground level. The tap changer shall conform to IEC 60214.

The operating handle can be padlocked at any tap position. The design shall be such that lock cannot be inserted unless the contacts are correctly engaged. The mechanism shall be provided with a mechanical tap position indicator and an operation counter.

All contacts shall be silver plated and held in position under strong contact pressure to ensure low contact resistance and avoid pitting. The OLTC switch contacts shall be located in a separate oil-filled chamber complete with its own oil preservation system, Oil Surge relay, shut-off valves, oil level gauge, gas vent, pressure relay etc.

OLTC mechanism and associated controls shall be housed in an outdoor weather-proof cabinet. Internal illumination lamp and thermostat controlled space heater shall be provided in the cabinet. The tap change equipment shall be so designed that if the mechanism is stuck in an intermediate position, the transformer shall be capable of delivering full load without any injury.

The OLTC gear shall be suitable for local and remote electrical control and local manual control. Further, there shall be provision of automatic operation through voltage sensing relay wherever specified.

1.13.1.6.5 Local Tap Changing Cubicle

The local tap changer cubicle shall be provided for housing motor drive mechanism for OLTC. The cubicle shall be fabricated of minimum 2 mm thick sheet steel complete with Control mechanism, all wiring, fuses, links, cubicle illumination lamps, anti-condensation heater with thermostatic control switch, gland plate etc. The Cubicle shall conform to IPW 55 degree of protection. The cubicle shall include the following:

- Driving motor (415 V, 3 phase, 50 Hz, AC squirrel cage).
- Mechanically & electrically interlocked motor starting contactors with thermal overload relay, isolating switch and MCCBs.
- Duplicate sources of power supply with automatic changeover from the running source to the standby source and vice versa shall be provided in transformer cooler control cabinet / marshalling box and one no. outgoing feeder extending to OLTC driving motor cabinet, with appropriate provision for receiving the same.
- Control switch for Raise / off / lower. Remote / local selector switch lockable in remote position.
- Mechanical tap position indicator and re-settable maximum and minimum indicators.
- Limit switches to prevent motor over-travel in either direction or final mechanical stops.
- Brake or clutches to permit only one tap change at a time on manual operation. Emergency manual operating device (hand crank or hand wheel).

- Tap Position Indicator, suitable electrical impulses shall be transmitted for remote indication.
- A five digit operation counter.
- Interior lighting fixture with lamp door switch and HRC fuses.
- Gasketed and hinged door with locking arrangement.
- Terminal blocks, internal wiring, earthing terminals and double compression cable glands for power and control cables. Necessary relays, contactors, current transformers etc.

The following indication/alarms shall be provided locally as well as for remote annunciation.

- AC supply failure
- Active Tap position.
- Tap changer in Local mode.
- Tap changer in Remote Mode.
- Tap changer faulty.
- Tap change delayed.
- Value of set point of voltage control device.
- It shall be possible to control (issue raise/lower commands, changing the set point of voltage control device) the tap changer locally as well as from SCADA PLACED AT MRSS/RTCC.

1.13.1.6.6 Remote Tap Changer Control Panel (RTCC)

A Remote Tap Changer Control Panel shall be provided and located in the relay room. The following facilities shall be provided in each control cabinet.

- RTCC provided shall be able to communicate to SCADA placed at MRSS.
- Tap position indicator of each transformer.
- Remote / local selector switch.
- Auto manual selector switch.
- Voltage regulating relay with time delayed under voltage cutout (for out operation only).
- Automatic Voltage Regulator.
- DC supply supervision.
- The following indication shall be provided in remote panel:
- Tap change in progress.

- Tap changer faulty
- OLTC in local mode.
- OLTC in remote mode.
- Tap change delayed.
- Value of set point of voltage control device
- It shall be possible to control (issue raise/lower commands, changing the set point of voltage control device) the tap changer from SCADA placed at MRSS. Necessary interposing relays and hardware as required shall be provided.

1.13.1.6.7 Insulating Oil

The transformer shall be filled with mineral insulating oil suitably inhibited to prevent sludging.

First filling of oil along with 10% excess shall be furnished for each transformer. Oil shall be supplied in non-returnable containers suitable for outdoor storage.

Oil preservation shall be by means of bellows/ diaphragm sealed conservator tank with silica gel breather to avoid direct contact between atmosphere and transformer oil. It shall be complete with level gauges, pipes, drain valve etc. The level gauges shall be so placed that same can be readable standing from ground. Necessary device shall be kept to provide annunciation in the event of rupturing of bellow.

1.13.1.6.8 Bushing

- All bushings exposed to the open atmosphere shall have increased creepage distance of 31 mm/kV. Bushings shall be arranged to facilitate easy access for mounting and dismounting. Where built-in current transformers are provided, bushings shall be arranged to permit their removal without interfering with the current transformers.
- Bushing rated 72.5kV class and above shall be condenser type. Bushing rated 36kV class and below shall be solid porcelain or oil communicating type. Condenser type bushing shall be provided with oil level gauge, bottom drain plug and test terminal for measurement of loss factor (tan-delta) and capacitance.

1.13.1.6.9 Terminations

- All Terminals shall be brought out through top cover mounted bushings along with necessary turret.

- LV winding neutral shall be brought out through top cover mounted bushing for cable connection.
- LV neutral terminals shall be housed in neutral Gas insulated cable box

1.13.1.6.10 Transformer Cooling

- Detachable type cooler shall be provided for each bank. Nos. of cooling units and capacity of each unit will be decided as required. Each unit cooler shall have its own cooling fans with shut off valves both at top and bottom.
- The design shall be such that rated transformer output with specified temperature rise can be maintained:
- Continuously with one fan in any of the cooling bank out of service.
- For at least ten (10) minutes in case of failure of the complete cooling system when the transformer was delivering its rated output.
- The radiators shall be detachable type with top and bottom isolation values to permit the removal of the same without drainage of oil from the tank.
- All fans shall have safety guard.
- Convenient means shall be provided to remove or replace fan with the transformer in service.
- Complete control of fans inclusive of all switches, fuses, starters, relays and wiring shall be furnished. Each motor circuit shall have over load and short-circuit protection.
- Fan motor controls will be actuated automatically from winding temperature indicator contacts. Provision shall however be kept for manual operation both from local and remote.

1.13.1.6.11 Cooler control cabinet

The transformer cooler control cabinet shall be installed outdoor near the transformer.

Sheet steel, weatherproof, IPW 55 cooler control cabinet shall be provided for each transformer. The frames and the load bearing panels shall be fabricated of not less than 2 mm. thick sheet steel. The doors shall be provided with channel rubber/neoprene gaskets all round.

The starting and stopping impulses for fans shall be given by winding temperature detectors at a preset temperature limit. Control shall be such that hunting, i.e., frequent start stop operations for small temperature differentials shall not occur.

Selector switches shall be provided for selection of fans to be in 'service' or on 'stand by'.

A magnetic contactor with thermal overload relays and MPCBs (motor protection circuit breakers) for short circuit protection shall be provided for a maximum of 2 fans. Suitable means shall be provided for isolating any fan from supply. Overload relays shall be of hand reset type.

The following alarm initiating devices having normally open contacts shall be included as applicable for the method of cooling:

- Cooler power supply auto changeover
- Cooling fan/fans failure for each radiator bank and/or unit cooler

The following initiating contacts shall be provided:

- Cooling fans start
- Cooling system on automatic control
- Cooling system on manual control

All contacts shall be potential free and separately brought out to separate terminals. Necessary contacts shall be made available for remote alarm/indication in SCADA placed at MRSS.

1.13.1.6.12 Fittings and Accessories

a) Bushing Current Transformer

- Where bushing CT's are specified, the same shall conform to the specification indicated in the data sheet. Hot spot temperature of CT's shall be as specified for transformers.
- It shall be possible to remove the CT's at site, without opening the transformer tank cover/active part.
- All secondary leads shall be wired with 2.5 sq.mm stranded copper wire and including tappings shall be brought to a weatherproof terminal box. Rating and terminal marking plate of the CT shall be mounted on the terminal box. It shall be terminated in a box with stud type termination. Conduit wiring from this outlet box up to the transformer marshalling box or control cabinet shall be provided.

- Neutral bushing CTs for back up earth fault protection and restricted earth fault protection shall be provided for transformers as specified in a box with stud type termination.

b) Conservator

i. All conservator shall be Air Cell type.

ii. Conservator shall be located in such a position as not to obstruct the electrical connections to the transformer. The conservator volume shall be sufficient to maintain the oil seal from ambient temp. of 5 °C to oil temp. of 90 °C, with oil level varying within min. and max. Levels.

iii. 150 mm dial type magnetic level gauge with alarm and trip connection shall be provided. In addition, prismatic type oil level gauge with min. and max. levels marked shall also be provided. Taps or valves shall not be fitted to the oil gauge.

iv. Drain valve shall be designed so that conservator can be completely drained by means of the drain valve provided when mounted as in service. One end of conservator shall be bolted into position so that it can be removed for cleaning purposes. If the sump is formed by extending the feed pipe into the conservator vessel, the extension shall be for at least 25 mm. Oil filling hole with cap shall be provided.

v. Filling plug and sump valve of 15mm size shall be provided for conservator of diameter up to 650mm and 25 mm size valve shall be provided for conservator above 650mm diameter. Valve for shutting off oil to the transformer shall be provided for conservator.

vi. A silica gel breather with inspection window and oil seal shall be mounted at 1.4 meter above transformer base with suitable supports and connected to the conservator.

vii. Separate conservator shall be provided for OLTC.

c) Buchholz Relay

i. All transformers shall be provided with double float buchholz relay fitted in the pipe connecting the tank and the conservator pipe and shall have the following dimension,

- 25 mm dia. for transformers up to and including 1000 KVA.
- 50 mm dia for ratings from 1 MVA to 10 MVA.
- 80 mm dia for ratings above 10 MVA.
- In addition oil surge relay shall be provided for OLTC.

ii. Pipe shall be arranged at a rising angle of 3 to 9 degrees to the horizontal, up to the buchholz relay. Valves shall be provided on either side of relay after providing necessary length of straight pipes.

iii. The relay shall have pet cocks at the top and bottom, drain plug, inspection windows, calibrated scale to indicate gas present, built in test facility and terminal box with oil tight brass gland.

iv. The relay shall have electrically separate; potential free self reset contacts for alarm and trip. Contacts shall be rated to make, carry & break 0.5 Amp. at 110 V DC. The contacts shall be wired to Marshalling box. The relay shall conform to IS: 3637 (C 1966).

v. Copper pipe of nominal diameter 5mm shall be connected from the relay test cock to a valve located about 1.25 M above ground level to facilitate sampling of gas when the transformer in service.

d) Valves and Connections

i. Valves shall be of forged carbon steel up to 50 mm size and of gunmetal or of cast iron bodies with gunmetal fittings for sizes above 50 mm. They shall be of full way type with screwed ends and shall be opened by turning counter clockwise when facing the hand wheel. There shall be no oil leakage when the valves are in closed position.

ii. All valves shall be provided with an indicator to show clearly the position of the valve. Oil sampling valves shall be provided at top and bottom of the main tank and these shall not be fitted on the filter valves. Non-return valves in pump scheme shall be provided. All transformers shall have bottom drain valve, top and bottom filter valves suitable for connecting to oil filtration unit. All transformers shall have bottom drain valve and shall be connected to oil pit through necessary pipes.

iii. Each transformer shall be provided with following valves on the tank,

a. Two filter valves on diagonally opposite corners, suitable for connecting to oil filtration unit.
b. Oil sampling valves not less than 8 mm, at top, middle and bottom of main tank with provision for fixing PVC pipe.
c. One 15 mm air release plug at all required locations.
d. Valves between radiators and/or coolers.
e. Two plugged pipe outlets for applying vacuum.
f. Drain valve so located as to completely drain the tank to oil choke pit through necessary pipes and with locking arrangements.
g. Shut off valves between OLTC and its conservator.
h. Valves for connecting Online DGA (Dissolved Gas Analyzer) / Monitoring System.

iv. All screwed valves shall be furnished with pipe plugs for protection.

e) Joints and Gaskets

All gaskets used for making oil tight joints shall be of proven material such as granulated cork-bonded synthetic rubber or synthetic rubber gaskets compatible with oil.

f) Explosion Vent/Pressure Relief Device

i. Pressure relief device shall be provided for Transformer. Pressure relief device provided shall be of sufficient volume for rapid release of any pressure that maybe generated within the tank and which might result in damage to the equipment. The device shall operate at a static pressure of less than the hydraulic test pressure for transformer tank. Means shall be provided to prevent ingress of rainwater.
ii. The relief device shall be mounted on the main tank and if on the cover shall be fitted with skirt projecting 25mm inside the tank and of such a design to prevent gas accumulation.
iii. If diaphragm is used, it shall be of suitable design and material and situated above max oil level
iv. The equaliser pipe connecting the pressure relief device and conservator shall be provided for relieving or equalising the pressure in the pressure relief device.

g) Temperature Indicators

i. 150 mm & dial type top oil, and winding temperature indicator for the HV & LV windings shall be provided for all transformers. Further an additional terminal of winding temperature indicator for automatic control of Blowers shall be provided.

ii. Each thermometer shall have potential free NO alarm contact and trip contact. No multiplying contactor / relay shall be used. Temp. Setting of each contact shall be independently adjustable at site. A manual reset type maximum temperature indicator shall be provided for each thermometer.

iii. The temperature-sensing element mounted in pockets of oil on the top cover of the transformer shall be connected to the indicating elements through capillary tube.

iv. Each winding temp indicator shall have temp. Sensing element, image coil and bushing mounted current transformer.

v. Each thermometer shall be provided with remote temp. Indicator along with associated Accessories. The remote temperature Indicators shall be mounted on relay panel.

vi. The local winding temperature indicator shall be provided with necessary contacts for Automatic starting and stopping of cooling fans, alarm and trip functions. Settings for closing and opening contacts shall be independently adjustable.

vii. All contacts shall be rated to make 0.5A(min) and break 0.2 A (min) at 110V DC. All contacts shall be wired to Marshalling box.

viii. In addition to the above winding temperature indicators /controllers shall be provided, for control of forced cooling system of the transformer.

ix. 4-20 mA signals for oil and winding temperatures shall be made available for interfacing with SCADA placed at MRSS.

h) Marshalling Box

i. The transformer marshalling box shall be used for control, interlocking, metering and indication for transformer and shall be installed outdoor near the transformer.

ii. Sheet steel of 2 mm thick enclosed, outdoor, weather proof Marshalling box conforming to IP-55 enclosure shall be provided for auxiliary equipment of the transformer. The doors shall be provided with channel rubber/neoprene gaskets all round.

iii. Marshalling box shall accommodate control and protection equipment of transformer, temp. Indicators, bushing CT secondary terminals, stud type terminal blocks, 415V voltmeter etc.

iv. Tap changing gear cubicle shall accommodate motor drive and associated control Equipment of tap changing gear, terminal block, mechanical indicators etc.,

v. Space heaters with temperature controller, illuminating lamp and toughened glass windows shall be provided

vi. All indication. alarm, trip contact etc. shall operate on 110 V ± 10 % DC and Cooler Control supply shall work on 110 V AC

vii. Bidder shall supply necessary 415/110 V transformers.

viii. Mechanical indications, temperature indicators, double compression brass glands with necessary gland plates for terminating cables etc. shall be provided in each box. All auxiliary equipment, protection and signalling contacts shall be wired to these transformer-mounted cabinets.

ix. Transducers, Auxiliary relays etc required for linking to bidder's Automation system and spare potential free contacts (for all alarm & trip signals) for purchaser's use would be provided in the Marshalling box. All contacts shall be potential free and separately brought out to separate terminals. Necessary contacts shall be made available for remote alarm/indication in SCADA placed at MRSS.

x. Cabling between the transformers and common Marshalling box shall be through cable trenches included in the scope of this contract. Sufficient space shall be provided in cable trays for cabling from Marshalling box by other vendors.

i) Earthing

i. Two earthing pads, located on the opposite sides of the tank, shall be provided for connection to ground mat.

ii. Earthing terminals shall also be provided on marshalling box to ensure its effective earthing. For continuity of earth connection, all gasketted joints shall be provided with braided copper wire jumpers.

j) Wiring

i. All control, alarm and indication devices provided with the transformer shall be wired up to the terminal blocks.

ii. Wiring shall be done with [650] V PVC wires in conduit or PVC armored cable. [Minimum wire size shall be 1.5 sq.mm stranded copper. Not more than two wires shall be connected to a terminal. 20% spare terminals shall be provided.]

iii. Multi-way terminal block complete with mounting channel, binding screws and washers for wire connections and marking strip for circuit identification shall be provided for terminating the panel wiring. [Terminals shall be stud type, suitable for terminating 2 nos. 2.5 mm2 stranded copper conductor and provided with acrylic insulating cover.]

iv. All devices and terminal blocks shall be identified by symbols corresponding to those used in applicable schematic or wiring diagram. Each wire shall be identified, at both ends, with interlocking type permanent markers bearing wire numbers as per Bidder's Wiring Diagrams. AC / DC wiring shall have separate colour-coding.

v. Wire termination shall be made with crimping type connectors with insulating sleeves. Wires shall not be spliced between terminals.

1.13.1.6.13 Terminal Block

a) Terminal blocks shall be [650] V grade, 10 Amps rated, one piece moulded, complete with insulated barriers, stud type terminals, washers, nuts, lock nuts and identification strips. Markings on the terminal strips shall correspond to wire numbers on the wiring diagrams.

b) Not more than one wire shall be terminated on either side of a terminal. When it is required to terminate two or more wires on the same terminal, the wires shall be terminated on adjacent terminals and these terminals shall be shorted using suitable shorting links.

c) At least 10% spare terminals shall be provided.

d) Unless otherwise specified, terminal blocks shall be suitable for connecting the following conductors of the supplier wires on the same ter

i. All circuits except CT circuits: Minimum of 2.5 mm2 copper

ii. CT circuits: Minimum of 6 mm2 copper

iii. For instrument signals): Minimum of 0.5 mm2 for paired cable 1.5 mm2 for core cable.

1.13.1.6.14 Auxiliary Supply

a) A.C. supply will be made available to each transformer by two separate feeders one normal and the other standby.

b) Isolating MCCB shall be provided for each of the incoming supply along with automatic changeover scheme to switch on to the standby source in case of failure of the normal supply.

1.13.1.6.15 Painting

a) All Steel surfaces shall be thoroughly cleaned by using seven tank process or by sand blasting, to produce a smooth surface free of scales, grease and rust. Pre treatment of sheet using solutions wire brush etc. shall not be done.
b) Internal surface which shall be in contact with oil shall be painted with at least two coats of heat resistant, oil insoluble, insulating varnish.
c) External surfaces, after cleaning shall be given a coat of High quality red oxide or Zinc chromate primer followed by filler coats. Over the filler coat, two coats of epoxy paint of grey shade shall be applied as a finishing coat to a thickness of 80 microns.
d) The paints shall be carefully selected to withstand tropical heat, rain etc. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling.
e) All supporting structures and hardware shall be hot dip galvanized.

1.13.1.6.16 Name Plate

Nameplates of approved design shall be furnished at each cubicle (one no. each at front as well as at backside of cubicle) and at each instruments & device mounted on or inside the cubicle. The material shall be lamicoid or approved equal, 3 mm thick with white letter on black background. Self-tapping screws shall hold the nameplate. *[Nameplate size shall be minimum 20 x 75mm for instrument/device and 40 x 150mm for panels. Caution notice on suitable metal plate shall be affixed at the back of terminal Box.]*

1.13.1.7 Losses

a) The fixed losses should be as low as is consistent with normal design, reliability and economical use of material. The offers for transformers with higher losses will be liable for rejection.
b) Transformer Capacity: 10/12.5 MVA (ONAN/ONAF)
   - No Load Losses : 8.3 KW (max)
   - Load Losses at 750 C : 65 KW (max)
c) Capitalization of Losses and Damages: The capitalization of guaranteed losses of the transformer shall be calculated and considered while evaluating the bids.

The guaranteed values of no load losses and load losses shall be started in the bid. Liquidated damages will be applied to successful bidder for not achieving the quoted guaranteed figures.

d) Transformers with lower losses shall be preferred. The bidder shall indicate the values of load and no load losses of the transformer in his bid. Losses quoted shall be firm, without any tolerance. If nothing is indicated regarding tolerance on losses, it will be considered that losses are subject to tolerance. In case no ceiling is specified, these will be taken as per IS and the offer shall be loaded as per Table 7 of latest issue of IS: 2026 Part-I or Table 1 of IEC 660076-1.

e) Capitalization of losses

   i. For total cost evaluation, the capitalized cost of losses will be taken into account as per the following:

   ii. Capitalized Cost of transformer = Initial cost of Cost of transformer + Rs. 569.39 x Wi + Rs. 232.31 x Wc

   Where: Wi = Iron loss in Watt

   Wc =Copper loss in watt

The no load loss in Watts at rated voltage & frequency and the load loss in kW at rated voltage, rated frequency, rated output and 75 Deg C shall be quoted and these shall be guaranteed.

f) Liquidated damages for increase in losses:

Penalty shall be applied to the successful bidder in case he is unable to achieve the quoted guarantee figures at the following rates:

For each Watt of excess of no-load loss	Rs. 569.39/-
For each Watt of excess of load loss	Rs. 232.31/-

1.13.1.7.1 Tests

1.13.1.7.2 Type Tests

For each type & rating of LV Transformers, the Bidder shall submit for Owner's approval the reports of all the type tests as per relevant standards, that is IS 2026 and carried out within *[last five]* years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been conducted at an independent laboratory.

In case the Bidder is not able to submit report of the type test(s) conducted within *[last five]* years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Bidder shall conduct all such tests under this contract free of cost to the Owner and submit the reports for approval.

1.13.1.7.3 Routine tests

All equipment shall be completely assembled, wired, adjusted and routine tested as per relevant IS / IEC Standards at manufacturer's works in the presence of consultant /purchaser or his representative.

The following tests shall be performed on each transformer as a minimum:

The following tests constitute routine tests and they are not in specific order:

a) Measurement of winding resistance.
b) Measurement of voltage ratio and check of phase displacement.
c) Measurement of short-circuit impedance and load losses between pair of windings at rated frequency with approximately sinusoidal voltage.
d) Measurement of no-load loss and excitation current at 90%, 100%, 110% and 120% of rated voltage at rated frequency with approximately sinusoidal voltage.
e) Dielectric tests.
f) Measurement of capacitances and tan delta of winding to earth and between windings.
g) Measurement of capacitances and tan delta of capacitor bushings that are to be installed on the ordered transformers.
h) Measurement of Frequency response (Frequency Response Analysis - FRA).
i) Test on Tap Changer.
j) Magnetic balance test.
k) Measurement of single phase short circuit impedance of each limb with single phase 50 Hz, low voltage.
l) Measurement of single phase excitation current at low voltage at 50 Hz.
m) Check of core and frame insulation for oil immersed transforms with core or frame.
n) Winding insulation test, polarization index and absorption Index.
o) Transient saturation. In rush current test.
p) Tests on transformer oil. This shall be performed before starting tests on transformers.

q) Measurement of Sound level as per IEC 60076-10.

r) DGA test as per IEC 60567, IEC 60599 & IEC 61181.

1.13.1.7.4 Special Tests (As per agreement between manufacturer and purchaser)

a) Measurement of the harmonics of the no-load current.

b) Determination of sound levels. (IEC: 60076-10) for each method of cooling for which a guaranteed sound level is specified.

c) Vibration test.

d) Measurement of zero-sequence impedance(s) on three phase transformers.

e) Measurements of the power consumption by cooling system.

f) Determination and measurement of transient voltage transfer Characteristics.

g) Short-circuit withstand test.

h) Vacuum deflection test.

i) Pressure deflection test.

j) Vacuum tightness test on site.

1.13.1.7.5 Test Witness

[The tests shall be carried out in presence of the Owner's representative, for which a minimum 7 days' notice shall be given by the Bidder. The Bidder shall obtain the Owner's approval for the type test procedure before conducting the type test. The test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.]

1.13.1.7.6 Test Certificates

Certified copies of all tests carried out at works and at site shall be furnished in requisite no. of copies for approval of the Owner.

The equipment shall be dispatched from works only after receipt of Owner's written approval of shop test reports.

1.13.1.8 Drawings/ Data and Manuals

Drawings, data, and manuals for the transformers shall be submitted as indicated below:

- *[General Arrangement Drawing*
- *Dimensioned general arrangement drawing showing enclosure, core coil assembly, terminal arrangement, marshalling box and various fittings.*

- *Transport/shipping dimensions with weights, wheel base detail etc.*
- *Foundation plan & loading.*
- *Cable termination arrangement.*
- *Control schematics and wiring diagrams.*
- *Test reports and QAP*
- *Any other relevant drawing or data necessary for satisfactory installation, operation and maintenance.*
- *Instruction manuals on Transformer and its various fittings The manual shall clearly indicate method of installation, checkups and tests to be carried out before commissioning of the equipment.]*

Note: The drawings, data and manuals listed are minimum requirement only. The Bidder shall ensure that all other necessary write-ups, curves and information required to fully describe the equipment offered are submitted.

1.13.2 ..... Ratings and Requirements

S.N	DESCRIPTION	TRANSFORMER
1	3 Phase power supply system in which transformer is to be used	
a)	HV side max. Voltage	33 KV
b)	LV side Max.Voltage	11KV
c)	System earthing	
	- Primary Side (HV)	-
	- Secondary Side (LV)	Solidly Earthed
2	Max. 3 phase fault levels	
	- Primary Side (HV)	26.2 KA
	- Secondary side (LV)	18.3 KA
3	Direction of power flow	Uni-directional
4	Transformer application	
	Applicable standards	IS: 2026
5	Transformer type	
A	Indoor/ outdoor	Outdoor
B	Dry type / oil immersed	Oil Immersed
C	Core type/ shell type	Core type

S.N	DESCRIPTION		TRANSFORMER
6	Auto wound / two winding/ three winding		Two winding
7	Number of phases		Three
8	Rated frequency		50 Hz ± 5%
9	Rated no load voltage		
	- HV Winding		33 KV
	- LV Winding		11kV
10	Cooling		
	a) Method of cooling		ONAF
	b) Cooling liquid		Mineral oil (IS: 335)
11	Rated MVA at no load voltage & principle tap		
	ONAN		10MVA
	ONAF		12.5MVA
12	Overloading as per IS: 6600		Required
13	Design ambient temperature		45 °C
14	Max. temp. rise at rated MVA & principal tap		
	a	Top oil by thermometer method over design ambient temp. of 50 °C	55 °C over 45 °C
	b	Any winding (HV&LV) by resistance method over design ambient temp. of 50 °C	60 °C over 45 °C
	c	Hot spot temp. based on the design ambient of 50 °C	As per IS
15	Percentage impedance voltage at rated current, frequency, principle tap and 75°C		8.35%
16	Tappings		

S.N	DESCRIPTION		TRANSFORMER	
	a	Off-circuit/ ON load	ON Load tap changer	
	b	Manual /automatic	Manual	
	c	No. of steps	17	
	d	Percentage variation /step	-10% to +10% / 1.25%	
	e	Winding in which tappings are required	HV	
17	External terminal Short circuit withstand capability of transformer on any tapping for 3 phase and line to ground faults across LV winding		[Not less than 3sec.]	
18	Insulation		PF withstand KV (rms)	Impulse withstand KVP
	HV winding		70	170
	LV winding		28	75
	LV Neutral		17	44
	HV Bushing		NA	NA
	LV Bushing		NA	NA
19	Winding insulation category			
	a	HV-uniform/Graded Insulated	Graded Insulated	
	b	LV-uniform/ Graded Insulated	Uniform	
	c	Tertiary Winding	-	
20	Winding data			
	a	No. Of windings	Two	
	b	Winding material	Copper	
	c	Winding connection (HV / LV winding)	Delta	Star
	d	Vector groups HV-LV	Dyn 11	

S.N	DESCRIPTION	TRANSFORMER	
21	Core laminations		
	- Type	CRGO	
	- Material	SILICON STEEL	
	-Thickness mm (Max. Permissible)	0.3 mm	
22	Noise level in DB scale when measured 4 ft. from the transformer edge at a height of 5 ft. above the floor at rated voltage and load	As per NEMA Standard-TR-1	
23	Bushing current transformers		
	a) Location		
		HV/LV Line	LV Neutral
	b) Application	NA	Core 1-REF, SEF
	No. of cores on the CT (Quantity)	-	1
	Type	-	Ring
	Ratio Core 1	-	[800/1A]
	Core 2	-	[800/1A]
	Class and Accuracy Core 1	-	[Class PS]
	Knee point voltage	-	By bidder
	CT sec. Resistance at 75°C (for Core 1)	-	By bidder
	Short time rating for 3 Sec	-	As applicable for transformer
	Magnetizing current at Vk/2	-	By bidder
	Accessibility	-	Shall be accessible without removing tank cover and active parts
24	CT for winding Temperature compensation	HV line side	LV line side

S.N	DESCRIPTION		TRANSFORMER	
	-Type		By bidder	By bidder
	-Ratio		By bidder	By bidder
	-Class		Metering	Metering
	-Burden		By bidder	By bidder
25	Bushings		Not applicable	Neutral bushing
			HV LV	HV LV
	a	Type	Not applicable	NA Porcelain
	g	Short time rating	As applicable for transformer	
26.	Terminal Arrangement:			
	a	High Voltage	[Suitable for Cable termination]	
	b	Low Voltage	[Suitable for Cable termination]	
	c	HV Neutral	Not applicable	
	d	LV Neutral	Porcelain	
27	Radiators		Separately mounted (Detachable type)	
28	Transformer mounted on:			
		Rollers/flanged wheels	Flanged wheels	
		Flanged wheels (removable)	Removable	
		Rail gauge (in both axis)	1676mm Rail gauge	

1.13.2.1 33 kV & 11 kV Indoor Switchgear Units

1.13.3 ..... General

This specification is intended to cover the [design, engineering, manufacture, assembly, testing at manufacturer's works, supply in properly packed condition for transport to site, erection, site testing and commissioning] of 33 kV & 11 kV indoor Switchgear.

The system shall be complete in all respect including all accessories required for efficient and trouble-free operation of Atal Puram Township, Agra.

1.13.3.1.1 Codes and Standards

All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) / IEC as given below except where modified and/or supplemented by this specification.

Codes	Name of Standard
IS : 226	Structural steel (standard quality)
IS : 375	Switchgear bus bars, main connections and auxiliary wiring, marking and arrangement
IS :722	AC electricity meters
IS : 728	Galvanized steel structures
IS : 2099	Specification for bushings for alternating voltages above 1000 volts
IS : 2147	Degree of protection
IS : 2516	Alternating current circuit breakers
IS : 2544	Specification for porcelain post insulators for systems with nominal voltages greater than 1000 volts
IS : 2705	Current transformer specification
IS : 3043	Code of practice for earthing
IS : 3156	voltage transformers specification
IS : 3231	specification for electrical relays for power system protection

IS : 3427	A.C. metal enclosed switchgear and control gear for rated voltages above 1 kV and up to and including 52 kV.
IS : 4710	Switches and switch isolators above 1000 V but not exceeding 11000 V.
IS : 5082	Specification for wrought aluminum and aluminum alloy bars, rods, tubes and selections for electrical purposes.
IS : 6875	Control switches push buttons
IS : 8084	Specification for interconnecting bus-bars for ac voltage above 1 kV up to and including 36 kV
IS : 8686	Specification for static protective relays
IS : 9046	Specification for ac contactors for voltages above 1000 V up to and including 11 000 V
IS : 9224	Low voltage fuses
IS : 9385	HV fuses
IS :9431	Specification for indoor post insulators of organic material for system with nominal voltages greater than 1000 volts upto and including 300 kV
IS : 9921	Alternating current disconnectors (isolators) and earthing switches for voltages above 1000 V
IS : 10601	Dimensions of terminals of high voltage switchgear and control gear
IS : 11353	Guide for uniform system of marking and identification of Conductors and apparatus terminals.
IS : 13118	Specification for high voltage ac circuit breakers
IEC 6044-1	Current transformer
IEC 6044-2	Voltage transformer
IEC 6056	High voltage alternating current circuit breakers
IEC-60099-1	Non-linear resistor type gapped arrestor for AC systems

IEC-60099-4	Metal oxide surge arrestor without gap for AC system
IEC 60129	A.C. disconnectors and earthing switches
IEC 60255	Electrical Relays
IEC-60298	High voltage metal enclosed switchgear and control gear.
IEC 60529	Degrees of protection provided by enclosures
IEC-62271-100	High voltage alternating current circuit breakers.
CEA	CEA regulations

Equipment and material conforming to any other standard which ensures equal or better quality may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

The electrical installation shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

1.13.3.2 Design Criteria

All 33kV & 11kV Switchgear shall be suitable for an ambient temperature of 45 °C and relative humidity of 87%. The Switchgear shall be suitable for operation in a highly polluted environment.

All 33kV & 11kV Switchgear shall be suitable for following voltage & frequency variations as follows:

Voltage Variation	:	(±) 10%
Frequency Variation	:	(+) 3% to (-)5%
Combined Variation of Voltage & Frequency	:	10% (absolute sum)
For DC System	:	(+)10% to (-)15%

Motor rated [160-600kW] shall be provided with [vacuum contactor/vacuum circuit breaker] and motor rated above [600kW] shall be provided shall be provided with vacuum circuit breakers.

33kV & 11kV switchgear shall be Indoor, metal clad, floor mounted, Single front and fully draw out type. Design and construction shall be such as to allow extension at either end. These shall be Aluzinc/ CRCA sheet metal enclosed and assembled to form a rigid, free-standing floor mounted structure. Vertical units shall be assembled to form a continuous line up of panels

All 33kV & 11kV Circuit breaker shall be draw out type & should have Service, Test and Disconnected positions with positive indications for service & test positions. It shall be possible to charge the springs manually, if, required

Local/remote selection shall be provided for all incoming/Outgoing Circuit Breaker modules. Incoming/Outgoing breaker shall be closed at service position from remote (SCADA placed at MRSS) and at test position from Local (Switchgear).

Control and Indication voltage level shall be 110V DC.

Maximum system fault level at 33kV & 11kV buses shall be 26.2kA for 1 sec & 18.3kA for 1 sec respectively. Switchgear should be rated for Internal arc rating for 33kv, 26.2kA for 1Sec & 11kv, 18.3kA for 1Sec. Switchgear should be tested for Breaker, Cable and Busbar chamber for AFLR IAC for 1Sec.

33kV & 11kV System shall be solidly earthed.

Surge arrestor shall be provided for each Transformer feeder.

The switchgear will be located in a clean but hot humid and tropical atmosphere.

For continuous operation at specified ratings, temperature rise of the various switchgear components shall be limited to the permissible values stipulated in the relevant standards and this specification.

The switchgear and components thereof shall be capable of withstanding the mechanical forces and thermal stresses of the short circuit current without any damage or deterioration of material.

All the numerical relays shall have communication on two ports, local front port communication to laptop and a second port with [IEC 61850 protocol] to communicate with SCADA placed at MRSS.

1.13.3.3 Specific Requirements

1.13.3.3.1 Construction

All 33kV & 11kV switchgear shall have following minimum features.

a) 33kV & 11kV switchgear shall be of indoor, metal clad, single front, single tier, floor mounted, horizontal drawout type with vacuum circuit breaker and free standing type. The Panels shall be suitable for cable entry at bottom and bus duct connection at top.

b) Cable is considered between 33kV/11kV switchgear incomer and transformer. Hence switchgear shall be suitable for this connection.

c) All frames and load bearing members shall be fabricated using mild steel structural sections or pressed and shaped cold rolled sheet steel of thickness not less than 2 mm.

d) Frame shall be enclosed in cold rolled sheet steel of thickness not less than 2 mm. Doors and Covers shall also be of cold rolled sheet steel of thickness not less than 1.6 mm. Removable gland plates of thickness 3mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material)shall be provided for all panels. Suitable removable type lifting hooks and / or jacking pad shall be provided on each panel or shipping section for ease of lifting of switchgear. These hooks when removed shall not leave any opening in the panels.

e) Each breaker shall be housed in a separate cubicle, complete with an individual front access door. Each vertical section shall have a removable back cover. The vacuum-interrupter, circuit-breaker and the switchgear panel shall be of the same make.

f) The switchgear enclosure shall confirm to the degree of Protection of the IP-42 for indoor installation. However degree of protection of LV chamber shall be IP-52. No louvers/Opening shall be provided on the top of panel. All the other louvers if provided shall have very fine brash or GI mesh screen.

g) Paint shade for complete panels shall be [RAL 7032] for extreme end covers for all board.

h) The working zone shall be restricted to [750mm to 1800mm] from floor level. Total height of the switchgear panels shall not exceed [2600 mm].

i) Metallic barriers shall be provided between vertical sections and also between adjacent modules to ensure prevention of accidental contact with live parts during routine inspection/maintenance of functional units or cable terminations of one or more functional units when working on those of adjacent units. These

barriers shall have insulating inserts as necessary for taking the interconnections etc.

j) A nameplate with switchgear designation shall be fixed at the top of the central panel. A separate nameplate giving feeder details shall be provided for each compartment. A separate nameplate giving details of bus section shall also be provided for switchgear having more than one bus section.

k) Name plate shall be provided for each equipment (lamps, push buttons, switches, relays, auxiliary contactor, etc) mounted on the switchboard. Special warning plates one each on each feeder of a shipping section shall be provided on removable covers of doors giving access to cable terminals and busbars. Name plate size shall be minimum of 20x75 mm for Instruments/devices and 40x50 mm for panels. Thickness shall be minimum 3 mm.

l) Two 110V DC feeders shall be provided for control, Indication and annunciation of breaker operated module at any one cubicle. Further distribution to all verticals shall be in the scope of bidder.

m) Compartment door shall be interlocked with main power isolating device for safety with provision for defeating it by authorized person.

n) Supplier shall provide total 10% or minimum one (1) no. spare feeder of each type & rating with respect to total requirement of the switchgear.

o) Switchgear shall have provision to receive Single phase 240V Each cubicle shall be provided with thermostat controlled space heaters suitable for operation from 240 V ± 10%, single phase, 50 Hz, + 3% - 5% supply and 5A, 240V AC, 3 pin plug socket and cubicle lamp. The space heaters shall be located at the bottom of the switchboards. Cubicle heater, plug/socket/lamp circuits shall have individual switch fuse units. Motors shall be provided with anti- condensation heaters at 240V.Necessary provision for supply of motor space heating shall be considered in the switchgear.

p) All relays, meters, switches and lamps shall be flush mounted on the respective cubicle door or on control cabinet built on the front of the cubicle.

q) Controls and interlocks as required for the safe switching, operation and maintenance of the switchgear shall be provided. Mechanical interlocks shall be provided in addition to electrical wherever possible.

r) It should be possible to carryout maintenance on a feeder with adjacent feeders alive.

s) The switchgear shall be [natural/ gas cooled].

t) The circuit breakers, contactors, bus VTs shall be mounted on withdrawable truck which shall roll out horizontally from service position to isolated position.

1.13.3.3.2 Bus and Bus Taps

a) The main buses and connections shall be of high conductivity aluminum .Control and auxiliary buses shall be of electrolytic copper/copper wires.

b) Bus bars and connections shall be fully insulated for working voltage with adequate phase / ground clearances. Insulating sleeves for bus bars and shrouds for joints shall be provided.

c) Bus insulator shall be flame-retardant, non-hygroscopic, track resistant type with high creepage surface. This shall be of non-carbonizing material such as epoxy bonded fiberglass. Bus bars shall be color coded for easy identification. Standard type tested design without bus support insulator is also acceptable.

d) The bus bar supports shall be able to withstand stresses due to maximum short circuit and also take care of any thermal expansion.

e) Bus bars shall be color coded for easy identification and so located that the sequence R-Y-B shall be from left to right, top to bottom or front to rear, when viewed from the front to switchgear assembly.

f) The continuous rating of the main bus bars shall be same as that of the incomer circuit breaker and shall carry this continuous current without exceeding the temperature of [90 °C]. For silver plated joints maximum temperature shall be limited to [105 °C] inline with IEC standard.

g) The busbar chamber shall be provided with inter panel barrier with epoxy cast seal off bushings through which the buses will pass through so as to prevent fire from one panel to another.

1.13.3.3.3 Circuit Breaker

a) The circuit breaker shall be of vacuum type.

b) The circuit breakers shall be fully draw-out type, having service, test and disconnected positions with positive indicators for service & test positions.

c) The breakers shall have motor operated spring charged mechanism. It shall be possible to charge the springs manually, if, required. Breakers shall be trip free and shall have an anti-pumping device. The operating duty cycle shall be 0 -0.3 sec-CO-3 min.-CO.

d) For motor, spring charging shall take place automatically after each breaker closing operation. One ‘open-close-open’ operation of the circuit breaker shall be possible after failure of power supply to the motor.

e) Automatic safety shutters shall be provided to ensure the inaccessibility of live parts after the breaker is drawn out. There shall be distinct overall door for the breaker compartment and shall be lockable.

f) Truck shall have distinct service, Test and Isolated positions. It shall be possible to close the breaker compartment door in isolated position also. The truck and breaker frame shall get earthed while the truck is being inserted in the panel and positive earthing of the truck and breaker frame shall be maintained in all positions.

g) Outgoing breakers shall be suitable for switching transformers and motors at any load.

h) Mechanical safety interlocks shall be provided to prevent

   i. The circuit breaker from being racked in or out of the service position when the breaker is closed.

   ii. Racking in the circuit breaker unless the control plug is fully engaged

i) Breakers shall be adequately de-rated to account for design ambient temperature and temperature inside the cubicle.

j) Equipment and component rating and quantities shall be suitably selected according to the requirements with adequate margin.

k) Closing and tripping coil shall operate satisfactorily under the following conditions.

- Closing Coil: 85% to 110% of rated voltage.
- Tripping Coil : 70% to 110% of rated voltage

Closing coil and tripping coil must be rated for continues current and interchangeable.

1.13.3.3.4 Contactor

High voltage contactor shall be of AC-3 utilization category and shall be of vacuum type. Fuse and contactor shall be mounted on withdrawable truck. The contactor shall be latched type and shall be complete with mechanical trip indicator, anti pumping relay, surge suppresser, single phasing preventer etc.

1.13.4 ..... Current Transformers

Current Transformers shall be cast-resin type. All secondary connections shall be brought out to terminal blocks where wye or delta connection shall be made. They shall have sufficient thermal and mechanical capacity to withstand the maximum momentary current rating of the breakers.

CTs shall have polarity makings indelibly marked on each transformer at the lead terminations and at the associated terminal block. Facility shall be provided for short circuiting and grounding the CT secondary at the terminal blocks. Secondary terminals shall be provided with protective cap.

CT terminal block shall be disconnecting type and suitable for round type lugs with facility for testing and short circuiting of individual CT.

All CTs shall be provided with supports independent of busbars / busbar supports. The CTs shall be located in such a way that they can be easily approached for maintenance without necessitating shutdown of adjacent feeders.

CTs shall be provided with disconnected type test links in both secondary leads for carrying out current and phase angle measurement.

Accuracy class of CT shall be 5P20 for protection, PS for differential protection and 0.2 for incomer & 1.0 for outgoing metering.

CT VA shall be as per design requirement.

1.13.4.1 Voltage Transformer

Voltage transformers (VT) shall be cast-resin type with an accuracy class of 0.2 for line metering & 0.5 for bus metering and 3P for protection.

VTs shall be of the single-phase type. VTs shall be protected on their primary side by fuse and by MCB (with auxiliary contacts) on the secondary sides.

It shall be possible to replace VTs without having to de-energise the main busbars.

VTs shall be provided with disconnected type test links in both secondary leads for carrying out current and phase angle measurement.

1.13.4.2 Secondary wiring

The switchgear shall be fully wired at the factory to ensure proper functioning of control, protection and interlocking schemes.

Fuse and links shall be provided to permit individual circuit isolation from bus wires without disturbing other circuits. All spare contacts of relays, switches and other devices shall be wired up to terminal blocks.

Secondary wiring within the switchgear shall be carried out in a neat and systematic manner and securely held in position (either loomed or run in conduit / trunking).

Wherever wiring passes through compartment, it shall be run in conduit / trunking, if metallic shall be bonded to the main earth busbar.

Wiring shall be done with flexible, 1.1/0.650kV grade, PVC insulated switchboard wires with stranded copper conductors of 2.5 mm2 for CT & PT circuits and 1.5mm2 for control circuit wiring (applicable for internal panel wiring).

Each wire shall be identified, at both ends, with permanent markers bearing wire numbers as per bidder's wiring diagrams. Wire terminations shall be made with crimping type connectors with insulating sleeves, wire shall not be spliced between terminals.

1.13.4.3 Terminal blocks

Terminal blocks shall be of 1100 V grade, stud type with marking strips. Terminals for CT secondary leads shall have provision for easy shorting, earthing and shall be suitable for connecting 2 cables of 2.5 mm2 copper.

Sufficient terminals shall be provided on each terminal block to ensure that not more than two outgoing wires are connected per terminal. All spare contacts of auxiliary relays, timers etc. shall be wired up to the terminals. 20% spare terminals shall be provided on each terminal block.

Terminal blocks shall be located to allow easy access. Wiring shall be grouped such that the individual wires of a cable can be connected to consecutive terminals.

1.13.4.4 Ground bus

A ground bus, rated to carry maximum fault current, shall extend full length of the switchgear. The ground bus shall be provided with two-bolt drilling with G.I. bolts and nuts at each end to for connection to the grounding conductor / flat.

Each unit shall be connected directly to the ground bus. The frame of each circuit breaker and draw out V.T. unit shall be grounded through heavy multiple contacts at all times except when the primary disconnecting devices are separated by a safe distance.

C.T. & V.T. secondary neutrals shall be earthed through removable links so that earth of one circuit may be removed without disturbing others. All hinged doors shall be earthed by flexible copper bride.

1.13.4.5 Control & Indication

a) The circuit breaker shall be wired up for local & remote operation. Each breaker shall be equipped with following:
b) Remote selector switch with pistol grip handle and key interlock for breakers with motor wound spring charging mechanism. In Remote position, the breaker can be operated in service position with all interlock and protections. In Local position, the breaker shall be operated from switchgear only in test position.
c) Each cubicle shall be provided with Auto/ Manual Switch. Trip selection switch and Trip-Neutral- Close (TNC) switch.
d) Circuit breaker shall be indicated electrically. The following indication color shall be used.
   - Breaker closed – Red
   - Breaker opened – Green
   - Spring Charged – White
   - Breaker Auto trip – Amber
e) However any other indication shall be provided as per owner's requirements.
f) Lamps shall be LED type with resistance for voltage protection. Lamp and lens shall be replaceable from the front.
g) Breakers shall be controlled locally and/or remotely as per plant operational requirement. Necessary Interposing relays & feedback signal shall be provided based on the SCADA, placed at MRSS, IO list.
h) Breaker control supply shall be of 110 V DC. Breaker spring charging motor shall be suitable for 240V AC.

1.13.4.6 Cable termination

Switchgear shall be designed for cable entry from the bottom. Sufficient space shall be provided for ease of termination and connection.

1.13.4.7 Painting

All sheet steel surfaces shall be chemically cleaned, degreased and pickled in acid to produce a smooth, clean surface free of scale, grease and rust. After cleaning, the surface shall be given a phosphate coating followed by a coat of high quality primer and baking in the oven.

The paint shade shall be subject to owner's approval. Sufficient quantity of touch up paint shall be furnished for application at site.

1.13.4.8 Relays, Protection & Metering

a) The hardware design for protection and associated equipment shall use latest state–of–the-art technology and shall generally be integrated numerical/digital, modular in nature. Where design is based on numerical technology, adequate self-testing/monitoring/ diagnostic facilities shall be provided.

b) All numerical relays, auxiliary relays and devices shall be of types, proven for the application; satisfying requirements specified elsewhere and shall be subject to Purchaser's approval. Numerical Relays shall have appropriate setting ranges, accuracy, resetting ratio, transient overreach and other characteristics to provide required sensitivity to the satisfaction of the Owner. All numerical relays shall be compatible with IEC 61850.

c) All protective relays shall be in draw out or plug-in type / modular cases with proper testing facilities. Necessary test plugs / test handles shall be supplied loose and shall be included in supplier’s scope of supply.

d) All AC operated relays shall be suitable for operation at 50 Hz. AC voltage operated relays shall be suitable for 110 Volts VT secondary and current operated relays for 1 amp CT secondary. All relays and timers shall be rated for control supply voltage as mentioned elsewhere under parameters and shall be capable of satisfactory continuous operation between 80-120% of the rated voltage. Voltage operated relays shall have adequate thermal capacity for continuous operation.

e) Multifunction meters shall be provided for incomer of 33kV & 11kV Switchgear and shall able to communicate with SCADA at MRSS. The accuracy class of CT and VT for MFM shall be 0.2.

f) Provision shall be made for easy isolation of trip circuits of each relay for the purpose of testing and maintenance.

g) All protective relays and alarm relays shall be provided with one extra isolated pair of contacts wired to terminals exclusively for future use.

h) The relay shall be designed to perform satisfactorily under highly noisy electrical environment. Sufficient degree of high frequency disturbance immunity and impulse voltage withstand capacity shall be built into electronic designs as stipulated in relevant standards.

i) All protections shall be furnished complete with necessary auxiliary, supervisory, lock out relays. Suitably separate sets of single phase auxiliary C.T with multiple taps shall be provided with relay whenever required.

j) Visual and audible alarm annunciation shall be initiated in the event of operation of protective/supervisory relay.

k) D.C supply shall be supervised by DC supervision relays.

l) Trip circuit shall be supervised by Trip circuit supervision.

m) Tripping shall be done through high speed lock out relays.

n) All meters/ instrument shall be flush mounted on front panel, at least 96 mm2 size with 90 degree linear scales and accuracy class of 2.0.

o) Interposing relays for ON/OFF command or any other command shall be as per system requirement.

p) For alarm and Indication at SCADA placed at MRSS/ESS-3 end necessary contacts shall be provided at switchgear end.

q) Interposing relays for ON/OFF command or any other command shall be as per system requirement.

r) For alarm and Indication at SCADA placed at MRSS/ESS-3 end necessary contacts shall be provided at switchgear end.

s) Metering and protection shall be as per below table

i. The relays shall have the following tools for fault diagnostics:

ii. Fault record : The relay shall have the facility to store at least 100 last fault records with information on cause of trip, date, time, trip values of electrical parameters.

iii. Event record : The relay shall have the facility to store at least 1000 time stamped event records with 1ms resolution.

iv. Disturbance records : The relay shall have capacity to store at least 50 disturbance record waveforms at 1 sec.

v. Event log, trip log and disturbance record should go in to history.

vi. The relay settings shall be provided with adequate password protection.

PROTECTIONS

FOR INCOMERS

- Instantaneous and Inverse time phase over current relay (50,51)Inverse time Earth fault current relay (51N)
- Directional inverse time phase over current relay (67)
- Directional inverse time Earth fault current relay (67N)
- Bus-bar differential relay (87B- only for 33kV switchgear

- Reverse blocking mechanics- only for 11kV switchgear
- Cable differential relay (87C- only for 33kV remote switchgears (Switchgears at substation 2, 3 & 4)
- Under voltage Protection (27)
- Over voltage Protection (59)
- Fault Disturbance Recorder (DR)

FOR OUTGOING FEEDERS EXCEPT TIE & TRANSFORMER FEEDERS

- Instantaneous and Inverse time phase over current (50,51)
- Inverse time Earth fault current (51N)
- Bus-bar differential relay (87B) - only for 33kV switchgear
- Reverse blocking mechanics- only for 11kV switchgear
- Distance to fault locator (DFL)
- FOR TIE FEEDERS
- Instantaneous and Inverse time phase over current (50,51)
- Inverse time Earth fault current (51N)
- Bus-bar differential relay (87B) - only for 33kV switchgear
- Reverse blocking mechanics- only for 11kV switchgear
- Distance to fault locator (DFL)

FOR BUSCOUPLER

- Instantaneous and Inverse time phase over current relay (50,51)
- Instantaneous and Inverse time Earth fault current relay (51N)
- Bus-bar differential relay (87B) - only for 33kV switchgear
- Reverse blocking mechanics- only for 11kV switchgear

FOR PT/ LINE PT MODULES

- Under voltage Protection (27)
- Over voltage Protection (59)

TRANSFORMER FEEDERS

- Instantaneous and Inverse time phase over current (50,51)
- Inverse time Earth fault current (51N)
- Instantaneous Earth fault current (50N- for Transformer feeder (delta connected HV winding)
- Bus-bar differential relay (87B) - only for 33kV switchgear
- Reverse blocking mechanics- only for 11kV switchgear
- Distance to fault locator (DFL)

Metering In Incoming & Outgoing Feeders

- Current in all the three phases (Metering at Switchgear end)
- Voltage of all three phases
- MWH
- MW
- MVARH
- Frequency
- Power Factor
- Synchro. Check

1.13.4.9 Tests

1.13.4.9.1 Type Test:

For each type & rating of 33kV & 11kV Switchgear, the Bidder shall submit the reports of all the type tests as per relevant standards and carried out within [last five] years from the date of bid opening for Owner's approval. These reports should be for the tests conducted on the switchgear similar to those proposed to be supplied under this contract and the test(s) should have been conducted at an independent laboratory.

In case the Bidder is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Bidder shall conduct all such tests under this contract free of cost to the Owner and submit the reports for approval.

1.13.4.9.2 Routine Test

All equipment shall be completely assembled, wired, adjusted and routine tested as per relevant IS / IEC Standards at manufacturer's works in the presence of consultant /purchaser or his representative. However the following minimum routine tests shall be conduct.

- Power-frequency voltage tests on the main circuit
- Dielectric tests on auxiliary and control circuits
- Measurement of the resistance of the main circuit
- Partial discharge measurement
- Mechanical operation tests
- Heat Run test
- Pressure tests of gas-filled compartments
- Tests of auxiliary electrical, pneumatic and hydraulic devices

- Verification of correct wiring

1.13.4.9.3 Test Witness

[The tests shall be carried out in presence of the Owner's representative, for which a minimum 7 days notice shall be given by the Bidder. The Bidder shall obtain the Owner's approval for the type test procedure before conducting the type test. The test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.]

1.13.4.10 Test Certificates:

Certified copies of all tests carried out at works and at site shall be furnished in requisite no. of copies for approval of the Owner. The equipment shall be dispatched from works only after receipt of Owner's written approval of shop test reports.

1.13.4.11 Drawing & Documents

Drawings, data & manuals for the motors shall be submitted as indicated below.

- *[General Arrangement drawings and cross-section showing constructional features & cable entry with bottom view with opening]*
- *Bill of Materials.*
- *Technical Data sheet and Catalogue.*
- *Foundation drawing details with bottom view of switchgear.*
- *Descriptive write-ups and literature for the main equipment offered including relays, meters, etc.*
- *Control Schematics & Wiring diagram.*
- *Inspection and Test Plan (ITP).*
- *Suggestive list of protective relays.*
- *Transport/shipping dimensions and weights].*
- *Ratings & Requirements*

33kV & 11kV Switchgear shall comply with the particulars indicated in the following tables.

S. No.	DESCRIPTION	UNIT	DATA
1.0	General		
1.1	Name of Manufacturer		[By Bidder]
1.2	Place & Country of manufacture		[By Bidder]

S. No.	DESCRIPTION	UNIT	DATA
2.0	Switchgear Details		
2.1	Rated voltage(Nom/Max), phases & frequency		11 kV/12 kV, 3 Phase, 3 wire, 50 Hz. 33kV / 36kV, 3 Phase, 3 wire, 50 Hz.
2.2	System neutral earthing		Solidly Earthed
2.3	Voltage & frequency variation	%	+/-10%, -5%to +3% Hz.
2.4	Rated frequency	Hz	50Hz
2.4	Insulation Level One minute power frequency Voltage Impulse withstand Voltage		28kV for 11kV Switchgear & 70kV for 33kV Switchgear 75kV for 11kV Switchgear & 170kV for 33kV Switchgear
2.5	Continuous current rating of busbars under site reference ambient temp.		[As per Project requirement]
2.6	Reference ambient temperature		45°C
2.7	Maximum temperature of bus bars and droppers/connectors under site conditions specified		Continuous current without exceeding the temperature of 90 °C. For silver plated joints maximum temperature shall be limited to 105 °C.
2.8	Short circuit current withstand for busbars and droppers		
a	Short time	kA (rms)	26.2 kA for 1 Sec at 33kV and 18.3 kA for 1 sec at 11kV
b	Dynamic Rating	kA (peak)	65.5 kA for 33kV & 46kA for 11kV
c	Intern Arc AFLR	Ka	31.5 kA for 1Sec at 33KV 25 Ka for 1Seca at 11KV
2.9	Whether busbars have been insulated	Yes	Required
2.10	Type of insulation		[By Bidder]

S. No.	DESCRIPTION	UNIT	DATA
2.11	Material of bus bar supports		[By Bidder]
2.12	Switchgear designation		[As per project specific]
2.13	Bus bar material		Al
2.14	Fully draw out (FD)/ Fixed (F)		FD / Single front
2.15	Entry –Top (T)/Bottom (B)		Bottom for cables.
2.16	Degree of protection		IP-42 and for LV chamber shall be IP-52.
2.17	Color finish shade	Interior Exterior	Siemens Grey RAL 7032
2.18	Earthing bus	Material	Aluminum
2.19	Minimum clearances in air of live parts	mm	As per standard
3.0	Circuit breakers		
3.1	Maker's name		
3.2	Voltage, frequency & no. of phases , poles		33kV,50hz,3 phase,3 pole & 11kV,50hz,3 phase,3 pole
3.3	Rated operating duty		O-0.3sec-CO- 3min -CO
3.4	Circuit breakers type		VCB
3.5	Short circuit withstand current for 1 sec. Duration	kA	26.2 at 33kV ; 18.3 at 11kV
3.6	Rated making current	kAp	100
3.7	Rated current at site reference ambient temp	A	[By bidder]
3.8	Type of operating mechanism		Spring charged motor and manual
3.9	Minimum no. of auxiliary Contacts for purchaser's use		6 NO, 6 NC
3.10	Control voltage		
	For Spring charging motor	V AC/DC	230V AC
3.11	Closing Coil		
a	Voltage	V	110 V
b	Permissible Voltage Variation	%	85% to 110%

S. No.	DESCRIPTION	UNIT	DATA
c	Closing Current at rated Voltage	A	Within Limit
3.12	Opening Coil		
a	Voltage	V	110 V
b	Permissible Voltage Variation	%	85% to 110%
c	Closing Current at rated Voltage	A	Within Limit
3.13	Operating time		
	Opening time	ms	<65
	Breaking time	ms	<15
	Total tripping time	ms	<80 (total break time)
	Total Closing time	ms	<80 ms
3.14	Number of breaks per pole		One
4.0	Contactor		
	Voltage class	kV	36; 12
	Short time Rating		[By bidder]
	Duty		AC3
5.0	Fuse		
	Voltage class	kV	33; 11
	Rupturing capacity	kAp	100
6.0	Current Transformer		
a	Make		[By bidder]
b	Type		Resin Cast
c	Rated frequency		50Hz
d	Class of Insulation		[Class E]
e	Basic Insulation level	kV	For 33kV- 36/70/170 For 11kV- 12/28/75
6.1	CT for differential protection		
	Class		PS class
	Secondary resistance at 75 0 C		[By bidder]
	Knee Point Voltage		[By bidder]
	Excitation Current		<30mA
6.2	CT for Metering		
	Class		0.2 for incomers, 1 for outgoings

S. No.	DESCRIPTION	UNIT	DATA
	Secondary resistance at 75 0 C		[By Bidder]
6.3	CT for Protection		
	Class		[5P20]
7.0	Voltage Transformer		
a	Make		[By Bidder]
b	Type		Resin Cast
c	Rated frequency		50Hz
d	Class of Insulation		[Class E]
e	Voltage ration		[By Bidder]
8.0	Meters		
a	Make		[By Bidder]
b	Type		[By Bidder]
8.1	Voltmeter		
a	Make		[By Bidder]
b	Type		[By Bidder]
c	Applicable standards		As specified in the specification.
d	Accuracy class		Class 0.2 for line, Class 0.5 for bus
8.2	Ammeter		
a	Make		[By Bidder]
b	Type		[By Bidder]
c	Applicable standards		As specified in the specification.
d	Accuracy class		Class 0.2 for incomers, Class 1.0 for outgoing
9.0	Indicating lamps		
a	Make		[By Bidder]
b	Type		[By Bidder]
c	Voltage	V	As specified in the specification.
d	Wattage of lamp	W	[By Bidder]
10.0	Push buttons		

S. No.	DESCRIPTION	UNIT	DATA
a	Make		
b	Type		As specified in the specification.
c	Contact rating	A	[By Bidder]
11.0	Space heater		
a	Make		
b	Type		As specified in the specification.
c	Rated voltage	V	As specified in the specification.
d	Power rating	W	[By Bidder]
12.0	Wiring and terminal blocks		
a	Voltage grade		1.1 kV
b	Insulation		[By Bidder]
c	Minimum size of conductor for:		
	Power wiring	Sq.mm	2.5 for CT & PT for internal panel wiring only and 4 for external wiring
	Control wiring	Sq.mm	1.5 (for internal panel wiring only)
f	Type of terminal blocks:		
g	I) For Withdraw able Type		Sliding type
h	II) For Fixed Type		Stud & nut type
i	Minimum current rating of terminal blocks	A	10
14.0	Relays		
a	Make		
b	Model Number		
c	Parameter		Catalogue shall be furnished by the bidder.

1.13.5 ..... Ring Main Units

1.13.5.1 General

This specification is intended to cover the [design, Engineering, manufacture, assembly, testing at manufacturer's works, supply in properly packed condition for transport to site, Erection, site testing and commissioning] of 33kV & 11kV RING MAIN UNITS.

The system shall be complete in all respect including all accessories required for efficient and trouble-free operation of Atal Puram Township, Agra

All the ratings, indications, protections, annunciation & accessories indicated in SLD/Datasheet/specifications are minimum requirements & Contractor to provide any additional accessories / components / ratings to suit the actual requirements & for successful commissioning of 33kV & 11 kV RMU along with its integration with SCADA system located in MRSS/ESS-3 through FRTU, which shall be part of RMU & placed in the same enclosure.

Equipment Manufacturer's person shall supervise- equipment commissioning activities to be carried out by Contractor's personnel. The same shall be considered in Contractor's offer.

All the requirements of this specification are to be considered in conjunction with other sections of the specifications.

1.13.5.2 Applicable Codes and Standards

The design, material, construction, manufacture, inspection and testing of Switchgear shall comply with all currently applicable statutes, regulations and safety codes in the locality where the Equipment will be installed. The Equipment shall also conform to the latest applicable standards.

The Equipment shall conform to the latest standards specified. In case of conflict between the standards and this specification, this specification shall govern.

HV switchgear and control gear-AC Metal Enclosed switchgear and control gear	IEC 62271-1
HV switchgear and control gear-AC Metal Enclosed switchgear and control gear	IEC 62271-200

Circuit Breakers	IS / IEC 62271-100
Disconnectors & Earthing Switches Metal Enclosed switchgear	IEC 62271-102 IS : 3427 / BSEN:60298 / IEC:298 / IEC 265
Current Transformers	IS : 2705 / BS : 7626 / IEC:60044-1
Voltage Transformers	IS : 3156 / BS : 7625 / IEC: 186 / IEC:60044-2
Arrangement for Switchgear Bus bars, Main Connections and Auxiliary wiring	IS : 5578, 11353
Busbar Support insulators	IS: 2544 / BS : 3297 / IEC : 273
Degree of Protection	IS : 13947 (Part 1) / IEC : 947-1 / IEC : 60529
Electrical Relays for Power system protection	IS : 3231, 3842 / BS : 142 / IEC : 255
Electrical Indicating Instruments	IS : 1248 / BS : 89 / IEC : 51
High Voltage Fuses	IS: 9385 / BS : 2692 / IEC : 282
AC Electricity Meters	IS : 722, 8530 / BS : 5685 / IEC : 145, 211
Specification for copper rods and bars for electrical purposes	IS : 613
Code of practice for phosphating iron and steel	IS : 6005 / BS : 3189
Alternating current Switches for voltages above 1000 V	IS: 9920 / IEC : 129, 265 & 298
Low voltage fuses	IS : 13703 / BS 1362 / IEC 269
Toggle switches	IS : 3452 / BS : 3676
Code of practice for selection, installation and maintenance of switchgear and control gear	IS : 10118

Control switches/ Low voltage switchgear and control gear	IS:6875/BSEN 60947/IEC : 947
HV Cable Termination	IEC 62329
Communication Protocol	IEC 61850
Communication port	RS 485 / RJ 45
High Voltage Test Techniques	IEC 60060
HV switchgear and control gear-AC Switch Fuse combination	IEC 62271-105
Insulation	IEC 600071
Installation	IEC 61936-1
Voltage Detecting Device	IEC 61243-5

In the event of any conflict between the codes and standards referred to in the specification and the requirement of this specification, latter shall govern.

1.13.5.3 Switchgear / Panel Requirements

The RMU shall be 33 & 11 kV (Outdoor) type, 33 & 11 kV VCB enclosed in a close vessel having SF6 as insulating medium along with Load Break Isolator, Earth switch, 33 & 11kV Bus and other associated equipments. The Configuration of RMU shall be as mentioned below.

(2) nos. Network Ring switches i.e. Load break Isolators and 1 No. 630A Vacuum Circuit Breaker with self-powered protection relay along with BUS VT Metering Panel. The RMU shall be extensible on one side.

Symmetrical short circuit rating of the breaker shall not be less than 20kA/3sec at 11kV & 25kA/1sec at 33kV level.

33 & 11kV Outdoor type RMU shall be suitable for installation in severe outdoor environment conditions. Outdoor type RMUs shall have minimum IP 54 protection. The Outdoor RMU shall be with dedicated outdoor design.

The degree of protection for RMU tank (Outdoor) shall be IP 67. The mimic board shall be provided with IP2X/ IP3X degree of protection.

The RMU metal parts shall be of high thickness high tensile steel which must be treated with seven tank treatment and subsequently painted with epoxy based powder paint, the overall paint layer thickness shall not be less than 80 microns DFT.

All live parts except for the cable connections shall be insulated with SF6 gas. The SF6 enclosure shall be made of welded stainless steel. The gas leakage rate shall be less than 0.1% per annum and no gas filling should be required at site during the product life cycle in normal operating conditions.

The cubicle shall be metal enclosed with a sheet steel of appropriate thickness and provided with a pressure relief arrangement away from operator & type tested design. The high-voltage vessel shall be made up of non-magnetic stainless steel grade SS 304 or higher.

Protection of personnel against internal arc is of utmost importance, since the RMU will be installed outdoor and in public areas. It is mandatory that complete RMU (gas vessel & cable connection compartment) are required to be internal arc tests for minimum 25kA/1sec for 33kV RMU and 20kA/1sec for 11kV RMU. If any additional box is included to increase the cable termination height, RMU should be type tested for internal arc with the additional cable box.

Any accidental over pressure inside the sealed chamber shall be limited by the opening of a pressure-limiting device in the rear top part of the enclosure. Gas will be release to the rear of the switchgear away from the operator to ensure safety of the operating personnel and all the manual operations will be carried out on the front of the switchboard. The RMU must be tested for IAC AFLR to ensure safety of the personnel around the RMU during Internal arc. All manual operations shall be carried out on the front of the RMU.

Internal arc venting shall be Top explosion and the gas coming from the vent should be minimum at 1.62m height which is more than average human height.

The Entire units of RMU shall be in a single compact metal clad, outdoor/Indoor type (as applicable) suitable for all weather conditions. The SF6 tank must be sealed for life and shall meet the “sealed pressure system” criterion in accordance with the IEC 62271-200 standard. Sealed pressure systems shall be completely assembled, filled and tested in the factory. The RMU must be a system for which no handling of gas is required throughout the 20 years of service life. The maximum leakage rate of SF6 gas shall be lower than 0.1 % of the total initial mass of SF6 gas per annum. The filling

pressure for the switchgear shall be just above the atmospheric pressure so as to reduce the tendency to leak. SF6 gas used for the filling of the RMU shall be in accordance with IEC 376. An absorption material will be fitted in the tank to absorb the moisture from the SF6 gas and to regenerate the SF6 gas following arc interruption. The SF6 insulating medium shall be constantly monitored via a temperature compensating gas pressure indicator offering a simple indication. All the combination of the RMUs should have the required SF6 insulation by providing necessary gas chamber capacity.

The Outdoor type RMU shall be suitable for mounting on plinth with provision for cabling through gland plate in the base and trench below. The RMU shall be designed so that the position of the different devices is visible to the operator on the front and operations are also visible. The RMU shall be identified by an appropriately sized label which clearly indicates the functional units and their electrical characteristics. The RMU shall be designed to be tamper proof so as to prevent access to all live parts during operation without the use of tools.

The RMU shall be completed with all connection and contain Copper bus bars with continuous current carrying capacity of 630A at design ambient. The bus bar shall be fully encapsulated by SF6 gas inside the steel tank. There shall be continuity between the metallic parts of the RMU and cables so that there is no electric field pattern in the surrounding air, thereby ensuring the safety of people.

Each switchboard shall be identified by an appropriately sized label, which clearly indicates the functional units and their electrical characteristics.

The entire switching system shall be totally encapsulated. There shall be no access to exposed conductors.

All parts of main circuit to which access is required or provided shall be capable of being earthed prior to becoming accessible. This does not apply to removable parts which become accessible after being separated from the switchgear and control gear. The cables shall be earthed by an earth switch with short-circuit making capacity in compliance with IEC 62271-102. Circuit breaker shall not be closed in case Earth Switch is closed. The earth switch shall be fitted with its own operating mechanism and manual closing shall be driven by a fast-acting mechanism, independent of operator action. Mechanical interlocking systems shall prevent access to the operating shaft to avoid all operator errors such as closing the earth switch when cable is charged. An

anti-reflex mechanism on the operating lever shall prevent any attempts to reopen immediately after closing of the switch or earth switch.

Every cubicle shall be equipped with a mimic diagram reproducing the single line diagram and with clear indicators to show the position of the switches. The lever operating direction shall be clearly indicated in the mimic diagram. The position indicators shall give a true reflection of the position of the main contacts. They shall be clearly visible to the operator. The Contractor shall provide a marking plate showing RMU's main electrical characteristics.

Each panel shall be provided with FPI system mounted on the front panel. Provision to check the synchronization of phases with the use of external device shall be provided.

All the protection relay, master trip relay, annunciation panels, indication lamps, indicating meters etc. shall be mounted on the LV panel made of CRCA metal enclosure mounted on the RMU switchboard panel.

1.13.5.4 Outdoor Enclosure

The Outdoor enclosure shall be made up of CRCA of 2 mm thickness or galvanized of 1.6 mm thickness, high tensile steel which must be tropicalised to local weather conditions; grit/sand blasted, thermally sprayed with Zinc alloy, phosphate or should follow the 7 tank pre-treatment process and be subsequently Painted with epoxy based powder paint. The overall paint layer thickness shall be not less than 80 microns.

The metal base shall ensure rigidity for easy transportation and installation.

The protection degree of the Enclosure shall be IP54. The enclosure should have two access doors one for the operation and relay monitoring and other for the cable access. The doors shall be provided with proper interlocking arrangement for safety of operator.

All doors shall be provided with locking facility or it shall not be possible to open or remove them before doors used for normal operation have been opened. When they are closed, they shall provide the degree of protection specified for the enclosure.

The doors shall open outward at an angle of at least 90 Deg & be equipped with a device able to maintain them in an open position. Ventilation openings if provided, shall be so arranged or shielded that same degree of protection as specified for enclosure is obtained.

All metallic components shall be earthed to a common earthing point. It shall be terminated by an adequately sized terminal intended for connection to the earth system of the installation, by way of flexible jumpers/strips & Lug arrangement. The continuity of the earth system shall be ensured taking into account the thermal & mechanical stresses caused by the current it may have to carry.

There shall be an arrangement for internal lighting activated by associated switch.

Labels for warning shall be specified in min three languages including English, Hindi and Local Language. All the labels and Manufacturer's operating instructions etc. shall be durable & clearly legible. They should be located within operating height of the equipment.

The paints shall be carefully selected to withstand tropical heat and rain. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling.

1.13.5.5 SF6 Gas

The SF6 gas shall comply with IEC 376,376A and 376B and shall be suitable in all respects for use in 33kV and 11 kV panels under the operating conditions. The SF6 shall be tested for purity, dew point air hydrolysable fluorides and water content as per IEC 376,376A and 376B and test certificate shall be furnished to the owner indicating all the tests as per IEC 376 for each Lot of SF6 Gas. The stainless steel vessel shall be type tested for pressure test.

1.13.5.6 Load Break Isolators

The load break isolators for Incoming and Outgoing supply shall be provided and the load break isolators shall be fully insulated by SF6 gas.

The load break isolators shall consist of 630 Amp fault making/load breaking spring assisted ring switches, each with integral fault making earth switches. The switch shall be naturally interlocked to prevent the main and earth switch being switched 'ON' at the same time. The selection of the main and earth switch is made by a lever on the facia, which is allowed to move only if the main or earth switch is in the off position.

Closing and opening operation of the Load Break Switch shall be done from local/remote. The load break isolators shall be provided with 24VDC motor to have the facility for remote operation. It should be feasible to retrofit the motor at site.

Each load break switch shall be of the triple pole, simultaneously operated, non-automatic type with quick break contacts and with integral earthing arrangement. The operating mechanism shall be compatible for remote/SCADA operation.

1.13.5.7 Vacuum Circuit Breaker For Transformer Feeder Control

The Vacuum circuit breakers shall be of the maintenance free. The Vacuum circuit breaker must be with stored energy spring in combination with 3 positions disconnector with position ON-OFF-EARTH. This disconnector shall be mechanically interlocked with the VCB position & should not be operated when the VCB is in ON condition.

The circuit breakers shall have at least 2 positions: Open-disconnected and closed and shall be constructed in such a way that natural interlocks prevent all unauthorized operations. They shall be fully mounted and inspected in the factory.

The Circuit Breaker shall have closing and shunt trip coil .Closing and opening operation of the Circuit Breaker shall be done from remote. Spring charging shall be done with motorized spring operating mechanism. Motor shall be suitable for 24V DC supply. It should be feasible to retrofit the motor at site. The circuit breaker shall be fitted with a mechanical indicator on the panel front facia for indicating VCB ON/OFF positions. It shall be fitted with manual spring charging with a local system for manual tripping by an integrated push button. The operating mechanism shall be compatible for remote/SCADA operation.

There shall be provision for testing of cable without opening the cable connections. In case cables are to be tested with front door open, doors shall have interlocks such that doors can be opened only with earth switch in closed position. Termination boots as approved by the Employer's should have a proper opening to facilitate the testing. The opening shall be covered by means of removable protection cap.

The cable compartment cover must be interlocked with the switch position in all the feeders. The cable compartment cover shall open only when the load break isolator / VCB is in earth position. This ensures the complete safety of operator accessing the cables.

In case of front door opened, it shall not be possible to operate the breaker. All panel covers shall be provided with anti vandal screw bolts so that opening of panel covers is only possible with special tools, which shall be provided by the Contractor. This is required to prevent pilferage. The cable cover door shall be pad lockable and shall be Tamper and full Arc proof. The circuit breaker and earth switch shall be lockable in the

open or closed positions by padlocks. Breaker shall have mechanical endurance of at least 2000 operations.

An operating mechanism can be used to manually close the circuit breaker and charge the mechanism in a single movement. It shall be fitted with a local system for manual tripping by an integrated push button. There will be no automatic re-closing.

The circuit breakers should be able to carry the rated current continuously under site conditions without exceeding the permissible temperature rises for design ambient temperature outside the switchgear cubicle as mentioned in design criteria.

Following Indications shall be provided for each VCB unit-

- On
- Off
- Trip
- R / Y / B Indication

1.13.5.8 Relay

All relays shall be numerical relays and have protection O/C, S/C & E/F (50, 51, 50N, 51N) & trip circuit supervision relay is inbuilt in. Lockout relay shall be separate & not as element of numerical relays.

Contact multiplication shall be done by auxiliary relays instead of contactors in case the primary protection relays offered by Contractor do not have adequate number of contacts for protection/interlock schemes. Also all necessary auxiliary relays as required to meet the Employer's final control/protection/interlock schemes shall be provided by the Contractor.

All relays shall be numerical type and shall be supplied with latest version software without any extra cost. It should be possible to set relay, view fault parameters, download information from relay to computer connected for SCADA system. All relays in RMUs shall be on Modbus communicating directly with FRTU of RMU. Test terminal block for testing shall be provided. Relays shall be suitable for 1A CT secondary rating as indicated in 'Single Line Diagram'.

Relays shall include necessary auxiliary transformers, A/D & D/A converters, CPU modules for measuring and processing functions, power supply modules with regulator and DC/DC converters and suitable front end man-machine interface.

All Numerical protection relays shall be looped through MODBUS up to FRTU for further communication with SCADA.

The Ethernet Switch shall be suitably located in the Bus PT Panel with proper fitments and shall be easily accessible for accessing the same.

All Smart meters shall be connected through appropriate Protocol as decided by the Contractor based on the SMART GRID requirements.

Connections of all RS 485 ports shall be done using 3 core twisted & shielded 1.5 sq.mm Cu cable.

In order to fulfil the requirements of SCADA system, if provisions of additional auxiliary relays are necessary, then the same shall be provided by the VENDOR at no extra cost to the Employer.

All relays shall have clear identification on the associated panel by well-written inscription plates. Where indications are provided by flag relays or LEDs, these shall also be specifically identified by permanently fixed inscription adjacent to them.

The relays shall be suitable for application intended. The final relay ranges of each relay shall be decided at detailed engineering stage, if it is found that the offered relay range is not suitable for the intended application, the Contractor shall change the relay of appropriate range without any commercial / delivery implications whatsoever. The relay shall be subject to approval of Employer's representative.

Vendor shall furnish recommended relay settings with backup calculations. The Employer shall furnish all interface data for this purpose.

Closing and tripping coil shall operate satisfactorily under the following conditions.

- Closing Coil: 85% to 110% of rated voltage.
- Tripping Coil : 70% to 110% of rated voltage

1.13.6 ..... Metering Panel

Separate panel shall be provided for metering. Smart meter shall be provided for metering.

Metering panel shall include potential transformer 11/√3/110V/√3110V/√3, class 0.2, 50VA for 33 kV & 11 kV RMU and smart meter. Smart meter shall be communicable type.

There shall be no gap between RMU and metering panel.

Refer Smart Meter Specification for more detail.

1.13.7 ..... Current Transformers

Current transformers for metering shall be bar primary cast resin/ ring type (class of insulation B or better) suitable for operation on 33kV & 11kV 50 Hz system.

Rated VA burden for metering CTs and protection CTs shall not be less than 5VA or 120% of total VA burden whichever is higher.

The accuracy class for metering CT shall be 0.2s & for Protection CTs it shall be Class 5P20 or as per statutory requirement whichever is more stringent.

It shall be responsibility of Contractor to ensure that CT's are suitable for correct and satisfactory operation of relays connected across them.

Short time current rating and momentary withstand rating of CTs shall be as specified in this specification.

Secondary connection of CT and VT shall be made through disconnecting type terminals with necessary shorting and earthing facility.

1.13.8 ..... Bushings and cable terminations

All the bushings shall be in accordance to the relevant IEC standards, shall be of same height from the ground and protected by a cable cover.

Each cable compartment shall be provided with three welded maintenance free outside cone bushings of adequate sizes to terminate the incoming and outgoing cables along with a terminal block (TB) located at convenient accessible location so as to wire all inputs & outputs up to the terminal block (TB). The bushings shall be conveniently located for proper bend so as to allow easy working and termination of cables.

Bushings shall be conveniently located so as not to interfere with the cable termination.

Necessary dry Right angle terminal Boots shall be provided with cable testing facility for all the terminations.

Clamping arrangement of suitable insulating material such as HDPE shall be provided to hold the cable.

Provisions shall be suitable for the HT XLPE insulated, armoured, Aluminium /Cu conductor cables.

It shall be possible to test the cable without disconnecting them from the cable bushing.

1.13.9 ..... Extensibility

Each combination of RMU shall have the provision for extension on at least on one side for load break isolators / breakers in future, necessary plug-in/ Bolted type type bus bar link. Single extensible isolator/circuit breaker shall be individually housed in separate SF6 gas enclosures. There should not be any gap between the extended RMUs and both these RMUs shall be flushed with each other. The extension busbars links shall be of plug-in type without any gas handling at site. The extension busbar links shall be totally enclosed in between the 2 RMUs allowing the RMUs to be flushed with each other. The busbar links shall be protected with silicon insulation to avoid any ageing effect & also to provide the protection from harsh climatic conditions.

1.13.10 ..... Earthing

The RMU shall be equipped with an earth bus securely fixed along the base of the RMU. The size of earth busbar shall be to suit SC rating. Provision shall be made on end of RMU for connecting the earth bus to the main earth grid by minimum 2 connections.

1.13.11 ..... Voltage Indicator Lamps

Each feeder shall be equipped with a capacitive voltage detection system (CVD) on the front to indicate whether or not there is voltage in the cables. The capacitive dividers will supply low voltage power to the lamps. These devices shall be in compliance with IEC 61243-5 standard.

1.13.12 ..... Fault Passage Indicators (FPI)

These shall facilitate quick detection of faulty section of line.

The unit should be self-contained requiring no auxiliary power supply. The FPI shall be integral part of RMU.

FPI shall be Self-sustained with SC/EF indications and continues functioning using internal lithium battery even after the main incomer feeder has tripped. It should have

an Enhanced Power Management leading more than 2000 hours of operation under fault conditions (blinking).

FPI should have automatic reset facility through RTU. The FPI must have Configurable Binary Outputs, for remote indication to SCADA for faults/diagnostics via FRTU/RTU.

It is preferred, if the FPI shall be mounted outside the RMU in a separate box which shall be IP54 in-order to view the FPI with RMU door closed in operational conditions.

The FPI shall include;

- Fault detection- Phase to phase and Phase to earth faults.
- One potential free output contacts.
- Local fault Indications- LCD display on FPI front panel along with LED indication on front panel of RMU enclosure.
- Multiple Reset option.
- End of time delay (adjustable from 1 to 8 hrs).
- Remote reset (Via potential free input contact of FPI).
- Manual reset (Reset button on front panel of FPI).
- Automatic reset on current restoration.
- The Characteristics of the FPIs shall include:
- Phase fault thresholds configurable from at least 200 to 1200A.
- Earth fault thresholds configurable from at least 10 to 100A.
- Multiple number of steps for adjusting phase and earth fault thresholds.
- Fault current duration range configurable from at least 40ms to 100ms in 20ms steps and further 100ms to 300ms in 50ms steps.

Variations with respect to above characteristics can be acceptable if vendor/ Manufacturer shall provide the same or better flexibility.

1.13.13 ..... Self-Heal Grid System

The self-healing grid, could significantly reduce outage time and cost. The Self Heal Grid System shall be totally decentralized in nature. The series of events will be as follows-

- Fault occurs in one network segment
- All affected FPIs activated.
- Upstream protection trips

- Outage until the normally-open RMU
- Peer to peer communication between each other
- Identification of affected segment
- Isolation of affected segment (downstream)
- Normally open RMU Closed
- Isolation of affected segment with upstream switch
- Re-closing of MV Feeder P1
- Overall Supply restored & faulty part isolated within a less than one minute

1.13.13.1 SCADA Features

The switches and breakers are to be fitted with motors for remote operation.

Necessary terminals shall be provided inside the RMU for interface with SCADA RTU/Ethernet Switch.

Following minimum features shall be enabled in SCADA -

- Remote control for Load Break Switches and circuit breakers
- Position indicator for Load Break Switches, Circuit Breakers and Earthing Switches
- Remote monitoring and Control of Fault indication system
- FPI status and reset
- SF6 gas pressure status (indication & annunciation)

1.13.13.2 General

Panel illumination lamp shall be 5W LED with fixture & shall be provided with door limit switch.

All unused auxiliary contacts of circuit breakers, protection, auxiliary, control relays shall be wired up to terminal block.

Each control wire shall be with identification ferrule of Terminal No., component designation and cross ferruling on both sides.

Insulated sleeves shall be provided for control wires.

Feeder and board name plates to be provided at front and rear of switchboard.

Stud type terminals and ring type lugs shall be used for control cables.

Printed ferrules (tubular type- cut to size after printing) white with black lettering shall be provided. Printing shall be done with the indelible ink.

It shall be entirely the responsibility of the Contractor to ensure that characteristics of CTs, VTs and all other devices offered by him are such as to be suitable for the purpose for which they are intended.

AC fail & DC fail annunciation shall be included in the annunciation.

All the wiring shall be able to withstand the tropical weather conditions. All wiring shall be carried out with 1.1kV grade, multi-stranded (Class 5) copper conductor wires with FRLS P.V.C insulation.

All control wiring shall be done with 1.5sqmm size grey colour wires. All CT wiring shall be done with min 2.5sq mm size wires with phase colour coding.

Panel wiring shall be securely supported, neatly arranged readily accessible and connected to equipment terminals, terminal blocks. The cables shall be uniformly bunched and tied by means of PVC belts and carried in a PVC carrying trough.

The terminal blocks should be stud type for controls and disconnecting link type terminals for CT leads with suitable spring washer and lock nuts.

20% spare terminals and contacts to be provided for each terminal strip for each panel for future interconnection and interlocks.

Additional red coloured ferrule to be provided for all panels.

Caution name plate, “Caution Live Terminal” shall be provided at all the points where the terminals are likely to remain live and isolation is possible only at remote end i.e. incomer to the switchboard.

Danger notices in three languages (Hindi, English) and in line with the requirements of IS 2551 shall be riveted & not pasted at appropriate locations of the switchgear.

24V DC supply for protection circuit, motor & indications/annunciations shall be through in built battery & battery charger system placed in each RMU. Battery shall be sized such that minimum 3 hr. back up is ensured for all operation, protection & indications of RMU as well FRTU.

1.13.14 ..... Routine Test

Contractor shall also include cost towards factory testing of switchgear as per IEC 62271-1/200/203/204/100 in presence of Employer's representative.

Test at factory as follows but not limited to,

Power frequency high voltage test as per IEC 60060 & IEC 60071.

a) DC resistance test as per IEC 60228.
b) HV test on control circuit (2kV for 1 minute.)
c) CT/PT testing as per IEC 60044. Primary injection test shall be carried out as a part of acceptance test before dispatch of the switchgear panels.
d) Operational & interlock test like
    - Close / trip / auto trip operation with electric supply (with given voltage tolerances)
    - Spring charging of motor (Electric as well as manual)
    - Manual close / trip test
    - Breaker closing /opening analysis
    - Interlock & anti pumping operation
    - Checking of filling pressure
    - Checking of gas tightness
    - Checking of partial discharge on individual components

Contractor shall also assist by carrying all test sets/kit accessories required for site test and also following site tests but not limited to ,

- Operational & interlock test for open/close operations, tripping, interlocks & anti-pumping.
- Insulation resistance test - Megger For 1Min with 2.5/5 kV.(taking value for 10 sec & 60 sec)
- Power frequency withstand test
- Relay setting as per relay co- ordination and off line relay testing.
- Acceptance testing of individual relays over complete range.
- Panel system communication test (For Data Acquisition & Monitoring System only)
- Any other tests deemed necessary by the Employer.

Vendor shall submit his standard format for testing and commissioning of all individual relays and equipment's along with vendor drawings to be submitted by him to enable proper testing and commissioning at site

1.13.14.1 Type Test

The Contractor shall furnish type test certificates and descriptive & illustrative technical literature along with all catalogues for circuit breaker, HT panel and other equipment's supplied by him along with the bid.

The Contractor/supplier shall submit Type Test report (not older than five (5) years) from CPRI or other independent agency for Employer's/ Engineer's review.

Contractor shall quote separately the Unit price as well as time required for following type tests separately as asked in the schedule-

- Ingress protection test.
- Heat run test.
- Lightning impulse voltage withstand test.
- Short time withstand current
- Internal arc withstand 21kA for 1 sec
- Checking of partial discharge on complete unit

1.13.14.2 Drawings and Data

Technical Documents to be submitted along with the BID;

a) Confirmation to the specifications including Make list.
b) Technical GTP as per asked in Data Sheet.
c) Descriptive & illustrative technical literature along with all catalogues for circuit breaker, HT panel and other equipment.
d) Type test certificates(from CPRI or equivalent agency), not older than five (5) years from the date of submission of this BID for similar rating for the following tests;
    - Short circuit test
    - Internal Arc Test
    - Heat run test
    - Impulse test
    - Endurance test

e) A matrix of relay model offered with its parameters, Binary/ Analogue I/p –O/ps (IOs), coil voltage, port etc., offered/ considered for each element [with reference to each type of feeder panel(Incomer, Outgoing, Bus coupler, BPT etc.)] for each 33kV & 11kV Switchboard.
f) Tentative GA with dimensions and weight.
g) Details of sub-Contractors, if any.
h) Other submissions as asked for in the specification.
i) Any additional enclosure as per Contractor.

Documents to be submitted after receipt of Order/LOI for review and Approval.

All documents under this item shall be provided by Contractor-

- Detail execution plan highlighting the procurement, construction, internal testing, and inspection and delivery activities.
- Quality Plan for procurement, manufacturing and inspection.
- Design Calculations for Bus bar sizing, CT Sizing of all type etc. for each Switchboard along with a copy of relevant standard referred for the same.
- Guaranteed Technical Parameters
- Equipment GA & Section drawings with dimensions, clearances, locations of components- CT, Terminals, etc. of each type of switchboard with component layouts like LV Compartment, etc with general notes.
- Base frame and Foundation GA drawings with dimension and details.
- Electrical Control drawing for all panels with general notes like sizes, type, Material details and other details.
- Catalogue reference, Technical parameters and O&M manual/ write up of all bought out items.
- Test certificates of all bought out components progressively as they are procured.
- Bill of material along with make, quantity, model no and ratings.
- Upon completion of the installation, the Contractor shall furnish a complete set of drawings in soft copies as per Schedule of Distribution.
- All the Type Test certificates to prove the compliance with the requirements.

1.13.14.3 Ratings & Requirements

Refer following table for details of 33kV & 11 kV RMU requirements-

S. N.	DESCRIPTION	RATING
	Rated Voltage	33 ; 11 kV
	Highest System Voltage	36 ; 12 kV
	Frequency	50 Hz
	Design Ambient Temperature	45 Deg C
	One minute power frequency withstand capacity	70 kV for 33 kV RMU 28 kV for 11 kV RMU
	Basic Insulation Level	170 kV for 33 kV RMU 75 kV for 11 kV RMU
	Bus bar rating	630A for 33 kV 630A for 11 kV
	Short Circuit Rating	25kA/1sec for 33kV RMU 20kA/3sec for 11kV RMU
	Insulating Medium	SF6
	Type of breakers	VCB
	Rated operating Sequence	O-0.3min-CO-3min-CO
	Bus bars	Electrolytic Copper (Silver plated at Joints)
	Temperature Rise	Complying with IEC 62271-1
	Motors	24V DC operated motors shall be installed on the Isolator and CB function and to be flitted in/from the front LV compartment side.
	Power Supply	Necessary arrangement required for DC Power supply for Three (3) Hr backup to take care of the DC load requirements within the RMU & FRTU.
	RMU Type	Outdoor type.

1.13.15 ..... Compact Substation

1.13.15.1 General

This specification is intended to cover the [design, Engineering, manufacture, assembly, testing at manufacturer's works, supply in properly packed condition for transport to site, Erection, site testing and commissioning] of COMPACT SUBSTATION

The system shall be complete in all respect including all accessories required for efficient and trouble-free operation of Atal Puram Township, Agra

1.13.15.2 Scope

All scope for Supply, Installation, Testing and Commissioning (SITC) of the equipment and systems as specified in this contract/ specification shall be strictly as per specification, rules and regulations; and, not limited to this specifications and guidelines.

Each CSS shall typically consist of the following parts:-

- Metallic Enclosure with ventilation and rain/ dust protection as appropriate.
- 11kV Ring Main Unit (RMU) (630A, 2 nos. Load break switches as incomers + 1no. self-powered VCB as outgoing) with fault passage indicator.
- Smart meter
- 11kV / 0.433kV dry type transformer of respective rating along with required accessories.
- LT switchgear & APFC
- Necessary arrangement required for Eight (8) Hr backup to take care of the DC load requirements within the CSS.
- FRTU (Field remote terminal unit), should be part of enclosure.

All the above components of each CSS shall conform to latest relevant standards, codes and requirements.

Civil works for the preparation of equipment foundation, cable trench, earth pits electrodes, earth grid around CSS and chain link fencing with gate for each CSS is included in the scope of this specification. GA drawings for same shall be submitted by the Contractor.

Smart meter along with the mounting enclosure and all accessories like CTs, terminals, etc., shall be as per distribution company requirement & specifications and should be approved from Distribution Company.

All SAFETY considerations in design and manufacturing for safe operation & maintenance by Employer personnel and safe practices during installation at site shall be in the scope of the Contractor. Cost towards accomplishing the same shall be included in the BID price and no extra claim shall be entertained later.

Equipments furnished shall be complete in every respect with all mountings, fittings, fixtures, and standard accessories normally provided with such equipment and / or needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in the Technical Specification unless included in the list of exclusions. Materials and component not specifically stated in the specification but which are necessary for commissioning and satisfactory operation unless specifically excluded shall be deemed to be included in the scope of specification and shall be supplied without any extra cost. All similar standard components/ parts of similar standard equipment provided shall be inter-changeable with one another.

The Contractor shall be responsible for the selection and design of appropriate equipment to provide the best co-ordinated performance of the entire system. The design of various components, sub-assemblies and assemblies shall be so done that it facilitates easy field assembly and maintenance.

1.13.15.3 System Description

3 nos. of 11kV/0.433kV 250kVA CSS will be required to feed the LT load of Common services like Open space lighting, Street Lighting & other loads etc.

1.13.15.4 Applicable Codes And Standards

The design, manufacture and performance of equipment shall comply with latest applicable Codes of Standards IEC 694, IEC 298, IEC 129, IEC 265, IEC 420, IEC 60, IEC 1330, IEC 529, IEC 76, IEC 439-1.

All components as well as the CSS as a whole shall be Type tested in accordance with the above standards.

CONTRACTOR shall submit the type test certificates of similar equipment along with the BID.

1.13.16 ..... Specific Requirements of Compact Substation

1.13.16.1 Enclosure:

The CSS shall be skid mounted, metal clad housing, single enclosure with modular construction housing all the components and all necessary requirements as specified in this specification.

The enclosure shall have three distinct compartments with two distinct access isolated from each other for HT RMU, Transformer and LV Switchboard, FRTU along with their respective accessories.

The CSS metal clad housing shall be fabricated of powder coated hot dipped galvanised CRCA sheet of minimum 4mm thickness for outer enclosure and base while minimum 2 mm thickness for the rest balance enclosure parts. The base frame shall be fabricated of Mild steel channel of minimum size ISMC 100 mm or suitable enough to bear the load of the entire components on ground as well as when lifted as one entity. The structure of the substation enclosure shall be capable of supporting the gross weight of all equipment.

Intermediate water proof ceiling roof shall be provided. A minimum clearance shall be left between the top of any component installed in the substation and the roof of the substation.

The enclosure shall conform to IEC 61330 standards, for Prefabricated Secondary Substation and must provide high level of personal safety by protecting all live parts against any accidental contacts either during commissioning, operation or maintenance. All electrical clearances shall be as per relevant Standards for HV as well as for LV. All doors and ventilation grills shall be earthed to provide a fully earthed enclosure for better personal safety.

All non galvanised parts of the enclosure shall undergo rigorous seven tank process before applying epoxy powder coating of designated shade of RAL 7032 (Siemens Grey). Base frame shall be painted Tar Black.

The CSS enclosure shall be dust and vermin proof suitable for outdoor application, compact and easily portable. Long lasting and durable Neoprene gasket shall be provided on all doors, cut outs, louvers etc. to achieve internal protection.

Access Doors of suitable/ convenient size for entry movement of respective components and humans in and out of the enclosure, shall be provided in each

compartment with hinged construction with stoppers. All doors shall be provided with Pad locking and/or lock protected arrangement as well as an Internal Emergency handle so that door can be opened quickly in case of emergency.

The doors shall be provided with proper interlocking arrangement with the VCB for safety of operator.

Aluminium grilled Louvers with dust and vermin filter suitable for carrying out natural ventilation and adequate for limiting the temperature rise shall be provided in each compartment of the enclosure.

The enclosure shall conform to IP54 for RMU and LV compartment while the transformer compartment shall conform to IP23. The entire enclosure shall confirm to temperature class K10.

All cable entry shall be from Bottom. All the trenches below shall be at least 800mm wide.

Climate proof connection equipment shall be used to avoid leakage current and flashovers due to moisture/ condensation/ dust.

Anodized Aluminium Sheet labels shall be provided in all the compartments identifying the systems/ sub-systems inside/ outside the enclosure with black engraving on white background of appropriate size. Danger boards on Anodized aluminium plate shall be provided on all Doors as well as on all four sides of the enclosure.

Two (2) nos. 10W LED Lighting fixtures along with lamp, isolation switch and protection MCB shall be provided in each compartment. The power for the same shall be tapped from the LT side of the CSS.

One (1) no. Self contained, Non Maintained, Emergency lighting luminarie suitable for 1x10W LED with 3 hr backup & sealed rechargeable Ni-Cd batteries (high temperature type) shall be provided in each compartment for Emergency lighting. Suitable charging point with 5A switch socket shall be provided for each such luminaire.

The supply for all accessories like lighting within the CSS shall be tapped through isolation switch – HRC fuse - control transformer-DP MCBs in order to restrict the fault level within that of available MCBs.

All metallic compartments shall be earthed to a common earthing point for the whole package (Cu 70 mm2). It shall be terminated by an adequate terminal intended for

connection to the earth system of the installation, by way of flexible jumpers/strips & Lug arrangement. The continuity of the earth system shall be ensured taking into account the thermal & mechanical stresses caused by the current it may have to carry. The components to be connected to the earth system shall include :

- The enclosure of Package substation, doors, ventilators etc.
- The enclosure of High voltage switchgear & control gear from the terminal provided for the purpose,
- The transformer tank or metal frame of transformer & transformer neutral,
- The frame &/or enclosure of low voltage switchgear.
- Meter, its enclosure and all other accessories like terminals etc.

CSS FRTU feedback will be provided in SCADA at Main Receiving Sub Station (MRSS/ESS-3).

1.13.17 ..... System Particulars

Nominal System Voltage:	11kV
Highest System Voltage:	12kV
Frequency:	50Hz ±3%
No. Of Phases:	3 Phase
Neutral Grounding:	Solidly Grounded
Fault level:	21kA for 3 Sec
Internal Arc withstand level:	21kA for 1 Sec.

Max Ambient Temperature for design and temperature rise shall be 45ºC.

1.13.17.1 Ring Main Unit (RMU)

Refer 11 kV RMU specifications.

1.13.17.2 11kV/0.433kV Dry type Distribution Transformers

Refer Distribution transformer specifications.

1.13.17.3 415 V Metal Enclosed Switchgears (PMCC / MCC)

Refer 415 V Metal Enclosed Switchgears specifications.

1.13.17.4 415 V APFC Power capacitor and control panel

Refer 415 V APFC Power capacitor and control panel specifications.

1.13.17.5 FRTU

Refer SCADA specification.

1.13.18 ..... Installation of CSS

All installation works shall be carried out by Manufacturer's trained/ skilled personnel and supervised by Manufacturer Certified/ Approved Engineer as per good and safe engineering practices and relevant standards for installation of particular components.

All routine and pre-commissioning tests shall be carried out by certified engineer of Contractor at site and test reports shall be submitted duly signed and stamped. This is included in the scope and quoted price offered by Contractor. Proper tools for unloading/ lifting and erection shall be arranged by Contractor.

All testing equipment's and set ups shall be arranged by Contractor. This is included in the scope and quoted price offered by Contractor.

Proper unloading, handling, storage and security arrangement of all the materials/ equipment supplied are included in the scope and the Contractor shall ensure the same without any additional extra cost to the Employer.

Assembly of the various sections of the equipment, either free issue by Employer or supplied/ procured by Contractor, dispatched separately from the factory shall be in the scope of Contractor.

Installation shall be considered as being the erection of equipment at its permanent location. Thus, unless otherwise specified, shall include shifting from place of storage to the place of erection, unpacking, cleaning, assembly and lifting into position, grouting, levelling, aligning, coupling of or bolting down to previously installed equipment bases/ foundations, performing the alignment check and final adjustment prior to initial operation, testing & commissioning in accordance with Manufacturer's tolerances, instructions and the specifications.

It is expected that equipment/ systems shall be installed as per the best engineering practice and in strict accordance with the Manufacturer's recommendation(s). Employer shall have full authority to reject all/ any portion of the work that is considered

bad in quality or workmanship. The rejected work shall be made good by the Contractor free of cost. In this regard the decision of Employer would be final and binding

Pre-commissioning checks and final commissioning of the equipment's being supplied by the Employer or the equipment/ system supplied by the Contractor shall be carried out as per the provisions of this specification, relevant standards and Manufacturer's erection / commissioning manual.

Contractor shall submit site test reports & its test procedures; details of test equipment used etc. in printed format with sufficient no. of copies along with originals duly signed & stamped by appropriate authority as may be decided by relevant Statutory Bodies.

Contractor shall maintain necessary co-ordination with the Employer and various other agencies working at the same site as the Contractor.

1.13.18.1 Packing – Transport And Installation

The Package Substation shall be delivered in a protective cover made of polythene or similar product. Lifting facilities for transportation of the complete unit shall be provided. Commissioning and operating instructions shall be provided with each substation.

1.13.18.2 Tests

Routine factory testing, in accordance with IEC standards, shall be carried out and shall include the following:

check of conformity with wiring diagrams and plans,

mechanical operation tests, and checking of interlocks,

low voltage dielectric tests.

low voltage functional checking.

Type Tests certificates shall be submitted as per relevant standards. Contractor shall submit the following type test reports carried out on the highest rated CSS along with the BID as a confirmation to the specification requirements.

Temperature rise inside the enclosure

Internal arc protection

1.13.18.3 Drawings And Data

All Drawings, data, technical particulars, detailed literature, catalogues, type test certificates etc. shall be submitted along with the bid/ after award of contract as specified in Bid Document.

1.13.19 ..... Power And Control Cables

1.13.19.1 General

This specification is intended to cover the [design, engineering, manufacture, assembly, testing at manufacturer's works, supply in properly packed condition for transport to site, Erection, site testing and commissioning] of MV(33kV &11kV),three core XLPE insulated armoured cable having stranded Aluminium, copper wire screen and extruded PVC or PE over sheath complete with all accessories for efficient and trouble-free operation.

1.13.19.2 Codes And Standards

All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) / IEC as given below except where modified or supplemented by this specification.

S.N	Standard Number	Description
1	IS: 2982	Copper conductor in insulated cables and cords.
2	IS: 3961	Recommended current ratings for cables.
3	IS: 3975	Mild steel wires, strips and tapes for armouring cables
4	IS: 5609	Specification for low frequency wirers and cables with PVC insulation and PVC sheath
5	IS:5831	PVC insulation and sheath of electric cables
6	IS: 6380	Specification of elastomeric insulation of sheath of electric cables.
7	IS:7098(Part II)	XLPE insulated PVC sheathed cables for working voltage from 3.3kV up to and including 33kV
8	IS: 8130	Conductors for insulated electric cables and flexible cords
9	IEC: 60	High voltage test techniques

10	IEC: 71	Insulation co-ordination
11	IEC: 60228	Conductors of insulated cables
12	IEC: 60229	Tests on cable over sheaths
13	IEC: 60230	Impulse tests on cables and their accessories
14	IEC: 60287	Calculation of the continuous current rating of the cables(100% load factor).
15	IEC: 60288	Nominal cross sectional area and composition of conductor of insulated cables.
16	IEC-331	Fire resisting characteristics of electric cables
17	IEC: 332-1	Test on electric cables under fire conditions.
18	IEEE: 383	Standard for type test for class IE electric cables, filled splices and connection for nuclear power generation station.
19	IEC: 60502	Extruded solid dielectric insulated power cables for rated voltages from 1kV upto 30kV.
20	IEC: 60 540	The methods for insulations and sheath of electric cables and cords(elastomeric and thermoplastic compounds)
21	IEC-754-I	Test method for acid gas generatin
22	NEMA-WC-5	Thermoplastic insulated wires and cables for transmission and distribution of electrical energy.
23	ASTM-D-2843	Standard test method for density of smoke from burning/decomposition of plastics.
24	ASTM-D-2863	Test for determination of oxygen index.
25	DIN/VDE0273	Cross linked Polyethylene Insulated Cables.
26	DIN 46391	Cable Delivery Drums

Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted subject to approval of the Owner. In such case, copies of the English version of the standards adopted shall have to be submitted along with the bid.

The electrical installation shall meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Codes of Practice. In addition, other rules and regulations applicable to the work shall be followed.

1.13.19.3 Design Criteria

The cables shall be installed in hot, humid tropical atmosphere with ambient temperature of 45°C.

All MV cables shall be suitable for operation under the following voltage & frequency variations:

Voltage Variation	:	(±) 10%
Frequency Variation	:	(+) 3% to (-)5%
Combined Variation of Voltage & Frequency	:	10% (absolute sum)

MV cables shall be 33 kV & 11 kV of earthed grade suitable for use in solidly earthed system, stranded & compacted electrolytic aluminium conductor, extruded semi conducting screen over conductor, XLPE insulated, armoured as required, semi-conducting followed by copper tape screened, extruded PVC, Type ST–2 inner sheathed, overall FRLS, PVC outer sheathed, conforming to IS 7098 (Part II), IEC 60502 for constructional details and tests.

The LV power cables shall be 1100V grade, single/multi core stranded Aluminum conductor, extruded XLPE/PVC insulated with extruded PVC inner sheath, armoured and overall sheath with extruded Flame Retardant Low Smoke (FRLS) PVC compound (Type ST-1). These cables shall conform to IS 7098 (Part I) for XLPE and 1554(part 1) for PVC insulation.

The control cables shall be 1100 V grade, multi core, stranded annealed high conductivity copper with extruded PVC insulated inner sheath, armoured and overall sheath with extruded Flame Retardant Low Smoke (FRLS) PVC compound (Type ST-1).

The continuous and short time current carrying capacity of XLPE insulated cables shall be based on maximum operating temperature of 900C and 2500C respectively.

The continuous and short time current carrying capacity of PVC insulated cables shall be based on maximum operating temperature of 700C and 1600C respectively.

MV & LV power cables shall be sized taking into account the following derating factors:

- Max Ambient air temperature
- Max Ambient ground temperature
- Grouping of cables/Method of laying
- Depth of laying for cable buried in ground.
- Soil thermal resistivity for cable buried in ground.

MV cables shall be chosen taking into account the following factors:

- System Fault level.
- Maximum time for fault clearance (i.e, operating time of the backup protection relays plus the time of operation of the circuit breakers).
- Full load current of the circuit.
- Short circuit current and duration (for breaker protected cables)
- Installation conditions.
- Voltage drop under normal running and starting condition
- Voltage drop at motor terminals shall be within permissible limit during starting & normal running. i.e 5% during steady state and 15% during transient or starting at motor terminal.
- The cable should withstand the maximum fault current corresponding to the particular voltage level for the minimum time before the fault is cleared.
- Consideration shall also be given to limit the cable to the nearest standard sizes instead of using too many types.
- The minimum size of LV cables to be used shall be as follow :
  a) Aluminium conductor : 6 Sq. mm.
  b) Copper conductor : 2.5 Sq. mm

1.13.19.4 Specific Requirement

1.13.19.4.1 Type of Cable

The MV cable shall be multi core/ single core XLPE insulated type as specified.

LV power cables shall be 1100V grade, heavy duty, stranded aluminium conductor, XLPE/ PVC insulated, extruded black FRLS PVC inner sheathed, armoured and overall FRLS extruded black PVC outer sheathed (Type ST-1) cables conforming to IS: 1554(Part 1) for PVC insulation and IS 7098(Part 1) for XLPE insulation.

Control Cables shall be 1100 V grade, heavy duty with annealed high conductivity stranded copper conductor, PVC insulated, FRLS PVC inner sheathed, armoured and FRLS extruded black PVC outer sheathed (Type ST-1) cables conforming to IS : 1554.

LV power cables of size above 35 sq. mm may be provided with XLPE insulation. Bidder shall clearly indicate the type of insulation provided in the technical bid.

The instrumentation cables shall be annealed, tinned stranded copper conductor, 0.5 mm2, twisted into pairs, overall screened (L1 type) for digital signals, individual and overall screened (for L2 type) for low level analogue signals, individual triplet and overall screened (type L3), PVC insulated, inner PVC sheathed, GS wire armoured and overall sheathed with FRLS PVC. The insulation shall be strippable manually as well as by mechanical stripping devices without damage to the conductor.

Lighting Wires shall be 1100 V grade, single core, stranded, copper conductor, PVC insulated wires conforming to IS 694 / IEC 60227 Part 1 to 5 / IEEE-719. Minimum cross section of copper wires shall be 2.5 mm2 for lighting circuits and 4 mm2 for receptacle circuits.

1.13.19.4.2 Conductor

The cable conductor shall be made from standard Aluminum to form compact conductor having a resistance within the limits specified.

Conductor Shield

The conductor having a semi-conducting screen shall ensure perfectly smooth profile and avoid stress concentration. The conductor screen shall be provided over the conductor by applying non-metallic semi conducting tape or by extrusion of semi conducting tape or by extrusion of semi-conducting compound or a combination of the two. The semi conducting polymer shall be cross linked for XLPE cables.

1.13.19.4.3 Insulation

The insulation of the MV cables shall be XLPE type and LV power and control cables shall be [XLPE/PVC] type. It shall be designed and manufactured for the specified system voltage. The manufacturing process shall ensure that insulation shall be free from voids. The insulation shall withstand mechanical and thermal stresses under steady state and transient operating conditions. The extrusion method should give a very smooth interface between semi conducting screen and insulation. The insulation of the cables shall be of high standard quality.

1.13.19.4.4 Insulation Shield

A non magnetic semi conducting shield shall be put over the insulation to confine electrical field to the insulation. The XLPE cable insulation shield shall be strippable.

The metallic layer of the insulation shield shall be grounded at least at one location in the cable's run. In the case of single conductor cable, care should be taken with regard to ampacity when grounding at more than one point.

For all the cables having insulation shield, it shall have some form of stress relief measure at every splice at termination. This can be stress cones, moulded devices, heat shrink or cold shrink kits. All kits must be suitable for the voltage class and cable size.

1.13.19.4.5 Inner Sheath

The sheath shall be suitable to withstand the site conditions and the desired temperature. It shall be of adequate thickness and applied by a continuous process to produce a sheath of consistent quality free from all defects. PVC sheath shall be extruded with FRLS properties.

1.13.19.4.6 Outer sheath

Outer sheath shall be extruded layer of FRLS PVC compound (ST-1).Sheath shall be resistant to water, Ultra Violet radiations, fungus, termites and rodent attacks. The color of the sheath shall be black.

1.13.19.4.7 Packing

[Cables shall be supplied in non-returnable drums]. Drum lengths shall be such so that cable joints are totally avoided. The drums shall be of heavy construction*. [All wooden parts shall be manufactured from seasoned wood.]* All ferrous parts used shall be treated with suitable rust preventive finish or coating to avoid rusting during transit or storage*. [Wooden cable drum shall be treated by immersing in copper-nitrate solution.]*

The ends of each cable length shall be sealed before shipment. Heat shrinkable cable cap shall be used for this purpose.

[A label shall be securely attached to each end of the reel indicating the Purchaser's order number, Owner's identification mark, length, type, voltage grade, conductor size and number of cores of the cable.] A tag containing the same information shall be attached to the leadings end of the cable inside. An arrow and necessary instructions shall be marked on the drum indicating the direction in which it should be rolled. Drum

numbers are to be indicated on the cable drums. Drum length shall not be less than the following:

- Power cables: 500m
- Control cables: 1000m

1.13.19.4.8 Identification of cores:

MV & LV power cables shall be identified by color code. However LV control cables shall be identified by the number of its cores.

[Multi-core control cables shall have 20% spare core, minimum one spare.]

1.13.19.4.9 Constructional Requirements

Cable shall have suitable filters laid up with the conductors to provide a substantially circular cross section before the sheath is applied. Fillers shall be suitable for the operating temperature of the cable and compatible with the insulating material. All materials shall be new, unused and of finest quality.

Workmanship shall be neat, clean and of the highest grade.

Special Properties:

All the above cables shall be conforming to the relevant Indian/IEC standard in general, with the following special properties:

- Oxygen Index of the outer sheath shall not be less than 29, when tested as per ASTM-D-2863.
- Temperature Index of the outer sheath shall not be less than 250□C, when tested as per ASTM-D-2863.
- Halogen acid contents in outer sheath shall not be more than 20%, when tested as per IEC-60754.
- The maximum smoke density in percent light absorption should not exceed 60% in case of PVC compound and 20% in case of fire survival cables, when tested as per ASTM-D-2843.
- Swedish chimney test as per SS-4241475 class F3 and ladder test for flammability as per IEEE-383.
- The cables shall be tested for resistance to Ultraviolet radiation. The retention values of tensile strength and ultimate elongation after test shall be minimum 60% of tensile strength.

- Outer sheath of cable shall be subject to tests for water absorption. The methodology shall be as per IS 10810 part 33.

1.13.19.4.10 Joints and Terminations

Materials of construction for a joint/termination shall perfectly match with the dielectric chemical and physical characteristics of the associated cables. The material and design concepts shall incorporate a high degree of operating compatibility between the cable and joints. The protective outer covering (jacket) used on the joints/terminations shall have the same qualities as that of the cable outer sheath in terms of ambient/operating temperature withstand capability and resistance to hazardous environments and corrosive elements. No joints shall be allowed unless the cable drawn length is exceeded.

1.13.19.4.11 Cable Identification

Cable identification shall be provided by embossing the following on the outer sheath:

- [Manufacturer's name or trade mark
- Voltage grade
- Year of manufacture
- Type of insulation.
- Type of outer sheath e.g. "FRLS" etc.
- ISI marks
- Nominal cross sectional area of the conductor & no of cores
- Sequential marking
- Owner’s identification mark]

1.13.19.4.12 Fire Proof sealing system

General

Fire proof sealing system shall consist of Fire-stops/fire-seals for sealing of cable/cable tray and conduit/pipe penetrations, both horizontal and vertical, through brick or RCC walls/floors, to prevent the spread of fire from one area, which is separated from others by fire-resistant barriers.

‘Fire-breaks' provided on long runs of cable racks/trays to prevent the propagation of fire along the cable rack, within a single fire-area or fire- zone.

The FPS system shall also include all the necessary accessories and equipment required for supporting, holding in position, fixing and installation of the fire-stop/fire-break.

The FPS system shall comply in all respects with the requirements of the codes and standards listed below

- IEEE-634 ASTM-E-814
- ANSI-IEEE-383 IEC-331 IEC-332

Fire stop/ seal

The FPS system adopted for cables or cable trays penetrating through walls and floor constitute a openings, or cables passing through embedded conduits / pipes / pipe-sleeves, fire stop / seal', which is meant to prevent spreading of fire between areas separated by fire-resistant barriers.

Fire Break

The fire proofing system, other than fire-stops, adopted to retard flame propagation long runs of horizontal or vertical cable trays in the same fire zone or area, in an event of a fire, shall constitute a `fire-break' and shall be provided by applying a suitable fire –resistance coating on cables and cable trays for the required length, with or without a fire resistant panel, at the point of the fire break to obtain the fire-rating specified.

Application of fire proof sealing system

- Fire stops shall be provided for cable penetration openings listed below.
- The passage of cables/cable trays pipe sleeves/embedded conduits through walls / floors.
- Vertical raceways, which carry cables between successive floors, through openings provided in the RCC floor slab, shall be sealed by fire stops at each floor level.
- Cable entry through openings in floor slabs below HT/LT switchgear, MCCs, various Control and relay panels and other bottom entry panels, shall be effectively sealed by fire stop
- Location of fire breaks
- Firebreaks shall be provided on both cable rack and trenches at all cable tray Intersections and tee-offs.

- On linear runs of cable trays between fire stops or fire breaks, fire breaks shall be provided at intervals of 15 metres on horizontal cable runs and 5 m on vertical cable runs.
- Fire breaks in linear runs of cable trenches between intersections and tee-offs shall be provided at intervals of 30 metres.
- Bidder shall furnish the test certificates for the fire stops and fire breaks after award of contract for Owner/Owner's Representative review. If the certificates are not satisfactory all the tests shall be conducted free of cost. The offered system i.e. fire stops and fire breaks shall be identical (or better) with the system which is successfully type tested for the specified rating i.e. the composition density of the material, thickness of coating in case of fire breaks and any other properties of the material / system offered shall be identical or better than the tested system and shall be subject to Owner / Owner's Representative.

Test on fire stops

The fire stops shall be subjected to the following type tests:

- Fire Rating Test
- Hose Stream Test

Type tests shall be conducted on different fire stop test specimens described above as per IEEE-634. The sizes of the fire stop test specimens shall be similar to the largest of the sizes being used in the plant.

Preconditioning of fire stop test specimens before conducting the fire rating and hose stream tests, each test specimen shall be preconditioned for thermal ageing, water immersion and vibration.

Test on Fire Stops

During the fire rating test, the transmission of heat through the cable penetration fire stop shall not raise the temperature on its unexposed surface above the self ignition temperature of the outer cable covering, the cable penetration fire stop material, or material in contact with the cable penetration fire stop, with a maximum temperature limit on the unexposed surface of 200°C.

Tests on fire breaks

Firebreaks shall undergo the following tests as per ANSI-IEEE-383:

- Ampacity test
- Flame test

1.13.19.5 Cable Characteristics

1.13.19.5.1 Cable Installation

Core screen will be earthed at both ends and cables will be laid in duct buried underground.

In addition the Bidder shall advise rating/derating factors for variations in the above conditions as well for multiple circuits.

Permissible minimum bending radius of power cables during laying:

During pulling of power cables, the bending radius should not fall below the values listed.

In the case of single bends (placing cables in final position), the above values may be reduced to a minimum of 20 x cable outer diameter (Milliken and stranded conductors) or even 15 x cable outer diameter (solid conductors)

During laying of power cables, particular attention must be paid to the permissible tensile force, as follows:

Permissible tensile forces when using cable pulling grips:

F = 2 x D2 in N for cables with copper wire sheath

F = 2 x D2 in N for cables with sheath.

D represents the cable outer diameter expressed in mm

Maximum recommended tensile forces when pulling eye is attached to the conductor:

Alu stranded: F = A x 30 N/mm2

Alu solid: F = A x 20 N/mm2

Alu Milliken: F = A x 30 N/mm2

Cu stranded: F = A x 50 N/mm2

Cu Milliken: F = A x 80 N/mm2

A represents the cross-sectional area of conductor expressed in mm2.

1.13.19.5.2 Sizes Of UG Cables Required

Voltage rating	Cross sectional area.
33kV	300mm² Aluminium Cables
11kV	300mm² and 240mm², Aluminium Cables

1.13.19.6 Inspection

Before dispatch the cables offered shall be made available for inspection by the Engineer. Inspection may also be made at any stage of manufacture at the option of the purchaser and the cables found unsatisfactory due to the material used or poor workmanship shall be rejected.

The contractor shall guarantee free access to the places of manufacture to the Engineer at all times when the work is in progress. The contractor shall inform the Engineer in advance the time of starting of manufacture and the progress of manufacture of the cables offered by him so that arrangement can be made for inspection.

Inspection and acceptance of cables by the Engineer shall not relieve the contractor of his obligation of furnishing cables in accordance with the specification and shall not prevent subsequent rejection if such cables are later found to be defective.

The cables shall comply with type tests stipulated in prescribed section and the relevant standards. Test reports for all type tests shall be submitted with the tender.

All type and sizes of cables shall be subjected to routine and acceptance tests as stipulated in relevant standards without any extra cost to the purchaser. Cables should not be dispatched until the test reports are duly approved by the Purchaser or his authorized representative and specific instructions to despatch the inspected items issued.

The purchaser reserves the right of having any other special tests of reasonable nature carried out at site or at manufacturer's works or at any other place in addition to the aforesaid type and routine tests to satisfy himself that the cables comply with the specification, without any financial liability.

Six copies of test reports (or as indicated in the Schedule of Vendor Drawings) shall be supplied for approval. The reports shall indicate clearly the governing standards and the standard values specified for each test to facilitate checking of the test reports.

Six bound copies of the test reports shall be submitted after approval of test reports along with the cables.

1.13.19.7 Tests

1.13.19.7.1 Type Test

For each type & rating of HV cables, the Bidder shall submit for Owner's approval the reports of all the type tests as per relevant standards and carried out within [last five] years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been conducted at an independent laboratory.

In case the Bidder is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Bidder shall conduct all such tests under this contract free of cost to the Owner and submit the reports for approval.

The list of type tests are as follows:

- Tests on conductor:
- Annealing test (for copper)
- Tensile test (for aluminum)
- Wrapping test (for aluminum)
- Conductor resistance test.

Test for armouring wires/strips

Test for thickness of insulation and sheath

Physical tests for insulation and outer sheath:

- Tensile strength and elongation at break
- Ageing in air oven
- Shrinkage test
- Hot deformation
- Loss of mass in air oven
- Heat shock test
- Thermal Stability
- Insulation resistance test
- High voltage test (water immersion test)
- High voltage test at room temperature
- Flammability test

1.13.19.7.2 Routine Test

Cables shall be subject to acceptance and routine tests as per IS codes. Acceptance tests and FRLS test as specified earlier shall be conducted on cables and the same shall be witnessed by purchaser.

The FRLS test shall be carried out on one cable of each batch of compound used. Other acceptance tests shall be carried out on drums selected as per sampling plan as indicated in IS. Test certificates for routine acceptance and special tests shall be furnished by the Bidder for review and approval of purchaser.

1.13.19.7.3 Drawings, Data and Manuals

The following drawings/documents and calculation as listed below but not limited to shall be furnished along with the bid for review

- [Cable datasheets and cross sectional drawings]
- [Cable sizing calculation]
- [QAPs & Test Reports]
- [Relevant catalogues]
- [Estimated weight of cable and cable drum]

1.13.20 ..... Guaranteed Technical Particulars

S.No	Required Particulars	Manufacturer's Information
1.	Manufacturer's name and works address	
2.	Manufacturing process: a) CCV Line Process (Dry Curing)	
3.	Standard specification to which the material shall conform.	
4.	Type of cable and voltage grade.	
5.	Power frequency withstands voltage kV_{rms}.	
6.	Permissible voltage & frequency variation for satisfactory operation. Voltage % Frequency % Combined voltage & frequency %	
7.	Conductor details : Aluminium grade.	

S.No	Required Particulars	Manufacturer's Information
	Nominal cross sectional area (guaranteed). Shape of the stranded conductor. – Number of strands in each conductor. Nominal diameter of each inlet wire before stranding mm Maximum permissible resistance of Conductor at 20˚C in Ω/ Km.	
8.	Diameter over laid-up cores mm	
9.	Conductor screening : Type and material. - Continuous working temp. ˚C c) Max. Allowable temp. at termination of short circuit ˚C	
10.	Insulation : Material Nominal thickness of insulation mm Minimum thickness of insulation. mm Approx. diameter of core over insulation.	
11.	Insulation screening : a) Material. - b) i) Approx. thickness of semi-conducting part. mm ii) Thickness of metallic part. mm c) Approx. diameter of cable over screening.	
12.	Whether Binder Tape provided	
13.	Inner sheath : Material - Process of application - Min. thickness of inner sheath. mm d) Diameter of cable over inner sheath	
14.	Type of filler used Material Shape and size mm Central filler (shape & size) mm	

S.No	Required Particulars	Manufacturer's Information
15.	Armouring : Material and type of armouring Nominal dimensions of Armour mm Whether galvanized. Lay Ratio of Armouring i) Minimum ii) Maximum Total Number of Armour Strips Nos. %age Covering with Armour Strip Diameter of cable over armouring mm	
16.	Outer sheath : Material - Nominal thickness of outer sheath. mm Color of sheath.	
17.	Approx. over all diameter of cable. mm	
18.	Minimum weight of Aluminium in Kg./Km. corresponding Kg/Km to nominal cross sectional area of conductor.(guaranteed) Total weight armouring Kg/ Km. Total weight of PVC contents Kg/ Km. (Inner / Outer Sheath / Filler)	
19.	i) Standard length of cable. Mtrs ii) Tolerance on standard length	
20.	No. of length(s) of cable on each drum.	
21.	Approx. gross mass of each drum including cable.	
22.	Drum Size Details of Drums Approx. net weight of each empty drum. Kg	
23.	Max. continuous AC current carrying capacity : a) When laid in covered trenches. Amps	
24.	Recommended length of laying. cm	
25.	Short circuit current carrying capacity and KA-Sec Duration of short circuit.	

S.No	Required Particulars	Manufacturer's Information
26.	Allowable/attainable max. Conductor temp. in ˚C When carrying continuous rated current.	
27.	Allowable/attainable max. Conductor temp. ˚C At the termination of short circuit current.	
28.	Voltage drop per 1000 meters length of cable at rated current: When laid directly in ground Volts When laid in covered trenches. Volts	
29.	Max. Conductor temp. a) When laid in covered trenches. ˚C	
30.	Impulse strength, kV	
31.	DC resistance of each conductor at 20 ˚C (Max.) Ohms/KM AC resistance of each conductor at 90 ˚C (Max.) Ohms/KM Approx. reactance of each conductor Ohms/KM Approx. capacitance of each conductor Micro-F KM Insulation resistance (Min.) At 30 ˚C Ohm-Cm At 90 ˚C Loss tangent i) As a function of voltage ii) As a function of temperature. Dielectric constant.	
32.	Charging current at normal operating voltage. Amps/KM	
33.	Derating factors: Furnish charts showing derating factors for: Variation in ambient temp. Variation in ground temp. Different spacing of cables in horizontal single row formation for 3 Core Cables under the following conductions of laying: Cables laid in ground.	

S.No	Required Particulars	Manufacturer's Information
	Cables laid in pipes or ducts. Variation in depth of laying for cables laid direct in ground Variation in Thermal resistivity of soil for cables laid in Ground.	
34.	Quantity Tolerance	
35.	Recommended min. bending radius. mm	
36.	Embossing	
37.	Any other technical particulars	

1.13.21 ..... HDPE Pipe Conduit for Power Cables

1.13.21.1 General

This specification is intended to cover the [design, engineering, manufacture, assembly, testing at manufacturer's works, supply in properly packed condition for transport to site, Erection, site testing and commissioning] of High-Density polyethylene primarily intended for buried for laying of MV (33kV & 11kV) and LV underground Power cables up to 400 mm2 as per NEMA TC-7 or any equivalent Indian standard with latest amendment. The expected service life of HDPE pipe and accessories shall not be less than 50 years.

1.13.21.2 Detail Requirements Of HDPE PIPE

The HDPE pipe shall be of grade quality PE100 and the pressure rating shall be PN10.

The HDPE pipe of standard make shall have the outer diameter as follows.

S. No.	Type of Cable	Outer Diameter of Pipe in mm
1	33 kV/11 kV(MV)	200
2	LV cable	200
3	Service Cable	200

1.13.21.3 Codes And Standards

All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) / IEC/ASTM as given below except where modified or supplemented by this specification.

The PLB (Permeant Lubricant) HDPE pipe shall conform to the following standard and the technical specifications described below.

S.N	Standard Number	Characteristics	Requirement
1	ISO 1183	Density of Raw Material	≥ 930 Kg/m³
2	ISO 1133	Melt Flow Rate	The melt flow rate of the duct should be 0.2 to 1.1 Grams/10 Minutes @5kg.
3	ISO 6259 - 1 & 3	Tensile Strength At Yield	Min 18 N/mm²
4	ASTM D 1693	Environmental Stress Crack Resistance	There should be no crack or split when tested with 10% IGEPAL - CO – 630 solution at 50 ± 1º C for 96 hours.
5	IS 4984-1995	Ovality	Maximum 2% of outer diameter.
6	IS 4984-1995	Reversion	3.00% Max
7	ISO 6259 - 1 & 3	Elongation	Min 350%
8	ISO 4427 / ISO 18553	Colour Pigment Dispersion (Outer Layer)	≤ Rating A3
9	ASTM D5630	Ash Content of Outer Layer of the Duct	≤ 0.3%
10	IS 12235 (Part 9)	Impact Strength	There should be no crack / split when 10 Kg load dropped from 1.50 Meter height after conditioning at 0º C for 1 hour.

S.N	Standard Number	Characteristics	Requirement
11	ASTM F 2160	Toe- in	Outside diameter at cut end of the conduit shall not be more than 1.5% smaller than outside diameter that measured at 300mm away from the cut end of the conduit.
12	ASTM F 2160	Friction reduction	Lubrication materials shall be compatible with the conduit & any cable jacketing.

Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted subject to approval of the Owner. In such case, copies of the English version of the standards adopted shall have to be submitted along with the bid.

The electrical installation shall meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Codes of Practice. In addition, other rules and regulations applicable to the work shall be followed.

1.13.21.4 Material:

The raw material used for the HDPE pipe shall meet the following requirements

i. the anti-oxidant establishers, color master batch and other additive used shall be physiologically harmless and shall be used only to minimum extent necessary to meet the specification.
ii. Usage of any additives used separately or together should not impair the long-term physical and chemical properties of the HDPE pipe.
iii. Suitable Ultra-Violet stabilizers may be used for manufacture of the HDPE pipe to protect against UV degradation when stored in open for a minimum period of 8 months.
iv. In case of HDPE pipe of three concentric layer construction, the friction reducing, polymeric material to be used as the inner layer lubrication material shall be integral with HDPE layer.

1.13.21.5 Tests on Material of HDPE pipe:

The base HDPE resin material shall be subjected to following tests and shall satisfy

- Melt flow Index: ISO 1133
- Density: ISO 1183

1.13.21.6 Dimension of Pipe:

Duct shall have Nominal Diameter of 200mm and shall have a dimensional ratio of 13.5 (SDR)

Dimensions of HDPE Duct:

Sl. No	Description	200 DIA
1	Outer Diameter of Pipe (mm)	200 + 1.50
2	Wall Thickness (mm)	14.80 to 16.50
3	Ovality	Max 4

Pipe Length shall be 6 or 12 meters, length of supply preferred to be 12 mtrs.

HDPE Ducts should be sourced from the manufacturer with ISO 9001 accredited manufacturing facility.

1.13.21.7 Accessories:

The following accessories are required for jointing the pipe and shall be supplied along with the pipe. The manufactures shall provide complete design details, procedure for method of installation and type of the material used for the accessories.

Plastic coupler: The coupler shall be used to join two HDPE pipes. The coupling shall be able to provide a durable water tight joint between two pipes without deteriorating the strength of the pipes. The strength of coupler shall match the primary strength of the HDPE pipe. It should either snap fit or Split type. The jointing shall meet the air pressure test of 2 kg/cm2 for a minimum period of 2 hours without any leakage.

1.13.21.8 Workmanship:

The pipe shall be free of blisters, shrink holes, break and other defects. The HDPE pipe ends shall be cut as square as possible to longitudinal aspects. The external HDPE pipe surfaces shall be smooth. The color of outer surface should be Red uniform throughout.

1.13.21.9 Marking:

Each straight length of pipe shall be clearly marked hot embossed on white base or ink jet in black on straight length of the pipe at every meter of pipe with the following information:

a) Employer's name,

b) Manufacturer's name/Trade-mark,

c) Designation of pipe,

d) Lot number/Batch number,

1.13.21.10 Tests On Finished HDPE PIPE:

Visual Inspection: The external surfaces of the pipes shall be smooth and inner surface of the pipe shall be clean and free from grooving and other defects. The pipe shall be cleanly cut and shall be square with axis of the pipes. Slight shallow longitudinal grooves or irregularities in the wall thickness shall be permissible, if the wall thickness remains within the permissible limits.

Dimensions: The wall thickness and diameter of the pipe, shall be measured by a dial Vernier or ball ended micrometer. The diameter shall be measured with circometer and shall conform to the figures given in the clause 1.4.1.

Reversion Test: This test shall be carried out as per IS: 4984. The dimension of inner layer or outer layer shall not change by more than 3% in the longitudinal direction when a sample pipe placed (sample length 200mm approx..) horizontally in an air-oven at 110+/-2o C for 60 minutes and cooled to the room temperature.

Tensile Strength at yield and Elongation at break Test: The tensile strength and elongation of the HDPE pipe shall be carried out as per ISO: 6259 1& 3.The tensile strength for finished material shall be minimum 18 N/mm2 and elongation at break shall be 350%.

Environmental Stress Crack Test: The test shall be conducted as per ASTM D 1693 with the specimen prepared from HDPE pipe after making compression moulding sheet. The specimen shall be immersed in 10% IGPAL (CO 630) Solution at 50± 1o C for 96 hrs. There shall be no crack or split.

Impact Strength Test: The test shall be carried out as per IS:12235 (Part 9). A sample HDPE pipe 150mm in length shall be conditioned at 0◦C for one hour and placed on a

heavy rigid block whose faces are at angle of 120o. A striker with a total weight of 10kg shall be allowed to fall freely in a suitable vertical guides through a height of 1.5m. The HDPE pipe shall not crack or split.

Crush Resistance: The test shall be in a sample of 200± 2 mm length of HDPE pipe which shall be subjected to crush load as specified below with compression speed 12.5 mm per minute. The deflection with crush load on period shall not exceed 5%.

200 mm: 1500 N Minimum

Ovality test: The ovality is the difference between maximum outside diameter and the minimum outside diameter of the HDPE pipe at same cross section of the duct at 300mm away from the cut end. The same shall be measured as per IS-4984 as described above.

Raw Material: HDPE Virgin material shall be used. No other reworked or recycled material shall be used

1.13.21.11 Packing And Condition Of Delivery:

All materials furnished and all work performed shall be inspected and tested. Deliverables shall not be shipped until all required inspections and tests have been completed, and all deficiencies have been corrected to comply with this Specification and approved for shipment by the Employer.

Except where otherwise specified, the Contractor shall furnish all manpower and materials for tests, including testing facilities, power and instrumentation, and replacement of damaged parts. The costs shall be borne by the Contractor and shall be deemed to be included in the contract price.

The entire cost of testing for factory & site acceptance, routine tests, production tests and other test during manufacture & site activities specified herein including the expenses of Inspector/Employer's representative shall be treated as included in the quoted unit price of materials.

Acceptance or waiver of tests will not relieve the Contractor from the responsibility to furnish material in accordance with the specifications.

All tests shall be witnessed by the Employer and/or its authorized representative (hereinafter referred to as the Employer) unless the Employer authorizes testing to

proceed without witness. The Employer representative shall sign the test form indicating approval of successful tests.

Should any inspections or tests indicate that specific item does not meet Specification requirements, the appropriate items shall be replaced, upgraded, or added by the Contractor as necessary to correct the noted deficiencies at no cost to the Employer. After correction of a deficiency, all necessary retests shall be performed to verify the effectiveness of the corrective action.

The Employer reserves the right to require the Contractor to perform, at the Employer's expense, any other reasonable test(s) at the Contractor's premises, on site, or elsewhere in addition to the specified type. Acceptance, Routine or Manufacturing tests to assure the Employer of specification compliance.

The Employer also reserves the right to require any retesting of previously approved tests at the Employer's expenses. However, if the retest(s) reveal non-compliance to the specification, the Contractor shall bear the expenses for the retesting and remedial action at no cost to the employer.

1.13.21.12 Factory Acceptance Test:

Factory acceptance tests shall be conducted on randomly selected final assemblies of all equipment to be supplied. Visual inspection shall be carried out on 100% basis for all the equipment/items offered. Factory acceptance testing shall be carried out on HDPE and accessories.

Material shall not be dispatched to the Employer until required factory tests are completed satisfactory all variances are resolved, full test documentation has been delivered to the Employer, and the Employer has issued Material Inspection & Clearance Certificate (MICC). Successful completion of the factory tests and the Employer approval to dispatch shall in no way constitute final acceptance of the system or any portion thereof. These tests shall be carried out in the presence of the Employer's authorized representatives.

Factory acceptance tests shall not proceed without the prior delivery to and approval of all test documentation by the Employer.

The factory acceptance test shall demonstrate the technical characteristics of the equipment in relation to this specifications and approved drawings and documents. The factory acceptance test for items shall be proposed by the Contractor in

accordance with technical specifications and Contractor's (including Sub-Contractor's/supplier's) standard FAT testing program. For Test equipment, FAT tests shall include supply of proper calibration certificates, demonstration of satisfactory performance, evidence of correct equipment configuration and manufacturer's final inspection certificate/report.

1.13.21.12.1 Sampling for FAT

From each batch HDPE pipe presented by the Contractor for Factory acceptance testing, the Employer shall select random sample (s). For HDPE pipes, following sampling plans shall be followed.

Sampling plan for Visual inspection and dimensional test

Scale of sampling for Visual inspection and dimensional test shall be as per below table:

No of Pipes in the Lot	Sample No A	Sample Size	Cumulative Sample Size	Acceptance No	Rejection No
(1)	(2)	(3)	(4)	(5)	(6)
Upto 150	First	13	13	0	2
	Second	13	26	1	2
151 to 280	First	20	20	0	3
	Second	20	40	3	4
281 to 500	First	32	32	1	4
	Second	32	64	4	5
501 to 1200	First	50	50	2	5
	Second	50	100	6	7
1201 to 3500	First	80	80	3	7
	Second	80	160	8	9
3501 to above	First	125	125	5	9
	Second	125	250	12	13

The number of pipes given for the first sample in col 3 of above Table shall be examined for dimensional and visual requirements given in clause 8.1.1 & 8.1.2. A pipe failing to satisfy any of these requirements shall be considered as defective. The lot shall be deemed to have satisfied these requirements, if the number of detectives found in the first sample are less than or equal to the corresponding acceptance number given in col 5 of above Table. The lot shall be deemed not to have met these requirements if the number of detectives found in the first sample is greater than or equal to the corresponding rejection numbers given in column 6 of above Table.

If, however, the number of detectives found in the first sample lies between the corresponding acceptance and rejection numbers given in col 5 and 6 of above Table, the second sample of the size given in col 3 of above Table shall be taken and examined for these requirements. The lot shall be considered to have satisfied these, requirements, if the number of detectives found in the cumulative sample is less than

or equal to the corresponding acceptance number given in col 5 of above Table; otherwise not.

Sampling Plan for performance test

The lot having satisfied dimensional and visual requirements shall be tested for other requirements with the sample size selected as per below Table from the lot. The lot shall be considered to have met the requirements of these tests, if none of samples tested fails.

No. of pips in the lot	Sample size
Up to 150	3
151 to 1200	5
1201 and 3500	8
3501 and above	12

Since FAT testing provides a measure of assurance that the Quality Control objectives are being met during all phases of production, the Employer reserves the right to require the Contractor to investigate and report on the cause of FAT failures and to suspend further testing/approvals until such a report is made and remedial actions taken, as applicable.

1.13.21.12.2 Site Acceptance Tests

Randoms checks somewhere in the middle of the pipe, by cutting the duct, will be made at site to ensure that ducts supplied are of correct dimension and thickness and there is no compromise on thickness in intermediate length, for saving in materials cost.

100% Duct pipe being supplied would be measured length to cross check the length of the duct pipe.

To keep a check on the use of filler material, ash contents would be determined on randomly selected samples as per ASTM D 1603 method and the value of ash content, thus determined, shall not exceed 0.3% (outer coloured layer).

UV Stabilise Content: UV Stabiliser content of finished duct shall not be less than 0.15%

Third party inspection on above, in addition to inspection at factory, would be carried out by independent agencies. on randomly picked up samples from field for testing of

relevant parameters, thereby ensuring right quality of ducts. Failure of samples to pass any of the prescribed tests/parameters would result in immediate invoking of PBG/Blacklisting of the Vendor.

1.13.21.13 Guaranteed Technical Particulars

S. No.	Required Particulars	Manufacturer's Information
1.	Manufacturer	
2.	Pipe diameter (outside) Nominal (mm) Tolerance (mm)	
3.	Wall thickness Nominal (mm) Tolerance (mm)	
4.	Standard Length Nominal (mm) Tolerance (mm)	
5.	Three concentric layers type Construction.	
6.	Construction material of outer layer	
7.	Construction material of middle layer	
8.	Construction material of inner layer	
9.	Pipe color Outer Layer Middle Layer Inner layer	
10.	Base HDPE Resin: Density at 27oC Melt flow rate at 190oC & 5 kg load. Kg/m3 g/10 minutes	
11.	Service life span (Year)	
12.	Suitable for laying in trenches by- Directly burying (Y/N)	
13.	Tensile strength N/mm2	
14.	Elongation at break (%)	

15.	Bend radius	

1.13.22 ..... Earthing and Lightning Protection System

1.13.22.1 General

This specification is intended to cover the [design, Engineering, manufacture, assembly, testing at manufacturer's works, supply in properly packed condition for transport to site, Erection, site testing and commissioning] of Earthing and Lightning Protection System.

The system shall be complete in all respect including all accessories required for efficient and trouble-free operation of Atal Puram Township, Agra

1.13.22.2 Codes and Standards

All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) / IEC as given below except where modified and/or supplemented by this specification.

IEC 62305-3	Protection against lightning – Physical damage to structures and life hazard
IS:2629	Recommended practice for hot dip galvanizing of iron & steel
IS:2633	Method for testing uniformity of coating on zinc coated articles.
IS:3043	Code of practice for Earthing
IS:9537	Conduits for electrical installation.
IEEE:80	IEEE guide for safety in AC substation grounding
IEEE:142	Grounding of Industrial & commercial power systems
CEA	CEA Regulations and standard technical specification for main plant package.

Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

The electrical installation shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

1.13.22.3 Design Criteria

a) Earthing system design shall consist of earth grids and electrodes buried in soil in the whole substation area, embedded in concrete inside all the buildings to which all the electrical equipment, metallic structures are connected to have earth continuity for safety reasons.
b) The main objectives of earthing system is to:
   - Provide safety to personnel from contact of dangerous potential caused by ground fault.
   - Ensure sufficient grounding current for effective relaying.
   - Stabilize circuit potential with respect to ground.
c) The earthing conductor shall be designed for fault current of [26.2 kA] for duration of 1 second.
d) It is the responsibility of the Bidder to undertake the soil resistivity measurements at site and select suitable size of conductor based on the soil resistivity.
e) Ground conductor shall be of galvanized iron for above ground and mild steel for embedded and below ground earthing.
f) Main earth grid conductor shall be mild steel (MS) of [32] mm dia.
g) Suitable corrosion allowance shall be considered over ground conductor size depends upon soil resistivity.
h) The main purposes of lightning protection system are to :
   - Provide protection to structures from lightning strokes.
   - Provide a low resistance-conducting path to lightning discharge.

1.13.22.4 Specific requirements

Scope of Work

The scope of work shall include Design, supply, unloading at site, storing, laying, fixing, jointing/termination, erection, testing and commissioning of equipment associated with the safety earthing and Lightning Protection system for following areas Listed below but not limited to the following:

[Note: With reference to particular package, scope of work shall be modified.]

33/11kV Substation Building:

a) Earthing and lightning protection system for Transformer area, Switchgear Room, Control rooms, all roads within battery limit etc.
b) For all above areas, above ground Earthing and Lightning protection system shall be provided.
c) System Neutrals are earthed through Treated Earth Pit. All areas of substation are interconnected to form an integrated single earthing system.

Earthing system

a) Earthing system shall be designed in accordance with IS 3043 and Indian Electricity Rules and Acts.
b) Fault current for the earthing system shall be designed for [26.2] KA for duration of 1 sec.
c) All electrical equipment, non-current carrying metal parts, structures, building steel, lightning protection system, transformer neutrals shall be connected to station ground grid.
d) Treated earth pits including riser shall be provided for transformer neutral earthing.
e) Connection between the equipment earth lead and the grid conductor shall be welded. For rust protection, the welds shall be treated with zinc chromate primer and coated with zinc rich paint.
f) Entire erection of grounding work shall be carried out in such a way as to be capable of withstanding the intended services of carrying full short circuit level currents to ground mat without any damage/deformation.

Ground Grid Conductor

Ground grid conductor of mild steel rod shall be used.

However bidder shall consider as per CBIP norms " Manual on Earth mat design" the corrosion allowance as below:

- For soil resistivity greater than 100 ohm-meter: No allowance.
- For soil resistivity greater than 25- 100 ohm-meter: 15% allowance.
- For soil resistivity less than 25 ohm-meter: 30% allowance.

Underground Grid

a) The ground grid mesh is designed to keep the touch and step voltages within safe limits as per recommendation of IEEE 80.
b) [The ground grid conductors shall be buried in earth at a depth of 600 mm]. The length of ground conductors below earth shall be sufficient to ensure a ground resistance less than one (1) ohm.
c) The ground grid conductor shall be so laid as to provide short and direct connection to building steel and major electrical equipment.
d) Ground rods shall be provided at the points where system neutrals/lightning protections are connected to the ground grid.
e) All ground grid conductor connections shall be welded type.
f) Ground grid shall be interconnected with the ground grid of neighboring areas at least at two (2) points for further reducing the ground grid resistance.
g) A minimum earth coverage of [300] mm shall be provided between the ground grid conductor and the bottom of trenches, tunnels, underground pipes, foundations, railway tracks etc. The ground grid conductor shall be re-routed in case it fouls with equipment foundations.
h) In some cases, it may happen that the construction work of cable trench, foundation and laying of underground pipes are being taken up after the grounding mat has been laid. It may be required to cut a portion of grounding conductor to avoid fouling with cable trench, equipment foundations, underground pipes etc. In this case, the ground conductor shall be properly rerouted and rejoined/reconnected with the main grounding mat during the construction/laying of above underground objects and good electrical continuity of grounding conductor shall be ensured.
i) Grounding conductors crossing the road may have to be laid at greater depth to suit the site conditions.
j) The Bidder shall carryout the grounding of all electrical equipments and connection to main earth grid.

Ground Electrode

Ground electrodes shall be [40] mm dia. and [3] metre long M.S. rod. These are to be fabricated and driven into the ground by the side of mat conductors. All connections to the conductors shall be done by arc welding process.

Above Ground Connections

a) Galvanized iron flats shall be used for all connections above earth.
b) Inside building, ground conductors shall be run for each floor supported on building steel and/or cable trays. These ground conductors in turn shall be connected to the station ground grid through riser (at least two) coming up along building columns/cable shafts.
c) Two separate and distinct ground connections shall be provided for each electrical equipment in compliance with I.E. Rules.

All steel columns and structures shall be connected to the earth mat through earth leads.

All connections above ground shall be welded type except connection to equipment/structures which shall be bolted type.

Risers

Risers are required for connecting the equipment and structures with the ground mat. Risers are to be provided from underground mat to above ground levels where the ends shall be left free for connecting to the equipment. Each riser shall be 1 No. [40] mm dia. M.S. rod and shall project above grade level/concrete floor level by minimum 300 mm. They are to be clamped or supported along the outer edge of the concrete foundation. Connection to the ground mat shall be done by arc welding.

Equipment Ground Lead

Equipment ground connections shall be sized to carry the ground fault current. Considerations shall also be given to mechanical ruggedness of the connections and to limit the number of sizes.

The minimum ground conductor sizes for various equipment and structures are given in below.

DESCRIPTION	SIZE	MATERIAL
a) Main Grounding Grid Conductor	[32] mm dia Rod	Mild Steel
b) Riser/Pigtail From Grounding Grid/Mat	[40] mm dia Rod	- Galvanised Iron -
c) Electrode	[40] mm dia, [3000] mm long Rod	- Mild Steel -
d) Conductor used for connection of various equipment/structures as listed below		

DESCRIPTION	SIZE	MATERIAL
Structures, Control Panels, Cable Trays etc.	[50 x 6] mm Flat	–Galvanised Iron
415V Power Control Centres, Motor Control Centres, Distribution Boards etc.	[50 x 6] mm Flat	- Do -
Local Panels, Lighting Panels	[25 x 6] mm Flat	- Do -
Motors :		
Above 90 kW	[50 x 10] mm Flat	Galvanised steel
Above 30 kW Upto 90 kW	[25 x 6] mm Flat	- Do -
Above 5 kW Upto 30 kW	[25 x 3] mm Flat	- Do -
Upto 5 kW	[8] SWG	- Do -
Miscellaneous Items, viz. Push Button Station, Junction Boxes etc	[8] SWG	- Do -

{The Above size of Earth flat is indicative only. Bidder shall refer Volume II Section I for size of earth flat used for existing plant or as per design.}

Jointing and Connection

a) All ground conductor connections below ground level shall be done by electric arc welding with low hydrogen content electrode. The contact surfaces shall be thoroughly cleaned to provide good electrical continuity.

b) The bending of the large diameter ground conductor where necessary shall be done by gas heating.

c) The projected portion of riser/pigtail above ground shall be coated with two coats of bitumen paints (anti-corrosive paints) with a minimum thickness of 1 mm after connection.

d) The connections between the riser/pigtail and earthing conductors (galvanized iron flats) and between the earthing conductors above ground level shall be made by electric arc welding.

e) The earthing connections to equipment grounding pads/terminals and some removable structures shall be bolted type with GI bolts and nuts. The contact surfaces shall be thoroughly cleaned (to free from scale, paint, enamel, grease, rust) before connection to ensure good electrical contact.

f) Equipment/structures ground connections shall be coated with weather resistant paints/cold galvanizing paints after proper checking / testing.

g) Whether specifically shown or not, all conduits, trays, cable armour and cable end box, electrical equipment such as motors, switchboards, panels, cabinets, junction boxes, lockout switches, fittings, fixtures, etc. shall be effectively grounded.

Earthing system installation

a) The spacing between two electrodes shall be at least equivalent to twice the length of the electrode.

b) Earthing conductor running exposed on column, walls, etc., shall be supported by suitable cleating, at intervals of 750 mm.

c) The earthing conductor crossing the road / track shall be laid in hume pipe or laid at a greater depth to avoid damage.

d) When earth conductor passes through floors, walls, etc. suitable pipe sleeves shall be provided and the same shall be sealed after installation.

e) The connection between earthing pads / terminal to the earth grid shall be made short and direct and shall be free from kinks & splices.

f) Metallic conduits and pipes shall not be used as earth continuity conductor.

g) Street lighting poles, flood light poles & towers, their junction boxes shall be connected to the earthing conductor to be run along with supply cable. This earth conductor shall be in turn connected to earth grid at two extreme points.

h) The steel columns, metallic stairs, hand-rail etc. of the building where electrical equipment are located shall be connected to the nearby ground mat by earthing conductor. Electrical continuity shall be ensured by bonding the different sections of handrails and metallic stairs.

i) Fence within the ground grid shall be bonded to the plant ground system at regular interval not exceeding ten [10] metres. Fence gate shall be separately grounded with flexible connection to permit movement.

j) [50 x 10] mm galvanized iron flats(minimum size) shall be run as main earthing conductors above ground along building columns, walls, steel structure, etc. for equipment and other structures earthing. These earthing conductors shall be interconnected between them and to the main ground grid through risers/pigtail. The connection between earthing conductor and riser shall be made above ground. Earthing conductors can be embedded in concrete floor of the building wherever necessary without having direct contact with the

reinforcement rods. At the crossing of building walls, floors etc. the earthing conductor shall be passed through galvanised conduit sleeves. Both ends of the sleeve shall be sealed to prevent the passage of water through the sleeves.

k) All indoor and outdoor electrical equipment and associated non-current carrying metal works, supporting structures, building/ boiler columns, fence, system neutrals, lightning masts/arresters shall be connected to the substation ground system.

l) Miscellaneous devices such as junction boxes, pull boxes, pushbutton stations, lockout switches, cable end boxes, lighting fixtures, receptacles, switches etc. shall be effectively grounded whether specifically shown or not.

m) Metallic conduits and pipes shall not be used as earth continuity conductor. These shall be grounded at both ends.

n) A continuous [50 x 6] mm (minimum size) G.I. flat earthing conductor shall run along the cable trays and supporting structure of all cable routes. This earthing conductor shall be attached to each section of cable tray/trays through [50 x 10] mm G.I. flats. The earthing conductor shall be securely connected to the earth mat at both ends.

o) Flexible earth conductors shall be provided at expansion joints for earthing the gates, operating handles, etc.

p) Equipment bolted connection after being checked and tested shall be painted with anti-corrosive paint / compound.

q) Connection between the equipment earth lead and the grid conductor shall be welded. For rust protection, the welds shall be treated with zinc chromate primer and coated with zinc rich paint.

r) The cable sheaths, screens armour shall be earthed at both ends for multi-core cables. For single core cables the same shall be done at one end (switchgear end) only.

s) All bimetallic connections shall be treated with suitable compound to prevent moisture ingression.

t) Main plant earth grid and switchyard earth grid shall be interconnected each other by minimum two numbers of leads.

Lightning Protection System Design

a) Lightning protection system shall consist of vertical air termination rods, horizontal roof conductors, down conductors and pipe electrodes.

b) The need for providing the lightning protection system shall be established by calculating risk index value for each building structure, etc., as per procedure given in IEC 62305-3 and any building whose risk index is more than value specified in IS shall be provided with lightning protection. However, Substation building, switchyard building shall be provided with lightning protection irrespective of the arrived risk index.

c) Shielding angle for one vertical air termination shall be 45 degrees. For more than one rod, shielding angle between the rods shall be taken as 60 Degrees.

d) Down conductors shall run along the outer surfaces of the building and shall have a test joint about 1500 mm above ground.

e) A Lightning electrode shall be provided at the connection point of the down conductor with the station ground.

f) Galvanized steel rods and flats shall be generally used for air termination and connections. All connections shall be welded type.

Air Terminations

a) The projected length of the Air termination rod shall be as required to protect the object (on which the rod is fixed) from lightning stroke.

b) The air terminal rod shall be properly fixed on the top of the building/structure to withstand very high wind pressure. In case the air terminal rod is embedded at the top of roof of building, the portion embedded inside the concrete shall not touch the reinforcement bars and shall be duly insulated from them.

c) All the vertical air terminal rods shall be electrically connected together by means of horizontal conductors of size [25 x 6] mm galvanized iron flats.

Down Conductors

a) Galvanized steel down conductors of suitable size [25 x 6] shall be connected with air terminal rod/horizontal conductor at the top of roof/structure and other end connected to the nearest 40 mm dia. mild steel rod riser from ground electrode.

b) Each down conductor shall have an independent earth termination. In no case conductors of the lightning protection system shall be connected with the conductor of grounding system above ground level.

c) The connection between each down conductor and rod electrode (by means of 40 mm mild steel rod riser) shall be made by others. However Bringing down

comer with test link at a level of 1500mm approximately from above ground level shall be boiler contractor scope of work.

d) The down conductor shall be laid straight and sharp bends shall be avoided as far as practicable. These shall be cleared on outside of the building wall and column/structure at about 750 mm intervals unless stated otherwise in the drawing.
e) At all supports for down conductor along the column/wall of the buildings etc. the portion embedded inside the building concrete should not touch the reinforcement bars.
f) All exposed metallic parts of the buildings shall be bonded to the down conductors. Such parts shall include ladders, balconies, conduits etc.
g) The down conductors shall be protected at the ground level against mechanical injury by means of non-metallic pipes, viz. PVC pipes filled with bituminous compound.

Electrodes (for Lightning Protection)

a) The electrodes shall be [40 mm] diameter [3000 mm] long mild steel rod. These shall be driven into the ground.
b) All the electrodes shall be interconnected by means of one (1) [40 mm] dia mild steel rod which shall be laid under ground at a minimum depth of [600 mm] below finished grade level unless stated otherwise. This ground mats/electrode in turn shall be connected to main grounding grid.

Riser (for Lightning Protection)

All risers connected to grounding mat shall be [40 mm] mild steel rods and shall be projected 300 mm above grade level unless stated otherwise.

Jointing & Connection

a) All ground conductor connections below ground level shall be done by electric arc welding with low hydrogen content electrode.
b) The projected portion of riser above ground shall be coated with two (2) coats of bitumen paints (anti-corrosive paints) with a minimum thickness of 1 mm after connection.
c) The joints in the lightning conductors shall be kept to a minimum and there shall be no joint in the underground portions of conductors.

d) All the joints shall be done by arc welding process overlapping of the conductors at straight joints shall not be less than 150 mm. The contact surfaces shall be cleaned properly before jointing.

e) The portion of galvanized iron flats, which undergoes welding at site, shall be coated with two (2) coats of cold galvanizing anti-corrosive paint after welding.

f) The bolted joint of the test link shall be covered with thick coating of bitumen paint after successful testing.

g) The air terminal rods and shielding mast shall be coated with weather resistant anti-corrosive paint (zinc chromate followed by two coats of aluminium paint).

h) The steel to copper connection shall be brazed type.

i) The lightning protection of inflammable liquid storage tanks wherever required, shall be provided with horizontal conductors strung between tall poles covering the entire zones or with air terminal rods mounted on top of poles/structure. These horizontal conductors/vertical air terminal rods shall be connected to rod electrodes, which in turn shall be connected to station ground mat.

j) The sizes and materials of earthing conductors to be used in lightning protection system are listed below :

DESCRIPTION	SIZE	MATERIAL
a) Vertical Air Termination	[20] mm dia Rod	Galvanised steel
b) Horizontal Conductor		------do-----
	[25 x 6] mm Flat	
c) Down Conductors		------do-----
	[25 x 6] mm Flat	
d) Ground electrode / riser	[40] mm dia Rod	Mild Steel
e) Interconnection with earth mat	[40] mm dia Rod	Mild Steel

1.13.22.5 Tests

1.13.22.5.1 Type Test

The Bidder shall submit for Owner's approval the reports of all the type tests as per relevant standards and carried out within last [five] years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those

proposed to be supplied under this contract and the test(s) should have been conducted at an independent laboratory.

In case the Bidder is not able to submit report of the type test(s) conducted within last [five] years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Bidder shall conduct all such tests under this contract free of cost to the Owner and submit the reports for approval.

1.13.22.5.2 Routine Test

All equipment shall be completely assembled, wired, adjusted and routine tested as per relevant IS / IEC Standards at manufacturer's works/site in the presence of consultant /purchaser or his representative.

The following test shall be conducted:

a) Measurement of earth resistance for each electrode.
b) Measurement of total earth resistance.
c) Measurement of earth loop resistance for E/F path of biggest LV drive.
d) Check tightness of all earth connections
e) Check earthing of all metallic equipments, cable trays, bus bar supporting structures, building column (if steel all elect equipments, pipe lines etc. as per the drawing / specification)

1.13.22.5.3 Test Witness

[The tests shall be carried out in presence of the Owner's representative, for which a minimum 7 days notice shall be given by the Bidder. The Bidder shall obtain the Owner's approval for the type test procedure before conducting the type test. The test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.]

1.13.22.5.4 Test Certificates

a) Certified copies of all tests carried out at works and at site shall be furnished in requisite no. of copies for approval of the Owner.
b) The equipment shall be dispatched from works only after receipt of Owner's written approval of shop test reports.

1.13.22.6 Drawings, Data & Manuals

Drawings, data & manuals for the motors shall be submitted as indicated below:

a) *[Earthing Material like conductor, flat, welding description etc.]*
b) *[Air termination rod and its accessories etc.]*
c) *[Technical Data sheets for Earthing and Lightning system].*

1.13.23 ..... Rating and Requirements

Major technical parameters of motor are listed below. However, Bidder may also refer to Volume-III, technical schedule in order to submit technical data of equipment along with their technical proposal.

S.NO.	DESCRIPTION	UNIT	DATA
1.0	EARTHING SYSTEM		
1.1	Manufacturer Name		
1.2	Main ground grid conductor material & size		
1.3	Ground electrode material & size		
1.4	Riser material & size		
1.5	Grounding installation work carried out as per specification	Y/N	
2.0	LIGHTNING PROTECTION SYSTEM		
2.1	Manufacturer Name		
2.2	Vertical air termination conductor material & size		
2.3	Horizontal air termination conductor material & size		
2.4	Down Conductor material & size		
2.5	Electrode material & size		
2.6	Riser conductor material & size		
2.7	Lightning Protection work carried out as per specification.	Y/N	

1.13.24 ..... UPS

This specification covers the requirements of Uninterruptible Power Supply (UPS) for SCADA & critical AC load systems or any other critical systems, which have stringent requirements, imposed on voltage and frequency regulation, harmonic content and transient recovery.

The system shall be complete in all respect including all accessories required for efficient and trouble-free operation of Atal Puram Township, Agra.

1.13.24.1 Applicable Codes & Standards

The design, manufacture and testing of equipment shall be carried out as per the latest Indian Standards/International standards.

Wherever the Indian Standards do not exist, the equipment/components shall be designed, assembled and tested in accordance with the latest editions of the Standards of the International Standard Institutions, Institution of Electrical & Electronic Engineers, USA (IEEE), National Electrical Manufactures Association, USA (NEMA) and/or International Electro-Technical Commission (IEC).

APPLICABLE STANDARDS	
Basic climatic & mechanical durability tests for components for electronic and electrical equipment	IS 9000
Environmental tests for electronic & electrical equipment	IS 9000
Transformer and inductors (Power, Audio, Pulse & switching) for electronic equipment	IS 6297
Printed wiring boards	IS 7405
Environmental requirements for semiconductor devices and integrated circuits	IS 6553
Terminals for electronic equipment	IS 4007
HRC Catridge fuses	IS 9224, BS 88, IEC 60269.1
Indicating Instruments	IS 1248, BS 89, IEC 60051
Degree of protection	IS 13947, IEC60 947-1
Semiconductor converters	IEC 60146
Semiconductor rectifier equipment code	IS 6619
Thyristor converters	IS 5082
Emergency std by power systems	IEEE 446

Sealed lead acid cells	IEC 60896-2
Vented type Ni-Cd batteries	BS : 10918, IEC 60623
Stationary cells of batteries lead acid type- Tabular plate	BS : 1651, IEC 60896-1
IEEE recommended practice for sizing Ni-Cd batteries for stationary application.	IEEE 1115
1100V cables	IS 1554
Surge withstand capability test in accordance with	IEC 60255-5, ANSI C-37-90-1
Harmonic levels	IEEE-519

1.13.24.2 System Requirements

The UPS system shall be true on line static type and the components of UPS shall isolate power line transients, frequency and voltage variations. The UPS shall provide no-break power supply to the critical loads under normal conditions, during outages in the input power and during failure / mal operation of the main components of the UPS by switching the alternate supply. Static UPS systems shall be as described below:

Parallel redundant operation with bypass to regulated supply

UPS system shall be working in Parallel Redundant configuration having two sets of 100% rectifiers, batteries and inverters and shall share the load. Under normal conditions, when AC mains power is available, both the rectifiers shall operate independently and supply DC power for float / boost charging the batteries and simultaneously to inverters. In case of failure in any one rectifier, the respective battery shall feed the load on the bus without any interruption. Each rectifier shall be designed for feeding inverter load and float / boost charging of the battery to its rated capacity within 8 hours. Each rectifier shall be equipped with automatic 'On Line' as well as manual charging facility.

Normally both inverters will be synchronized with each other and with bypass (Solid State Voltage Stabilizer) supply. The two inverters shall operate in parallel and share the load equally. When a disturbance / fault occurs in any one of the inverters, the faulty unit shall automatically get disconnected and the entire load shall be fed from the other inverter. In case, both inverters develop a fault, the complete load shall be transferred to stabilized bypass (Solid State Voltage Stabilizer) supply through static switches and retransfer of load from bypass to inverter supply shall be automatic.

Both the inverters shall be paralleled and redundant cable shall be provided to feed the redundant ACDB.

A manually operated make before break changeover switch in a segregated compartment shall be provided to bypass the UPS power circuits (inverters and static switches) for maintenance and repair purposes.

1.13.24.3 Design Requirements

All UPS components, i.e., inverter, static switch, by-pass switch, isolation transformer, associated controls shall be mounted in floor mounted, sheet steel panel. The panels shall be designed for continuous operation for the ambient conditions defined in Data sheet.

Battery

The battery backup time, type of batteries shall be as specified in Data Sheet. The CONTRACTOR shall choose the required voltage and number of the battery. The AH capacity of battery shall be chosen by CONTRACTOR, based on the battery back up time / duty cycle, and minimum ambient temp. specified in Data Sheet and the guaranteed DC/AC efficiency of the UPS system offered.

CONTRACTOR shall furnish calculation for sizing of the battery based on the requirements specified in Data Sheet.

Rectifier

The rectifier shall essentially be a three phase 6 pulse design with input isolation transformer. For Redundant UPS design the two rectifier input isolation transformers shall have vector grouping and connections to ensure 12 pulse operation seen from the source side. The rectifier shall be provided with soft start feature. The rectifier shall have features for temperature compensation charging of the batteries

The rectifier shall be capable of supplying the inverter full load, in addition to charging the fully discharged batteries in 8 hours or as recommended by battery manufacturer and then maintain the battery on trickle charge mode. The rectifiers shall automatically share the load during parallel operation in case of common battery, as specified in Data Sheet.

Inverters

The inverter shall be of PWM (Pulse Width Modulation) type. The inverter system shall be complete with necessary filters to limit the harmonic distortions to the load. The system shall have features to prevent deep discharge of battery.

Static Switch

The static switch shall comprise thyristors connected in anti-parallel configuration, enabling loads on each branch circuit to be connected to the inverter of the other branch circuit or to the stand-by regulated AC supply.

The current rating of the static switch shall be not less than the continuous full load rating of the branch circuit and short time rating of 1000% for 20 milliseconds.

Automatic initiation of the transfer from a faulty branch circuit to either a healthy branch circuit or the stand-by regulated source shall be accomplished during following conditions :

(a) Inverter failure.

(b) Loss of inverter AC output.

(c) Load over current (in case of non-redundant UPS with static by pass to regulated supply).

Regulated Stand-by AC Supply

Regulated stand-by AC supply shall be derived from stand-by source through a 3 ph servo controlled voltage stabiliser (SCVS) and a 3 ph Delta-Vee connected adequately rated isolation transformer.

The voltage regulation and transient response shall be as specified in Data Sheet.

Circuit Protection

The following devices shall be provided to protect the UPS system :

(a) AC input circuit breaker to Rectifier unit.

(b) AC input circuit breaker to supply stand-by transformer / voltage stabilizer.

(c) DC circuit breaker for battery output.

(d) Fast acting semiconductor fuses.

1.13.24.4 Indications & Annunciation

The UPS system shall be provided with necessary meters, mimic diagram, local indication / alarm conditions.

Meters

Meters shall be suitable for semi flush mounting with flanges projecting in vertical panels.

Meters shall have circular 2400C scale, 110 mm square, moving coil (taut band) type, conforming to IS: 1248 with accuracy class 1.0 or better.

DC ammeters shall be provided with external shunts.

The following meters shall be provided:

(a) Voltmeter with selector switch to measure input voltage / stand-by AC supply.

(b) Ammeter with selector switch to measure input current.

(c) DC Volt meter for rectifier

(d) DC Ammeter for rectifier

(e) Volt meter for inverter output.

(f) Ammeter for AC output and regulated stand-by AC.

Frequency meter for AC output of digital type.

Alternatively an alphanumeric multi line display to indicate all the parameters is acceptable.

Control & Monitoring

Discrete LED indicators integrated in mimic diagram or multi line alpha numeric text display unit shall be provided for continuous monitoring of the UPS operation. The UPS control system shall be fully compatible for remote operation via communication link; communication protocol (60870/104). The control system shall operate on Windows or eqvt. platform. The following operating conditions shall be annunciated.

Alarm Indication

- System fault
- Rectifier charger failure
- Inverter failure
- Battery undervoltage
- Thyrister over temperature
- Fuse failure
- Over load
- Static transfer to stand-by
- Transfer inhibited
- Over load shutdown

- Emergency shutdown
- Battery circuit breaker / switch open
- AC Main failure
- AC stand-by source mains failure
- Manual bypass ON
- Fan failure
- Asynchronous condition
- Control power failure
- DC ground fault.

Status Indication on Mimic

- Mains on
- Rectifier on
- Battery on load
- Inverter on
- AC Stand-by source on
- Inverter on –load
- Manual by-pass on
- Load on static by pass.
- Invertor faulty

1.13.24.5 Harmonics

Necessary input and output filters shall be provided or the Rectifier and Inverter design shall be such that the harmonics injected back to the source and to the load shall be within limits specified in IEEE-519 at the point of coupling of the UPS to the system. The fault level of the system at the point of common coupling shall be as specified in data sheet

1.13.24.6 AC Distribution Board (ACDB)

Suitable ACDB for feeding various loads shall be provided. Refer to ACDB specifications.

1.13.24.7 System Earthing

The CONTRACTOR shall clearly bring out the earthing philosophy to be adopted for the UPS electronics, protective earthing (PE) and neutral earthing. Necessary earthing

system inclusive of protective earthing, neutral earthing, clean earthing etc. shall be provided by the CONTRACTOR.

1.13.24.8 TESTS ON UPS SYSTEM

1.13.24.8.1 Routine Tests

Routine tests shall be carried out on all components used in the UPS. Tests for components shall be as per relevant standard specifications. Routine tests on the complete UPS system shall be carried out as per IEC 62040-3. The following tests shall be conducted as a minimum :

- Wiring checks
- Light load test
- UPS auxiliary device test
- AC input failure test
- AC input return Test
- Simulation of parallel redundant UPS fault
- Transfer test
- UPS efficiency test
- Short circuit capability test
- Restart test
- Harmonic component test
- Earth fault test
- Full load test
- Output frequency stability test
- Current division in parallel redundant UPS
- Overload capability test
- Output voltage regulation
- Dynamic response test
- Endurance test on static switches
- Tests on ACDB

All completely assembled UPS systems shall be operated at rated load under relevant ambient conditions for not less than 96 hours continuously prior to release for shipment.

1.13.24.8.2 Type Tests

The following type tests shall be conducted on one of the UPS systems :

- Synchronisation test
- Audible noise test
- Seismic test

Acceptance Tests

- The Contractor shall be responsible for all site/commissioning tests. All necessary equipment required for testing and commissioning shall be arranged by the Contractor. The following minimum tests shall be conducted at site.
- 100% load test on UPS
- Mains failure test
- Main return test
- Synchronization test
- Load sharing test
- Simulation of parallel redundancy
- High voltage test
- IR test
- Under shoot & over shoot of voltage of rectifier output and inrush current
- Transient response test for Inverter
- Transfer – Retransfer test
- Harmonic measurement test
- Over voltage test
- Under voltage test
- Over load test
- Battery trip test on under voltage
- Battery load test
- UPS auxiliary devices test
- Tests on transformers includes IR test, ratio test, vector group & polarity test, turns ratio test
- CT tests
- Functional checks of various meters
- Functional tests of earth fault detection module

Tests on Batteries

1.13.24.8.3 Routine Tests

All tests as prescribed in the relevant IS standard shall be conducted on sample cells as per standards on typical and identical with the cells forming the complete battery offered. The following tests shall be conducted as minimum on all batteries as routine tests.

- Verification of constructional requirements
- Verification of marking
- Verification of dimensions
- Test for capacity
- Test for voltage during discharge
- Ampere-hour and watt-hour efficiency tests
- Tests for retention of charge
- Endurance test
- Battery impedance test
- Hear run test

1.13.24.8.4 Type Tests

Type test certificate for ageing test conducted on similar battery type and design shall be furnished by the Contractor for review and approval.

1.13.24.8.5 Acceptance Tests

The Contractor shall be responsible for all site/commissioning tests. All necessary testing equipment required for testing and commissioning shall be arranged by the Contractor. The following tests shall be conducted at site on completion of installation and commissioning and immediately prior to putting the battery in service.

- Verification of marking
- Verification of dimensions
- Test for capacity
- Test for voltage during discharge
- Battery impedance test to be conducted before and after the capacity test

- CONTRACTOR shall furnish detailed commissioning check lists along with procedures and formats for recording of the test results for all equipment for Employer's review/approval.
- The CONTRACTOR shall maintain all tests, calibration records in Employer's approved formats, and these shall be countersigned by authorized quality control personnel of the CONTRACTOR supervising these works.
- All meters and other reference devices used for testing shall have valid Calibration Certificate traceable to reputed national laboratories/institutes. Inspection by Employer/Engineer will not be carried out unless the CONTRACTOR confirms that such calibrated equipment are ready for proceeding with the tests.
- The CONTRACTOR shall completely assemble, mount & wire all the associated equipment including bought out items and test each cubicle as per relevant standards specified in Data Sheet.
- Copies of the test certificates for all bought out items shall be submitted for the Employer's approval before dispatch of the equipment. Bound copies of complete test results as specified in the distribution schedule shall be furnished with the equipment. These shall include complete reports and results of the routine tests as also certified copies of type tests carried out on equipment of identical design.

System tests shall be performed on the completely assembled UPS system. System tests shall include frequency regulations. Voltage regulation, current limiting feature and harmonic content tests in addition to the tests to prove the functional requirements such synchronization with range of adjustments, transfer of static switches for conditions of loss of square wave, overload and under voltage conditions.

1.13.24.9 RATINGS & REQUIREMENTS

1.1	Application	For supply to SCADA & any other critical AC load of MRSS/ESS-3 building (33/11kV Distribution system SCADA,). For supply to some lighting load (up to 1kW) in 33/11 kV buildings (all 33/11kV substation)
1.2	Power rating at load PF 0.8 lagging	15kVA (at S/S-1), 5kVA (at S/S-2,3,& 4)
1.3	Quantity (nos.)	4
1.4	Method of energy storage	Battery back -up
1.5	Type	Parallel Redundant with static by pass to regulated supply
1.6	Installation	Indoor, Natural ventilated

1.7	Ambient Temperature (0C)		45 Degrees.
1.8	Relative Humidity		Upto 87% Non-condensing
2.0	ENCLOSURE		
2.1	Sheet steel thickness		2mm, CRCA for doors and 1.6mm CRCA for side covers
2.2	Degree of protection as per IS-13947		IP – 42 if located in Non-air conditioned area /IP-31 if located in air-conditioned area.
2.3	Painting		
	- Exterior		
	- Interior		Glossy white
2.4	Cable Entry		Bottom / Top
2.5	Acoustic Noise level		60 – 65 dBA upto 40 kVA 60 – 70 dBA above 40 kVA Measured at a distance of 1m
2.6	Space heater, 240V, 1 Ph		Required
3.0	UPS SYSTEM		
3.1	Input		415 V 50 Hz AC
3.1.1	Supply voltage		415 V, 3 PH, 4 W, 50 Hz AC solidly earthed.
3.1.2	Allowable Variation		
	(a)	Voltage	+ 1%
	(b)	Frequency	+ 3%
	(c)	Combined voltage + frequency	10%
3.2	Output		
3.2.1	Output voltage		240 V, 1 PH, PN, 50 Hz
3.2.2	AC voltage accuracy (steady state) over entire load, load PF & DC voltage range.		+ 2% for balanced load

3.2.3	Transient voltage regulation		+ 8% at 100% load step
3.2.4	Transient recovery		Return to steady state condition within 50 ms after disturbance.
3.2.5	Voltage wave from		Sinusoidal
3.2.6	Range of adjustment of AC output voltage		+ 5% at rated load
3.2.7	AC Harmonic content(THD-Voltage)		5% Total, 3% for any single harmonic
3.2.8	Phase displacement for three phase output		1200 + 10 for balance load 1200 + 30 for 20% unbalanced load.
3.2.9	Nominal frequency		50 Hz
3.2.10	Frequency regulation (Without static by-pass source)		+ 0.1 Hz
3.2.11	Frequency regulation (With static by-pass source)		□ 2 Hz
3.3	AC standby supply		
3.3.1	Servo controlled voltage stabilizer (SCVS)		Required / Not required
	(a)	Rating	To match UPS continuous rating
	(b)	Overload capacity	10 times rated current for 100mS
	(c)	Input voltage phase & frequency	415V + 10% 3 ph 3 wire 50 HZ
	(d)	Percentage voltage regulation	+ 2%
	(e)	Spike busters / surge suppressors and input filters	Required.
3.3.2	Isolation transformer		
	(a)	Rating	To be decided by CONTRACTOR

	(b)	Input voltage phase & frequency	415V, 3ph, wire 50 Hz
3.4	Maintenance by pass switch		Required.
4.0	BATTERY		
4.1	No. of 100% capacity batteries		Contractor to furnish with supporting calculations
4.2	Type of battery cell		SMF type Lead acid (VRLA)
4.3	DC link voltage		To be chosen by Contractor
4.5	Battery backup time		- 120 Minutes
4.6	Mounting Arrangement		Open Type : Single tier / Multi Tier
5.0	RECTIFIER		
5.1	Rectifier unit		Three phase 6 pulse / 12 pulse
5.2	Parallel Operation		Required
5.3	Recharge time on battery boost charge		As per Battery manufacturers recommendation
6.0	INVERTER		
6.1	Overload Capacity		125% for 10 Min.
			150% for 1Min
			300% for 4 milli seconds
6.2	Synchronising		
	- Between inverters		Required
	- Between inverters and standby supply		Required
6.3	Parallel Operation		Required
6.4	Synchronising Range		50 □ 2 Hz(adjustable)
7.0	STATIC SWITCH		
7.1	Maximum transfer time		5ms (1/4 cycle)

7.2	Short time current rating	1000% for 20 milli seconds
8.0	CIRCUIT BREAKER & LOAD BREAK SWITCHES	
8.1	Type	ACB/MCCB / LOAD BREAK SWITCH
9.0	AC DISTRIBUTION BOARD	
9.1	Type	separate
9.2	Construction	Modular, single front
9.3	Busbars	Aluminium
9.4	Incoming	MCCB (TP2N)
9.5	Outgoing	MCCB (DPN)
9.6	Cable entry facility	Bottom

1.13.25 ..... 110 V DC SYSTEM

1.13.25.1 General

This specification is intended to cover the [design, engineering, manufacture, assembly, testing at manufacturer's works, supply in properly packed condition for transport to site, erection, site testing and commissioning] of 110V DC system

The system shall be complete in all respect including all accessories required for efficient and trouble-free operation of Atal Puram Township, Agra

1.13.25.2 Codes and Standards

All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) / IEC / IEEE as given below except where modified and/or supplemented by this specification.

Code		Name of Standard
IS- 266	:	Specification for Sulfuric Acid
IS- 1069	:	Specification for Water for Storage battery
IS- 1146	:	Specification for rubber and Plastic Containers for Lead Acid Storage Batteries
IS-1652-1991	:	Stationary Cells and Batteries, lead acid type (with Plante positive plates) – Specification
IS- 3116	:	Specification for Sealing Compound For Lead Acid Batteries
IS- 8320	:	General requirements and methods of tests for lead acid storage batteries.
IS- 6071	:	Specification for synthetic separators of lead acid storage batteries.
IS-14782-2000	:	Code of Practice for maintenance and testing of large Lead Acid Batteries in Generating Station and Substation.
ANSI-C- 37.90a	:	Guide for surge withstand capability test.

IEEE-485-1997	:	Recommended Practice For Lead Acid Battery For Stationary Application.
IEEE-946-1992	:	Recommended Practice For The Design Of DC Auxiliary Power Systems For Generating Station.
CEA	:	CEA Regulations
IS:5	:	Colours for ready mix paints.
IS : 694	:	PVC Insulated Cable for working voltages upto and including 1100V
IS : 1248	:	Specification for Direct acting indicating analogue electrical measuring instruments.
IS:13947 Pt-1	:	Degree of protection provided by enclosures for low voltage switchgear and control gear.
IS : 13947	:	Specification for low voltage switch gear and control gear
IS : 3231	:	Electrical relays for power system protection.
IS : 3842	:	Application guide for Electrical relays for AC System
IS : 3895	:	Mono-crystalline semi-conductor Rectifier Cells and Stacks
IS : 4540	:	Mono crystalline semi-conductor Rectifier assemblies and equipment.
IS:6005	:	Code of practice for phosphating of Iron and Steel
IS:6619	:	Safety Code for Semi-conductor Rectifier Equipment.
IS:6875	:	Control switches (switching devices for control and auxiliary circuits including contactor relays) for voltages upto 1000 VAC or 1200VDC
IS : 9000	:	Basic environmental testing procedures for electronic and electrical items.
IS:13703	:	Low voltage fuses for voltages not exceeding 1000 V AC, 1500VDC.
EEUA-45D	:	Performance requirements for electrical Alarm Annunciation system

Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted subject to approval of the Owner. In such case, copies of the English version of the standards adopted shall have to be submitted along with the bid.

The electrical installation shall meet the requirements of Indian Electricity (IE) Rules as amended up to date and relevant IS Codes of Practice. In addition, other rules and regulations applicable to the work shall be followed.

1.13.25.2.1 Design Criteria

110 V DC Systems shall be suitable for an ambient temperature of 45 °C and relative humidity of 87%. The system shall be suitable for operation in a highly polluted environment.

The permissible voltage variation for 110V battery shall be from -15% to +10%.

The battery shall be of storage type [Lead Acid Plante Positive Plate] Type. The Battery shall be of high discharge performance type. The plates shall be designed for maximum durability during all service conditions including high rate of discharge & rapid fluctuation of load.

While estimating the battery size, temperature correction factor [based on lowest expected temperature 5 Deg C], margin on capacity [10%] and aging factor [1.0 for Lead Acid Plante] shall be considered.

Cell Voltages for Lead Acid batteries:

	Nominal Discharge Voltage/cell	2.0 V
	Float Voltage/cell	2.2 V
	Boost Voltage/cell	2.7 V
	Capacity for eight(8) hour rate at 270C any time during the entire duty cycle	1.85 V/Cell

1x100% sets, 110V of Lead-Acid Plante Type battery banks with 2 x100% float cum boost charger catering to 100% of substation loads shall be provided.

Permissible voltage variation for 110V battery shall be from 95V to 120V.

The Ampere-Hour capacity of DC Storage Battery shall be based on Eight hours' continuous DC supply at rated voltage to essential loads.

Batteries shall be suitable for being boost charged to fully charged condition from fully discharged condition within 8 hours.

Lead acid batteries shall be boost charged at about 2.7 volts per cell maximum and float charged at about 2.2V/cell.

The float-cum-boost charger shall be rated to cater to the following:

- Trickle charging current of the battery
- Equalizing charging of the Battery
- Boost charging of the Battery
- Continuous load on the DC system
- 25% spare capacity over above loads.

1.13.25.3 Specific Requirements

1.13.25.3.1 Constructional requirements of battery

Containers

Container shall be made of transparent glass for lead acid batteries. It shall be robust, heat resistance, leak proof, non-absorbent, acid resistant, non-bulging type and free from flaws, such as wrinkles, cracks, blisters, pin holes etc. Electrolyte level lines shall be marked on container. The marking for the electrolyte level should be for the upper and lower limits. Container shall be closed / sealed lid type.

The pole sealing arrangement should be such that no acid particle gets entrapped due to acid creep as a result of capillary action and it should be possible to remove and refix the sealing to carry out the maintenance.

Vent Plugs

Vent plug shall be provided in each cell. They shall be anti-splash type, having more than one exit hole shall allow the gases to escape freely but shall prevent acid from coming out. The design shall be such that the water loss due to evaporation is kept to minimum. In addition the ventilator shall be easily removed for topping up the cells and of such dimensions that the spring type hydrometer can be inserted into the vent to take electrolyte sample.

Plates

The plates shall be designed for maximum durability during all service conditions including high rate of discharge and rapid fluctuation of load. The construction of plates shall conform to latest revisions of standards as applicable for type of battery.

The separators shall maintain the electrical insulation between the plates and shall allow the electrolyte to flow freely. Separators should be suitable for continuous immersion in the electrolyte without distortion. The positive and negative posts shall be clearly marked.

The plate positive plates shall be supported from the ledges of the SAN container. They should not be supported at the bottom of container. Sufficient space shall be provided to allow the creepage of the plates.

Sediment Space

Sufficient sediment space shall be provided so that the cells shall not have to be cleaned out during normal life and prevent shorts within the cells.

Cell Insulators

Each cell shall be separately supported on PVC / Porcelain / Hard rubber insulators fixed on the racks with adequate clearances between adjacent cells. Minimum distance between adjacent cell shall be more than the bulge allowed for two cells in accordance with relevant IS standard.

Electrolyte

The electrolyte shall be prepared from battery grade sulphuric acid conforming to IS: 266 and distilled water conforming to IS: 1069 for lead acid batteries. The cells shall be shipped dry uncharged. The electrolyte shall be supplied separately in a separate non-returnable container. 10% extra electrolyte shall be furnished to cover spillage in transit or during erection.

Connectors and Fasteners

Lead or Lead coated copper connectors (For Lead acid Plante Type batteries) shall be used for connecting up adjacent cells and rows. Bolts, nuts and washers shall be effectively lead coated to prevent corrosion. The thickness of lead coating of connectors should not be less than 0.025 mm. All the terminals and cells inter-connectors shall be fully insulated or have insulated shrouds. End take-off connections from positive and negative poles of battery shall be made by single core cables having

stranded aluminum conductors and XLPE insulation. Necessary supports and lugs for termination of these cables on battery shall also be supplied. All connectors and lugs shall be capable of continuously carrying the 30 minutes discharge current of the respective battery and through fault short circuit current which the battery can produce and withstand for the period declared. Suitable number of inter rack connectors shall be supplied by the bidder to suit the battery room layout during the detail engineering.

Battery Racks

Steel racks with anti-corrosive epoxy paint for all the battery shall be provided. They shall be free standing type mounted on porcelain / hard rubber / PVC pads insulators. Battery shall be located in the single tier arrangement. However battery having a complete cell weight of lower than 50 Kg could be located in the double tier arrangement. The battery rack and support for cable termination shall be coated with three (3) coats of anti-acid paint of approved shade. Numbering tags, resistant to acid, for each cell shall be attached on to the necessary racks. The bottom tier of the stand shall not be less than 150 mm above the floor.

- Wherever racks are transported in dismantled condition, suitable match markings shall be provided to facilitate easy assembly.
- Manufacturer's Identification Systems
- The following information shall be indelibly marked on outside of each cell:
- Manufacturer's name and trade marks
- Country and year of manufacture
- Manufacturer type of designation
- AH capacity at 8 hour discharge rate
- Serial number

1.13.25.3.2 Constructional Requirements of battery charger

The Charger shall be indoor, floor mounted, self-supporting sheet metal enclosed cubicle type. All necessary base frames, anchor bolts and hardware shall be supplied. The charger shall be fabricated using cold rolled sheet steel shall not less than 1.6 mm and shall have folded type of construction. The panel frame shall be fabricated using cold rolled sheet steel of thickness not less than 2.0 mm. Removable undrilled gland plates of at least 3.0 mm sheet steel and lugs for all cables shall be supplied. The lugs for cables shall be made of electrolytic copper with tin coat. The chargers shall be tropicalised and vermin proof. Ventilation louvers shall be backed with fine brass wire mesh. All doors and covers shall be fitted with synthetic rubber gaskets. The chargers

shall have hinged double leaf doors provided on front / or backside for adequate access to the charger internals. All the charger cubicle doors shall be properly earthed. The degree of protection of charger enclosure shall be at least IP-42.

All indicating instruments, control and selector switches and indicating lamps shall be mounted on the front side of the charger.

Electronic equipments shall be of modular design consisting of plug in modules in standard 19 inches metallic racks with metallic card guides. The cards should be provided with proper handles. Card to card wiring should be preferably through a motherboard. Unplanned jumpering and track modifications are not permitted and track modifications are not permitted. Mechanical interlocks to prevent wrong insertion of cards should be provided. Each card shall have its junction and test points identified. Maintenance aids such as extension printed wiring boards and jumper leads shall be provided.

The layout of charger equipment shall be such that their heat losses do not give rise to excessive temperature within the charger panel surface. Location of the electronic modules shall be such that temperature rises of the location, in no case, shall exceed 10°C over ambient air temperature outside the charger.

Printed Circuit Boards (PCB)

PCB shall be made of glass epoxy of 1.6 mm thick, fire resistant, bonded with 99.8% pure copper foil, free of wrinkles, blisters, scratches and pinholes. The contact surface of the edge connectors of the PCBs shall be plated with hard gold to a minimum thickness of 5 microns. Component identification shall be printed on PCB by silk screen method. All PCBs shall be tropicalised and masked.

Contactors

All battery chargers shall have an AC contactor on the input side. It shall be of air break type and suitable for continuous duty. The operating coil shall be rated for 415 Volts AC.

Thermal Overload Relay

A thermal overload relay incorporating a distinct single phase protection (using differential movement of bimetal strips) shall also be provided for the AC input. The relay shall trip the above contactor.

Rectifier-Transformer and Chokes

The rectifier-transformer and chokes shall be dry and air cooled (AN) type. The rating of the rectifier transformers and chokes shall correspond to the rating of the associated rectifier assembly. The rectifier-transformers and chokes shall have class-B insulation with temperature rise limited to class A insulation value.

Rectifier Assembly

The rectifier assembly shall be full wave bridge type and designed to meet the duty as required by the respective charger. The rectifier cells shall be provided with their own heat dissipation arrangement with natural air cooling. The rectifier shall utilize diodes / thyristors and heat sinks rated to carry 200% of the load current continuously and the temperature of the heat sink shall not be permitted to exceed 85 °C absolute duly considering the maximum charger panel inside temperature. Calculations to show what maximum junction temperature shall be and what the heat sink temperature shall be when operating at 200% and 100% load current continuously duly considering the maximum surrounding air temperature of 45°C outside the panel have to be submitted. Necessary surge protection devices and rectifier type fast acting fuses shall be provided in each arm of the rectifier connections.

1.13.25.3.3 System Concept for 110 V DC system

First float cum boost charger shall be normally ON in float mode, supplying the D.C. load and at the same time trickle charging the battery and shall (a) provide occasional equalizing charge (b) boost charge the battery up to 2.7/1.7 Volts per cell as required.

The characteristics shall be such that if load is high and exceeds the charger capacity, the excess load shall be supplied by the battery.

The second float-cum-boost charger shall be normally in stand-by (auto float/charge) mode and shall come into the circuit automatically (a) to take over the functions of first float cum boost charger in case of its failure (b) to provide occasional equalizing charge as required, (c) boosting charge the battery up to 2.7/1.7 Volts per cell.

The float-cum-boost charger shall also have provision for float, equalizing, and boost charging the battery through manual selection. On failure of station A.C. supply, float-cum-boost charger shall go out of service and battery shall take over to supply emergency loads.

1.13.25.3.4 Operational requirements of charger

The float-cum-boost charger shall be sized to restore the fully discharged battery to full charge condition in eight (8) hours with 10% margin over maximum charging rate and also to operate as a float charger.

The batteries & chargers shall be so designed that the maximum fault level on DC DB is limited to 15KA

The battery shall be trickle charged at 2.15 to 2.25 V per cell for lead acid battery. All chargers shall also be capable of boost charging the associated battery at 2.0 to 2.7 V per cell for lead acid at the desired rate. The chargers shall be designed to operate, as mentioned above, at an ambient air temperature of 45 °C.

Necessary interlocks shall also be provided to avoid accidental boost mode operation when loads are connected to the bus.

The battery chargers as well as their automatic regulators shall be of static type. Battery chargers shall be capable of continuous operation at the respective rated load in trickle mode i.e. trickle charging the associated lead acid battery while supplying the DC loads.

Battery chargers shall have a selector switch for selecting the battery charging mode i.e. whether trickle / float or Boost charging.

All battery chargers shall be provided with facility both automatic and manual control of output voltage and current. A selector switch shall be provided for selecting the mode of output voltage / current control, whether automatic or manual. Means shall be provided to avoid current / voltage surges of harmful magnitude/ nature which may arise during changeover from Auto to Manual mode or vice versa under normal operating condition.

Soft start feature shall be provided to build up the voltage to the set value slowly within fifteen (15) seconds. The chargers shall have load limiters which shall cause, when the voltage control is in automatic mode, a gradual lowering of the output voltage when the DC load current exceeds the load limiter setting of the charger. The load limiter characteristic shall be such that any sustained overload or short circuit in DC system shall neither damage the charger nor shall it cause blowing of any of the charger fuses. The charger shall not trip on overload or external short circuit. After clearance of fault, the charger voltage shall build up automatically when working in automatic mode.

When on automatic control mode, during trickle / float charging, the charger output voltage shall remain within (±) 1% of the set value for AC input voltage variation of (±) 10%, frequency variation of (+) 3 / (-) 5%, a combined voltage and frequency variation of 10% (absolute sum) and a continuous DC load variation from zero to full load. Uniform and step less adjustment of voltage setting (in both manual and automatic modes) shall be provided on the front of the charger panel covering the entire trickle / float charging output range specified. Step less adjustment of the load limiter setting shall be possible from 80% to 100% of the rated output current for trickle / float charging mode.

During boost charging, the battery chargers shall operate on constant current mode (when automatic voltage regulator is in service). It shall be possible to adjust the boost charging current continuously over a range of 50% to 100% of the rated output current for Boost charging mode. The charger output voltage shall automatically go on rising, when it is operating on boost mode, as the battery charges up. For limiting the output voltage of the charger, a potentiometer shall be provided on the front of the panel, whereby it shall be possible to set the upper limit of this voltage anywhere in the output range specified for boost charging mode. All voltage and current setting potentiometers shall be vernier type.

Energizing the chargers with fully charged battery connected plus 10% load shall not result in output voltage greater than 110% of the voltage setting. Time taken to stabilize, to within the specified limits as mentioned elsewhere shall be less than fifteen (15) seconds.

Momentary output voltage of the charger, with the battery connected shall be within 94% to 106% of the voltage setting during sudden load change from 100% to 20% of full load or vice versa. Output voltage shall return to, and remain, within the limits specified as mentioned elsewhere in less than 2 seconds after the above mentioned change.

The charger manufacturer may offer an arrangement in which the voltage setting device for trickle/ float charging mode is also used as output voltage limit setting device for Boost charging mode, and the load limiter of the trickle / float charging mode is also used as Boost charging current setting device.

Suitable filter circuits shall be provided in all the chargers to limit the ripple content (peak to peak) in the output voltage to 1% irrespective of the DC load, even when they are not connected to a battery.

1.13.25.3.5 Auxiliary Equipment

- DC Voltmeter, DC ammeter and AC voltmeter in 96 mm square shall be provided for each charger. The instruments shall be 240 scale, antiglare glass, flush mounted type, dust proof and moisture resistant. The instrument shall have easily accessible means from zero adjustments. The instruments shall be of 1.5 accuracy class.
- In addition to above, following metering provision shall be given for remote metering / recording at PLC/DCS
  a) Battery Voltage
  b) DC voltage of float & Boost charger
  c) DC current of float & Boost charger
  d) DC load voltage
  e) DC load current
  f) DC Voltage and Current at FCBC
  g) Centre Zero Ammeter with Shunt to read Discharge/Charge current
  h) Ammeter for Battery Trickle Charge current
  i) DC Bus Voltmeter indicating - +ve to Earth, -ve to Earth and +ve to –ve with Selector switch.

The following indications shall be provided

- AC Supply – R,Y,B Healthy
- DC supply – Available
- Charger in Float Mode
- Charger in Equalising mode
- Charger in Boost mode
- Charger tripped on fault
- D.C Earth fault sensing &alarm
- Suitable soft link to be provided for interfacing with DDCMIS.

Air Break Switches

All chargers shall have AC input and DC output switches of air break, single throw, load break and fault make type. The contacts of the switches shall open and close with

a snap action. Switches shall be rated for 120% of maximum continuous load. 'ON' and 'OFF' position of the switch shall be clearly indicated.

Control and Selector Switches

Control and selector switches shall be rotary, stay put type with escutcheon plates showing the functions and positions. The switches shall be of sturdy construction and suitable for mounting on panel front. Switches with shrouding of live parts and sealing of contacts against dust ingress shall be preferred. The contact ratings shall be at least the following:

i.	Make and carry continuously	-	10 Amps
ii.	Breaking current at 110V DC	-	0.5 Amp (inductive)
iii.	Breaking current at 240V AC	-	5 Amp. at 0.3 p.f.

Fuses

Fuses shall be of HRC cartridge fuse link type. Fuses shall be mounted on fuse carriers which are mounted on fuse bases. Wherever it is not possible to mount fuses on fuse carriers, fuses shall be directly mounted on plug in type bases. In such cases one insulated fuse pulling handle shall be supplied for each charger. Kick-off fuses (trip fuses) with alarm contacts shall be provided for all DC fuses.

Indicating Lamps

Three (3) indicating lamps shall be provided to indicate AC supply availability. The indicating lamp shall be of panel mounting, LEDs and capable of clear status indication under the normal room illumination. The lamps shall be replaceable from front. The lamp covers shall be preferably screwed type, unbreakable and moulded from heat resistant material.

Blocking Diode

Blocking diode shall be provided in the output circuit of each charger to prevent current flow from the Battery into the charger.

Annunciation System

Following annunciation shall be provided for local and remote indications in all chargers(List is indicative only)

- AC supply failure
- Rectifier fuse failure

- Surge circuit fuse failure
- Filter capacitor fuse failure
- Load limiter operated
- Charger fail / trip
- Battery on Boost
- Battery on Trickle
- DC output fuse failure
- Positive grounded
- Negative grounded
- Battery fully discharged
- AC input under voltage
- DC voltage low
- DC voltage high
- DC system earth fault

The annunciation system shall have audio-visual arrangement and shall incorporate acknowledge, reset and test push buttons. On occurrence of fault, the corresponding window lights up and shall stay in lighted condition till the fault is cleared and the reset push button is pressed. At least 20% spare annunciation windows with accessories shall be provided.

- Lamp / Space Heaters / Receptacles
- The charger panels shall be provided with:
    - Internal illumination lamp with door switch.
    - Space heater with thermostat control.
    - 3-pin 5A receptacle with plug.
    - Lamp, heater and receptacle circuits shall have individual switch fuse units/MCB.

1.13.25.3.6 Battery Accessories

Each battery shall be furnished complete with following:

- First charge of electrolyte plus 10% extra.
- Stand insulators 5% extra.
- Cell inter-connectors 5% extra and one extra end take-off.
- Lead-coated connection hardware 5% extra
- Cell numbering tag with fixing arrangements

- Insulated cable clamps with hardware
- Six (6) extra cell with all accessories but without acid
- In addition to the above each battery shall be furnished with a set of following accessories.
- One (1) Interconnector bolt wrench
- One (1) Hydrometer syringe
- One (1) Thermometer with specific gravity correction scale.
- One (1) Cell testing voltmeter with leads.
- One (1) Pocket thermometer
- One (1) set of Acid resisting funnels
- One (1) set of Acid resisting jugs of adequate capacity
- One (1) set of Rubber aprons
- One (1) set of Rubber gloves
- PVC spill trays under the battery cells
- Spanner for cells

Catalogues and Instruction manuals of battery and battery charger to be furnished.

1.13.25.3.7 Painting

- All surfaces shall be sand blasted, pickled and grounded as required to produce a smooth, clean surface free of scale, grease and rust.
- After cleaning, the surfaces shall be given a phosphate coating followed by 2 coats of high quality lead oxide primer and stoved after each coat.
- The equipment shall be finished in Siemens Grey RAL: 7032 color with two coats of epoxy based powder coated paint . The coating shall be done electro statically followed by stoving.
- Sufficient quantity of touch-up paint shall be furnished for application at site.

1.13.25.3.8 Installation

The battery room floor shall be acid resistant type and walls shall have acid resistant tiles up to a suitable height. Alternatively acid resistant paints are also acceptable. Adequate ventilation shall be provided in the battery room for the removal of hydrogen.

The Battery charger along with D.C. distribution board shall be located in separate rooms.

After erection and connection of the Battery Charger, the contractor shall complete the charging discharging cycles recommended by the manufacturer. The contractor shall rig up a suitable discharge resistor for this purpose.

Connection from Battery terminals shall be made by means of cables. Lead coated terminal connector shall be furnished for this purpose.

1.13.25.4 Tests

1.13.25.4.1 Type Test

For each type of Battery and battery charger, the Bidder shall submit for Owner's approval the reports of all the type tests as per relevant standards and carried out within last five years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been conducted at an independent laboratory.

In case the Bidder is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Bidder shall conduct all such tests under this contract free of cost to the Owner and submit the reports for approval.

1.13.25.4.2 Routine Test

All equipment shall be completely assembled, wired, adjusted and routine tested as per relevant IS / IEC Standards at manufacturer's works in the presence of consultant /purchaser or his representative.

All Battery, Battery chargers, Inverters and its components thereof shall be subject to shop tests as per relevant IS/IEC standards. The tests on Battery chargers shall include but not limited to the following:

- Voltage regulation check from 0 to 100% loads with ± 10% input voltage variation.
- Ripple content measurement.
- D.C short circuit test to prove ability of current limit.
- Measurements of transient overshoot/undershoot during switching ON/load throw-off.
- Current limiter operation.
- Special tests for electrical equipment, when specified in relevant Indian / International standard shall be carried out on at least one item of each rating.

1.13.25.4.3 Test Witness

The tests shall be carried out in presence of the Owner's representative, for which a minimum 7 days notice shall be given by the Bidder. The Bidder shall obtain the Owner's approval for the type test procedure before conducting the type test. The test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.

1.13.25.4.4 Test Certificates

- Certified copies of all tests carried out at works and at site shall be furnished in requisite no. of copies for approval of the Owner.
- The equipment shall be dispatched from works only after receipt of Owner's written approval of shop test reports. Drawings, Data & Manuals: Following drawings/ data and Manuals to be submitted for approval:
- [Dimensional battery layout diagram and plan & section.
- Connection details of take-off terminals.
- Dimensional general arrangement drawings of battery charger clearly showing device dispositions, cable entry, space requirement, etc.
- Sectional views of battery charger.
- Charger foundation plan and loading.
- Charger schematics and wiring diagrams.
- Test reports
- Detailed bill of materials
- Any other relevant drawing or data necessary for satisfactory installation, operation and maintenance.

Instruction manuals of battery and battery Charger. The manual shall clearly indicate method of installation, check-ups, and tests to be carried out before commissioning of the equipment.

Bidders shall note that the drawings, data and manuals listed herein are minimum requirements only. The Bidders shall ensure that other necessary write-ups, curves and information required to fully describe the equipment are submitted with their bids].

1.13.25.5 Ratings & Requirements

S.No	Technical Particulars	Unit	Parameters	Remarks
1.0	General			
1.1	Bidder's Name			
1.2	Make			
1.3	Application		FOR SUBSTATION	
2.0	Battery			
2.1	Make and country	:	[By bidder]	
2.2	Type	:	Lead acid(Plante)	
2.3	Reference standard		As specified in specification	
2.4	Rated system voltage	: (Volts)	110V DC	
2.5	Rated capacity for one hour discharge at 27°C	: (Ah)	275	
2.6	Rated capacity for 8 hour discharge rate at 27°C	: (Ah)	275	
2.7	Nominal voltage per cell	: (V)	2.2V /1.42V	
2.8	End cell voltage	: (V)	1.85/1.14V	
2.9	Number of cells per battery	:	Based on type of battery.	
2.10	Short circuit current	: (kA)	[By bidder]	
2.11	Mounting type	:	[By bidder]	
2.12	AH efficiency at rated load	: (%)	[By bidder]	
2.13	Watt hour efficiency	: (%)	[By bidder]	
3.0	Constructional details		[By bidder]	
3.1	Container			
a	Material			
b	Thickness	Mm		
3.2	Separator			
a	Type			
b	Material			
c	Thickness	Mm		
3.3	Electrolyte			

S.No	Technical Particulars	Unit	Parameters	Remarks
3.4	Quantity for first filling plus 10% extra			
3.5	Specific gravity at twenty seven (27) degree Centigrade			
a	With all cells fully charged			
b	At the end of discharge			
3.6	Method of supporting elements		[By bidder]	
a	Edges of plates and Inner surfaces of container	Mm		
b	Bottom of negative plates	Mm		
c	Top of plates	Mm		
d	Sediment space	Mm		
3.7	Weather explosion-proof cent plugs are provided		[By bidder]	
3.8	Distance between centre's of cells when erected	mm	[By bidder]	
3.9	Expected life span of battery	Year	[By bidder]	
3.10	Proposed Layout (attach layout)		[By bidder]	
4.0	Battery Charger			
4.1	Number of rectifiers	:	[By bidder]	
4.2	Reference standard	:		
4.3	Make and country			
4.4	Type	:		
4.5	Rectifiers with thyristors Y/N	:	[By bidder]	
4.6	Rated input AC voltage	: (V)	415V, 3ph, 4 wire	
4.7	Frequency	: (Hz)	50	
4.8	Output DC current	: (A)	[By bidder]	
4.9	Rectifier efficiency	: (%)	[By bidder]	

S.No	Technical Particulars	Unit	Parameters	Remarks
4.10	DC voltage setting adjustment of AVR for float charging		[By bidder]	
4.11	Boost mode:		[By bidder]	
a	Starting rate	: (V)		
b	Finishing rate	: (V)		
4.12	Protection class of cubicles	:		
4.13	Residual ripple	: (%)	[By bidder]	
4.14	Current limiting feather provided	: (Yes/No)	[By bidder]	
4.15	Soft staring feather provided	: (Yes/No)	[By bidder]	
4.17	Voltage and current setter in different mode provided	: (Yes/No)	[By bidder]	
4.18	Type of cooling	:	Natural	
4.19	Paint shade: Indoor and outdoor		RAL 7032	
5.0	Constructional details		[By bidder]	
5.1	List of major accessories			
5.2	Diode			
a	Make			
b	Type			
c	Rating			
d	Voltage	V		
e	Current	A		
5.3	Rectifier Transformer			
a	Make			
b	Rating	kVA		
c	Connection			
	Primary Winding			
	Secondary Winding			
d	Voltage			

S.No	Technical Particulars	Unit	Parameters	Remarks
	Primary Winding	V		
	Secondary Winding	V		
e	Percentage of tap provided			
	Primary Winding	%		
	Secondary Winding	%		
5.4	Control/ Selector switch			
a	Make			
b	Type designation			
c	Voltage Grade	V		
d	Current rating	A		
e	Make and carry			
f	Brake			
g	Spring return or stay out			
h	Type of handle			
i	No. of positions			
j	No. of poles/ ways			
k	Angular Movement			
m	Special features if any			
5.5	Indicating Lamp			
a	Make			
b	Type			
c	Voltage	V		
d	Series resistor value	Ohm		
6	Thickness of battery charger panel sheet steel;	Mm		
5.6	Weight & dimensions		[By bidder]	
a	Length	Mm		
b	Depth	Mm		
c	Height	Mm		
d	Weight	Kg		

1.13.26 ..... 415V SWITCHGEAR, APFC Panel, MCC and DB

1.13.26.1 General

This specification is intended to cover the [design, Engineering, manufacture, assembly, testing at manufacturer's works, supply in properly packed condition for transport to site, Erection, site testing and commissioning] of 415V Switchgear, APFC PANEL, MCC and DBs

The system shall be complete in all respect including all accessories required for efficient and trouble-free operation of Atal Puram Township, Agra

1.13.26.2 Codes and Standards

All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) / IEC as given below except where modified and/or supplemented by this specification.

Codes	Name of Standard
IS : 1248	Direct acting indicating analogue electrical measuring instruments and their accessories
IS: 2551	Danger notice plates
IS :2705	Current transformers-specification
IS :13925	Shunt Capacitors for AC Power Systems
IS :3156	Voltage transformer specification
IS :3231	Specification for electrical relays for power system protection
IS: 8084	Specification for interconnection busbars for AC voltages above 1kV up to and including 36kV.
IS :8623	Specification for low-voltage switchgear and control gear assemblies
IS :8686	Specification for static protective relays
IS :10118	Code-of practice for selection installation and maintenance of switchgear and control gear
IS :12021	Specification for control transformers for switchgear and control gear for voltages not exceeding 1000 V AC

IS : 13947 (Part 1)	Specification for low-voltage switchgear and control gear
IS : 13947 (Part 2)	Specification for low-voltage switchgear and control gear –part 2: circuit breakers
IS : 13947 (Part 4)	Specification for low-voltage switchgear and control gear -part 4 : contactors and motor feeders
IS : 13947 (Part 5)	Low-voltage switchgear and control gear specification Part 5 : control circuit devices and switching elements
IEC 61439	Low voltage switchgear and control gear assemblies.
CEA	CEA regulations for installation and operation of meters 2006.
CEA	Standard technical specifications for main plant package

Equipment and material conforming to any other standard which ensures equal or better quality may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

The electrical installation shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Codes of Practice. In addition, other rules and regulations applicable to the work shall be followed.

1.13.26.3 Design Criteria

All 415V Switchgear, MCC and DB shall be suitable for an ambient temperature of 45°C and relative humidity of 87%. The Switchgear shall be suitable for operation in a highly polluted environment.

All 415V Switchgear, MCC and DB shall be suitable for following voltage & frequency variations as follows:

Voltage Variation	:	(±) 10%
Frequency Variation	:	(+) 3% to (-)5%
Combined Variation of Voltage & Frequency	:	10% (absolute sum)
For DC system	:	-15% to +10%

415 V switchgear & MCCs shall be of indoor, single front and fully draw out type. ACB feeder may be of single tier/two tier configuration depending upon rating. DBs (ACDB / DCDB) shall be of single front and fixed type. These shall be CRCA sheet metal enclosed and assembled to form a rigid, free-standing floor mounted structure. Vertical units shall be assembled to form a continuous line up of panels. Compartmentalized multi-tier configuration shall be provided.

For all motors upto 5.5kW AC motor starters shall be suitable for Direct on Line (DOL) starting.For all motors greater than 5.5kW and upto 200kW AC motor starters shall be suitable for Star Delta starting. Motors rated below 132kW shall be provided with combination starters consists of MCCB/MPCB, contactors and electronic over load relay and the motor starter shall comply with Type – 2 coordination conforming to relevant code and standards. Motors rated 132 kW and above shall be breaker controlled and shall be provided with comprehenive motor protection relay.

For 415 V switchgear & MCCs Feeders rated more than 630A shall be equipped with Air Circuit Breaker (ACB). Outgoing/Incoming feeders rated upto 630 A shall be MCCBs.

For DBs Incomer rated more than 630A shall be ACB. Incomer upto 630A shall be MCCB. Outgoing feeder may be MCCB/MCB depending upon the bus fault level.

All ACB shall be draw out type & should have Service, test and disconnected positions with positive indications for service & test positions. It shall be possible to charge the springs manually, if, required

Local/remote selection shall be provided for all incoming/Outgoing ACB module. Incoming/Outgoing breaker shall be closed at service position from remote (SCADA) and at test position from Local(Switchgear).

Two out of three breaker logic shall be considered for switchgear/MCC. However mechanical interlock shall be considered for incomer of MCCB operated DBs.

Also, Local/remote selection switch shall be provided for all motor modules for control from Remote(SCADA). Also for breaker operated motor, breaker shall be closed in Test position from local(Switchgear).

All motors shall be provided with Emergency stop push button.

Control circuits shall operate at suitable voltage of 110V AC or 110V DC. Necessary control supply transformers having primary and secondary MCCB/MCB shall be

provided for each MCC, 2 x 100% per section. However breaker shall operate on 110V DC. The auxiliary bus bars for control supply shall be segregated from bus bars. This control supplies shall be monitored.

All the numerical relays shall have communication on two ports, local front port communication to laptop and a second port with [IEC 61850 protocol] to communicate with SCADA.

1.13.26.3.1 Design Criteria For Capacitor Banks

The capacitor banks shall be complete with all parts that are necessary or essential for efficient operation. Such parts shall be deemed to be within the scope of supply whether specifically mentioned or not.

The capacitor bank may comprise of suitable number of single phase units in series parallel combination. However, the number of parallel units in each of the series racks shall be such that failure of one unit shall not create an overvoltage on the units in parallel with it, which will result in the failure of the parallel units.

The complete capacitor banks with its accessories shall be metal enclosed (in sheet steel cubicle), indoor floor mounting and free standing type.

The assembly of the banks shall be such that it provides sufficient ventilation for each unit. Necessary louvers may be provided in the cubicle to ensure proper ventilation.

Each capacitor unit/bank shall be fitted with directly connected continuously rated, low loss discharge device to discharge the capacitors to reduce the voltage to 50 volts within one minute in accordance with the provisions of the latest edition of IS : 2834.

All panels of capacitor banks with MCCBs, Contactor, minimum 8 stage automatic power factor correction relay enclosed in IP 42 compliant CRCA Sheet Steel enclosure.

Capacitors shall be double layer All poly Polypropylene (APP) type having following specifications and conform to IS 13925:

Supply	**3phase, 3 wire**
Rated voltage	415 V
Rated frequency	50 Hz.
Permissible overvoltage	1.1 Vn
Permissible over current:	1.5 In

Temperature category: 50 deg c

The capacitors shall have Low Dielectric Loss of □ 0.5 W/ kVAR.

All capacitors shall be provided with 7% de-tuned filter along with all accessories and protections.

Any change in rated voltage level of the capacitor bank due to the filter or otherwise shall be considered by the vendor. The indicated rating of capacitor banks are at rated voltage of 415V.

The banks shall be switched ON and OFF in both Auto as well as Manual mode. An “Auto/Manual” Switch at the incomer feeder shall be provided.

All necessary auxiliary contactors of suitable duty along with feeder accessories are included in scope. All power Contactors for capacitor switching shall be of required duty.

Manual operation shall be done with recess type panel mounted ON/OFF pushbutton with delay timer.

Minimum current rating under site conditions, of circuit breakers, Contactors, and cables shall be at least 150% of rated capacitor current.

Capacitors shall be mounted in such a way that heat dissipation is proper and the capacitors are accessible for maintenance and inspections.

Capacitor switching and automatic power factor correction panel shall be designed in such a way that power factor of 0.98 lagging shall always be maintained. Timings to cut in capacitors shall be provided in such a manner to facilitate capacitor discharging before next switching and shall also avoid hunting due to temporary fluctuations of load. The timer shall be provided in both auto and manual mode.

The Automatic power factor correction panel and capacitor panel are integral type, prewired including power connections. Due consideration shall be given for adding/ removal of capacitor or other components and maintenance considerations. Contractor shall submit GA drawings of capacitor and capacitor control panel, with description of power factor control panel with its components.

a) Each unit shall satisfactorily operate at 130% of rated KVAR including factors of overvoltage, harmonic currents and manufacturing tolerance. The units shall be capable of continuously withstanding satisfactorily any overvoltage up to a maximum of 10% above the rated voltage, excluding transients.

b) Unit Protection

   i. Each capacitor unit shall be individually protected by a MCCB Breaker suitably rated for load current and short circuit capacity, so that a faulty capacitor unit shall be disconnected by the breaker without causing the bank to be disconnected. Thus, the breaker shall disconnect only the faulty unit and shall leave the rest of the units undisturbed.

   ii. The Inputs to the APFC system is Voltage input from two phases and current input from the third phase. Out of two phases of voltage one phase voltage is taken as Reference 0 and other phase voltage as 440 V. APFC need to be installed CT (Current Transformer) on the third phase at main incomer ACB after transformer, which will give signal to the APFC Relay. Based on this inputs the ASIC (Application Specific Integrated Circuit) OR Call it as Microprocessor internal to the APFC Relay will give output signal to relay outputs which will energize coil of the contactor so that the contactor come in line connecting the capacitor bank in circuit. However this is step correction means PF is corrected in steps. The Voltage rise due to connection of capacitor banks is marginal. There will be no frequency correction with APFC System.

1.13.26.4 Specific Requirements

1.13.26.4.1 Construction

All 415V switchgear, MCC and DBs shall have following minimum features.

a) All 415V switchgear, MCC and DBs shall be metal enclosed, indoor, floor mounted and free standing type. The panels shall be suitable for cable entry at bottom.

b) Between 415V Switchgear and dry type transformers, cable is considered. Hence switchgear shall be suitable for this connection

c) All frames and load bearing members shall be fabricated using mild steel structural sections or pressed and shaped cold rolled sheet steel of thickness not less than 2 mm.

d) Frame shall be enclosed in cold rolled sheet steel of thickness not less than 2 mm. Doors and covers shall also be of cold rolled sheet steel of thickness not less than 1.6 mm. Removable gland plates of thickness 3mm (hot/cold rolled sheet steel) or 4 mm (non magnetic material)shall be provided for all panels. Suitable removable type lifting hooks and / or jacking pad shall be provided on each panel or shipping section for ease of lifting of switchgear. These hooks when removed shall not leave any opening in the panels

e) Each breaker shall be housed in a separate cubicle, complete with an individual front access door. Each vertical section shall have a removable back cover.

f) The switchgear enclosure shall confirm to the degree of protection IP-54 (for outdoor). For indoor, enclosure shall confirm to IP52, however for Busbar chamber of switchboards rated above 1600A, degree of protection shall be IP-42.

g) The switchgear panel shall be powder coated with shade RAL 7032 (Siemens Gray) as per IS with minimum thickness 80 microns with structured finish

h) The switchgear assembly shall comprise a continuous, line-up of single / multi tier cubicles. The installations of circuit breakers however shall be limited to the bottom two tiers only. Working height shall be limited to 250 mm to 1800 mm from the floor level.

i) Metallic barriers shall be provided between vertical sections and also between adjacent modules to ensure prevention of accidental contact with live parts during routine inspection/maintenance of functional units or cable terminations of one or more functional units when working on those of adjacent units. These barriers shall have insulating inserts as necessary for taking the interconnections etc

j) A nameplate with switchgear designation shall be fixed at the top of the central panel. A separate nameplate giving feeder details shall be provided for each compartment. A separate nameplate giving details of bus section shall also be provided for switchgears having more than one bus section.

k) Name plate shall be provided for each equipment (lamps, push buttons, switches, relays, auxiliary contactor, etc) mounted on the switchboard. Special warning plates one each on each feeder of a shipping section shall be provided on removable covers of doors giving access to cable terminals and busbars. Name plate size shall be minimum of 20x75 mm for Instruments/devices and 40x50 mm for panels. Thickness shall be minimum 3 mm.

l) For MCC/DB a full height vertical cable chamber with cable supports shall be provided in each section to facilitate unit wiring.

m) 2x100%, 415V/110V AC control transformer shall be provided for control, Indication and annunciation supply for contactor operated motor feeder. All the necessary auxiliary and main contactor shall be provided suitable for this control supply.

n) Two 110V DC feeders shall be provided for control, Indication and annunciation of breaker operated module.

o) Compartment door shall be interlocked with main power isolating device for safety with provision for defeating it by authorized person.

p) Supplier shall provide total 20% or minimum one (1) no. spare feeder of each type & rating with respect to total requirement of the switchgear.

q) Motors of rating 30 kW and above shall be provided with anti- condensation heaters. Necessary provision for supply of motor space heating shall be considered in the switchgear.

r) The incoming connection to transformer of more than 1000kVA and inter-connecting sections between switchboards shall preferably be of cable.

s) It should be possible to carryout maintenance on a feeder with adjacent feeders alive.

1.13.26.4.2 Bus and Bus taps

The main buses and connections shall be of high conductivity Aluminum alloy sized for specified current ratings with temperature rise limited [to 45ºC over ambient temperature of 45ºC].

Silver plating shall be done on copper bar wherever copper to copper and copper to aluminum contacts are envisaged. All connection hardware shall be non-magnetic and shall have high corrosion resistance. Adequate contact pressure shall be ensured by means of two bolts connection with plain & spring washers and locknuts.Temperature rise shall not exceed 105 degree for siliver plated joints over an ambient temperature of 45 degree.

Bus bars and connections shall be fully insulated for working voltage with adequate phase / ground clearances. Insulating sleeves for bus bars and shrouds for joints shall be provided.

Bus insulators shall be flame-retardant, track resistant type with high creepage surface. All buses and connections shall be supported and braced to with stand the stresses due to maximum short-circuit current and also to take care of thermal expansion.

Bus bars shall be color coded for easy identification and so located that the sequence R-Y-B shall be from left to right, top to bottom or front to rear, when viewed from the front to switchgear assembly.

Power shall be distributed to each module or compartment by a set of vertical bus bars. The vertical bus bars shall run behind the modules. Necessary tee off connectors shall be used for distributing auxiliary supply to each vertical panel. Rubber grommets shall be used for all wire entries to make the entries dust and vermin proof.

The clearance between the individual bare phase power bus bars and between the phase and earth bus bars in air shall be not less than 25.4 mm.

Three phase, neutral (with at least [50] % rating of main Bus bar) and continuous earth bus shall be provided. Bus bar and tapping shall be provided with color coded PVC sleeves.

1.13.26.4.3 Air Circuit Breaker

All Circuit Breakers for incoming feeders and Bus couplers shall be four poles; single throw, motor operated and air break type. Circuit breaker for outgoing feeders shall be triple pole, single throw and air break type.

However for supply feeders it shall be four pole.

Circuit Breakers shall be draw out type having Service, Test & Disconnected positions with positive indication for each position.

Circuit breakers of identical rating shall be physically and electrically interchangeable.

Bolted disconnected links shall be provided for all outgoing feeders for isolation of neutral, if necessary.

For motor wound mechanism, spring charging shall take place automatically after each breaker closing operation. One open – close – open operation of the circuit breaker shall be possible after failure of power supply to the motor when the spring is charged after a closing operation.

Mechanical safety interlock shall be provided to prevent the circuit breaker from being racked in or out of the service position when the breaker is closed.

Automatic safety shutters shall be provided to fully cover the female primary disconnects when the breaker is withdrawn.

Each breaker shall be provided with an emergency manual trip, mechanical ON-OFF indicator, an operational counter and mechanism to indicate spring charge / discharge condition.

In addition to the auxiliary contacts required for normal breaker operation and indication, each breaker shall be provided with followings for interlocking purpose:-

- Position / cell switch with 4 No + 4 NC contacts.
- Limit / auxiliary switches shall be convertible type that is facility for changing N.O. contact to N.C. and vice-versa.
- Mechanical stopper to prevent accidental falling while withdrawing.

Breaker cannot be racked in from 'isolated' to 'test' position with the door open together with provision for defeat of this interlocking, however, the door can be closed only when the breaker is brought back to 'isolated' position. Insertion of breaker into 'Service' position not possible if the shutters are not free.

Door can be opened only when breaker is OFF and is in 'Isolated' position. Remote closing of breaker not permitted with door open.

Anti pumping relay / device to ensure that there can be only one closing operation for each closing command.

Suitable trolley arrangement shall be provided for breaker/starter modules. Two trolleys per switchgear room shall be provided so that top most breaker module of all types, sizes and rating can be withdrawn on trolley and lowered for maintenance purpose.

Closing and tripping coil shall operate satisfactorily under the following conditions.

- Closing Coil: 85% to 110% of rated voltage.
- Tripping Coil : 70% to 110% of rated voltage.

1.13.26.4.4 APFC PANEL

a) APFC Panel of 100 KVAR is required for power factor correction. Configuration of APFC panel shall be (1x50 kVAR+1x25kVAR+2x10kVAR+1x5kVAR).

b) Power capacitor and control panel shall be housed in metal enclosed cubicle. Power capacitor shall be housed in the lower compartment and capacitor control panel at top compartment.
c) The control equipment including capacitors shall be mounted in a panel of cold rolled sheet steel. The panel shall be of indoor type.
d) Bus bars shall be of aluminium conductor and high conductivity.
e) Isolating switch
f) Contactor with overload element
g) APFC Relays responsive to current/voltage/KVAR/PF as specified for automatic switching shall be of microprocessor based suitable for state board Electricity with reduced power factor.
h) Sequencing devices, timers and auxiliary relays for automatic sequential switching of the capacitors in and out of the circuit.
i) Auto-manual selector switches
j) Push button for opening and closing the power circuit.
k) Red and green cluster LED lights for capacitors ON/OFF indication
l) Protective numerical relays to protect the healthy capacitor units when one unit fails in a series connection
m) Space heater and cubicle lighting as per the requirements.

1.13.26.4.5 Contactors, MCCB and MPCB

a) Incomers for MCCs and DBs rated below 630A shall be MCCB.
b) Incomer and bus coupler rated below 630A shall be mechanically Interlocked.
c) Motor starter contactors shall be of air break, electromagnetic type. Suitable for DOL, Star-Delta, Soft, VFD starting of motor, and shall be of utilization category AC-3 for ordinary and AC-4 for reversing starters. DC contactor shall be of DC-3 utilization category.
d) The contactors shall be three pole, air break type designed for duty class III category A.C. –3 with non-bouncing silver / silver alloy.
e) Each contactor shall be provided with two (2) normally open and two (2) normally closed auxiliary contacts unless otherwise specifically stated. Rating shall be decided by the bidder.
f) Reversing contacts shall be electrically and mechanically interlocked.
g) Contactors with delayed dropout feature shall be provided for some essential auxiliaries. These contactors shall not dropout on power failure if the voltage is restored within 3 seconds.

1.13.26.4.6 Electronic over load relays

a) Electronic overload relays shall conform to IEC:292-1 and shall be triple pole, ambient temperature compensated with adjustable setting, inverse time lag, built in single phase preventer and hand/auto reset type provided as per requirement along with necessary command, feedback cable, coupling relays etc.
b) Provided with 1 NO and 1NC contact of rating same as the auxiliary contact of the contactors.
c) The relay shall be able to withstand prospective short circuit current without damage or injurious heating till the motor protection MCCB/MPCB clears the fault.
d) Relays may be direct acting or CT operated, depending on current rating. CTs shall be included in the scope of supply.

1.13.26.4.7 Bus Transfer scheme:

Each switchgear of two incomer and bus coupler shall be provided with the following provisions.

i) Dead bus closing.

ii) Manual live change over (Momentary paralleling)

iii) Automatic bus transfer scheme.

1.13.26.4.8 Current Transformer

Current Transformers shall be cast-resin type. All secondary connections shall be brought out to terminal blocks where wye or delta connection shall be made.

CTs shall have polarity makings indelibly marked on each transformer at the lead terminations and at the associated terminal block. Facility shall be provided for short circuiting and grounding the CT secondary at the terminal blocks. Secondary terminals shall be provided with protective cap.

CT terminal block shall be disconnecting type and suitable for round type lugs with facility for testing and short circuiting of individual CT.

All CTs shall be provided with supports independent of busbars / busbar supports. The CTs shall be located in such a way that they can be easily approached for maintenance without necessitating shutdown of adjacent feeders.

CTs shall be provided with disconnected type test links in both secondary leads for carrying out current and phase angle measurement.

1.13.26.4.9 Voltage Transformer

Voltage transformers(VT) shall be cast-resin type with an accuracy class of 1.0 for metering and 3P for protetction.

VTs shall be of the single-phase type. VTs shall be protected on their primary side by MCCBs with interrupting ratings corresponding to breaker rating and by MCB (with auxiliary contacts) on the secondary sides.

VTs shall have continuous over voltage factor of 1.2 and short time over voltage factor of 1.5 for 30 seconds for effectively earthed system

It shall be possible to replace VTs without having to de-energise the main busbars.

VTs shall be provided with disconnected type test links in both secondary leads for carrying out current and phase angle measurement.

1.13.26.4.10 Transducer

For all the incoming and the outgoing of 415V Switchgear / MCC/ DB Feeders requiring remote metering and/or current monitoring shall be provided with multi-functional transducers. The output shall be 4-20 mA DC which shall correspond to the normal range.

1.13.26.4.11 Secondary Wiring

The switchgear shall be fully wired at the factory to ensure proper functioning of control, protection and interlocking schemes.

Fuse /MCB and links shall be provided to permit individual circuit isolation from bus wires without disturbing other circuits. All spare contacts of relays, switches and other devices shall be wired up to terminal blocks.

Secondary wiring within the switchgear shall be carried out in a neat and systematic manner and securely held in position (either loomed or run in conduit / trunking). Wherever wiring passes through compartment, it shall be run in conduit / trunking, if metallic shall be bonded to the main earth busbar.

Wiring shall be done with flexible, 1.1/0.650kV grade, PVC insulated switchboard wires with stranded copper conductors of 2.5 mm2 for CT & PT circuits and 1.5mm2 for control circuit wiring.

Each wire shall be identified, at both ends, with permanent markers bearing wire numbers as per bidder's wiring diagrams. Wire terminations shall be made with crimping type connectors with insulating sleeves, wire shall not be spliced between terminals.

1.13.26.4.12 Terminal Blocks

Terminal blocks shall be 660V grade box-clamp type with marking strips, similar to 10 mm2 or equal. Terminals for C.T. secondary leads shall have provision for shorting.

Not more than two wires shall be connected to any terminal. If more than two wires at one terminal are required, separate terminals with function wise shorting links shall be provided. Spare terminal equal in number to 20% of active terminals shall be furnished.

Terminal blocks shall be located to allow easy access. Wiring shall be so arranged so that individual wires of an external cable can be connected to consecutive terminals.

1.13.26.4.13 Ground bus

A ground bus, rated to carry maximum fault current, shall extend full length of the switchgear. The ground bus shall be provided with two-bolt drilling with G.I. bolts and nuts at each end to for connection to the grounding conductor / flat.

Each unit shall be connected directly to the ground bus. The frame of each circuit breaker and V.T. unit shall be grounded through heavy multiple contacts at all times except when the primary disconnecting devices are separated by a safe distance.

C.T. & V.T. secondary neutrals shall be earthed through removable links so that earth of one circuit may be removed without disturbing others. All hinged doors shall be earthed by flexible copper bride.

1.13.26.4.14 Space Heater

Each vertical section shall be provided with thermostat controlled space heater 5A, 3 pin socket plug.

In addition, motor feeders rated 30 KW and above shall be wired up for feeding the motor space heater through suitably rated breaker auxiliary NC contact and/or contactor.

Cubicle heater, Motor heater, and Plug socket circuit shall have individual switch fuse units/MCB.

1.13.26.4.15 AC Distribution Boards (ACDBs)

AC Distribution Boards shall have MCCB/MCB at incomer depending upon the short circuit rating. Distribution Boards may be fed from switchgear and shall have two incomers. AC distribution Boards shall be of two types - one with 415V, 4-wire, triple pole and neutral (TPN) outgoing feeders and the other with 240V, 2-wire, single pole and neutral (SPN) outgoing feeders.

For small loads, MCB boards with TPN MCB as incomer and TPN/SP MCBs for outgoing may be considered. The feeder rating and quantity shall be as per requirement.

Board shall be single front, metal clad, front matched, dust and vermin proof, fixed type, compartmentalized and extensible on both sides.

Bus bars shall have same cross section throughout the length. Rating of the neutral bus bar shall be 50% of the main bus bar. Earth bus bar shall run in bottom chamber throughout the length of the Board.

Switches/MCBs/RCBOs shall be hand operated, air break, quick make, quick break type conforming to applicable standards.

The feeders shall be protected for short circuit by fuse and the MCB shall be provided with overload/short circuit protective device for protection under overload and short circuit conditions.

Switch shall have provision for locking in both fully open and closed positions.

MCBs/RCBOs shall be provided with locking facility.

Receptacle units shall consist of socket outlet with associated switch, neon indicating lamp and plug. The socket outlet and switch or MCB shall be flush mounted within a stove enameled / galvanised 1.2 mm thick CRCA sheet steel enclosure with Perspex /insulating cover. The box may be recessed into or mounted on a wall as per requirements of project layouts.

The outdoor type receptacles shall be housed in a 2 mm thick CRCA sheet steel epoxy painted enclosure with gasketed, hinged door having locking arrangement. The enclosure shall be with rain canopy and removable gland plate entry from bottom. Composite receptacle with switch modules housed in a box shall be with degree of protection IP 65.

Single phase receptacles shall be associated with a switch/MCB of same current rating and the receptacle shall become live only when the associated switch/MCB is in “ON” position.

Three phase receptacles shall be associated with a TPN switch housed in the same enclosure. The receptacle shall become live only when the associated switch is in “ON” position and it shall not be possible to withdraw the plug with the switch in “ON” position.

The plugs shall be provided with cord grips to prevent strain and damage to conductors/wires at connection and entry points.

Junction boxes with terminals shall be supplied for branching and terminating lighting cables when required for outdoor areas, 3 phase receptacles etc.

The junction boxes shall be dust and vermin proof and shall be fabricated from 1.2 mm to 2 mm CRCA sheet steel depending on the size of the junction box and shall be complete with removable cover plate with gaskets, two earthing terminals each with nut, bolt and washer. Boxes shall be additionally weather proof when specified.

The boxes shall have provision for wall, column, pole or structure mounting and shall be provided with cable/conduit entry knock outs, terminal blocks, HRC fuses, as indicated in the Project drawing.

The terminal blocks, with specified number of terminals, shall be mounted securely on brackets welded to the back sheet of the box. The terminals shall be 650 V grade, one piece construction complete with terminals, insulation barriers, galvanised nuts, bolts and washers and provided with identification strips of PVC. The terminals shall be made of copper alloy and shall be of box clamp type.

The boxes shall be hot dip galvanized /painted with one shop coat of red oxide zinc chromate primer followed by a finishing coat of paint as specified.

1.13.26.4.16 DC Distribution Boards

DCDBs shall have two incomers and a bus coupler. Incomers and outgoing feeders of DCDBs shall be MCB/MCCB modules. They shall be fixed type and floor mounted. Other constructional features shall be similar to ACDB.

The feeder rating and quantity shall be as per requirement.

1.13.26.4.17 Control & Indication

The circuit breaker shall be wired up for local & remote operation. Each breaker cubicle shall be equipped with following:

Remote selector switch with pistol grip handle and key interlock for breakers with motor wound spring charging mechanism. In Remote position, the breaker can be operated in service position with all interlock and protections. In switchgear position, the breaker shall be operated from switchgear only in test position with only protection (no interlock).

Two (2) heavy duty, oil-tight, push buttons for Trip & Close.

Circuit breaker shall be indicated electrically. The following indication colour shall be used.

Breaker open	-	GREEN
Breaker closed	-	RED
Spring Charged	-	WHITE
Breaker Auto Trip	-	AMBER

However, any other indication shall be provided as per owner's requirement.

Lamps shall be LED type with resistance for voltage protection. Lamp and lens shall be replaceable from the front.

For all MCCB feeders, trip indication lamp shall be provided on front of the compartment.

For all starters, ON, OFF and trip indication lamps shall be provided on front of the compartment.

1.13.26.4.18 Relays, Protection & Metering

a) The hardware design for protection and associated equipment shall use latest state–of–the-art technology and shall generally be integrated numerical/digital, modular in nature. Where design is based on numerical technology, adequate self testing/monitoring/diagnostic facilities shall be provided.
b) All numerical relays, auxiliary relays and devices shall be of types, proven for the application; satisfying requirements specified elsewhere and shall be subject to Purchaser's approval. Numerical Relays shall have appropriate

setting ranges, accuracy, resetting ratio, transient overreach and other characteristics to provide required sensitivity to the satisfaction of the Owner.

c) All protective relays shall be in draw out or plug-in type / modular cases with proper testing facilities. Necessary test plugs / test handles shall be supplied loose and shall be included in supplier's scope of supply.

d) All AC operated relays shall be suitable for operation at 50 Hz. AC voltage operated relays shall be suitable for 110 Volts VT secondary and current operated relays for 1 amp CT secondary. All relays and timers shall be rated for control supply voltage as mentioned elsewhere under parameters and shall be capable of satisfactory continuous operation between 80-120% of the rated voltage. Voltage operated relays shall have adequate thermal capacity for continuous operation.

e) Energy meters shall be provided for incomer of 415V Switchgear and MCC and shall able to communicate with SCADA. Accuracy class shall not be less than 1.0S.

f) Provision shall be made for easy isolation of trip circuits of each relay for the purpose of testing and maintenance.

g) All protective relays and alarm relays shall be provided with one extra isolated pair of contacts wired to terminals exclusively for future use.

h) The relay shall be designed to perform satisfactorily under highly noisy electrical environment. Sufficient degree of high frequency disturbance immunity and impulse voltage withstand capacity shall be built into electronic designs as stipulated in relevant standards.

i) All protections shall be furnished complete with necessary auxiliary, supervisory, lock out relays. Suitably separate sets of single phase auxiliary C.T with multiple taps shall be provided with relay whenever required.

j) Visual and audible alarm annunciation shall be initiated in the event of operation of protective/supervisory relay.

k) D.C supply shall be supervised by DC supervision relays.

l) Trip circuit shall be supervised by Trip circuit supervision.

m) Tripping shall be done through high speed lock out relays.

n) All meters/ instrument shall be flush mounted on front panel, at least 96mm2 size with 900 linear scales and accuracy class of 2.0.

o) Interposing relays for ON/OFF command or any other command shall be as per system requirement.

p) For alarm and Indication at SCADA end necessary contacts shall be provided at switchgear end.

q) Metering and protection shall be as per below table

a)	Incomers	
	Protections	Metering
i	Time graded short circuit protection	Local Current (single phase) indication and remote indication through transducer.
ii	Over current protection(51)	Voltage Measurement for all three phases and remote indication through transducer.
iii	Earth fault protection(51N)	KW, Kwhr
b)	Bus coupler	
	Protections	Metering
i	Over current protection(51)	Local Current (single phase) indication.
ii	IDMT Earth fault protection(51N)	
c)	Contactor controlled motor feeders [90kW and above motor only]	
	Protections	Metering
i	Time graded short circuit protection	Local Current indication and remote indication through transducer.
ii	Over current protection	
c)	[Motor Feeders [of 132KW and above only)]	
	Protections	Metering

	Composite motor protection to cover a minimum of protections such as over current, short circuit, earth fault, locked rotor, Negative phase sequence, thermal overload etc.	Local Current indication and remote indication through transducer.
[Other feeders]		
a)	Bus PT / Line PT Modules	
	Protections	Metering
	Under voltage protection	[Voltage – phase to phase,]
	Fuse failure protection	
b)	Motor feeders (MPCB/MCCB with Contractors)	
	Protections	Metering
	Electronic Overload relay (with single phase preventor), short circuit protection (through fuse/MCCB/MPCB as specified)	
c)	Incoming feeders for ACDB/DCDB	
	Protections	Metering
	Overload and Short circuit protection (if MCCB)	[Voltage (single phase and, Phase Current (1 Phase)] Local indication only.
d)	Outgoing feeders of ACDB/DCDB	
	Protections	Metering
	Short circuit protection (through fuse/MCCB)	

1.13.26.5 Tests

1.13.26.5.1 Type Test

For each type & rating of 415V Switchgear, the Bidder shall submit for Owner's approval the reports of all the type tests as per relevant standards and carried out

within last five years from the date of bid opening. These reports should be for the tests conducted on the switchgear similar to those proposed to be supplied under this contract and the test(s) should have been conducted at an independent laboratory.

In case the Bidder is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Bidder shall conduct all such tests under this contract free of cost to the Owner and submit the reports for approval.

1.13.26.5.2 Routine Test

All equipment shall be completely assembled, wired, adjusted and routine tested as per relevant IS / IEC Standards at manufacturer's works in the presence of consultant /purchaser or his representative.

The minimum tests shall be conducted are as follows:

a) Measurement of insulation resistance of Circuit Breaker in closed and open positions.
b) Measurement of milli-volt drop across Circuit Breaker main contacts and other joints.
c) Measurement of Circuit Breaker/Contactor operating time for close & open at nominal voltage and 80% of rated voltage.
d) Measurement of resistance, IR value and drop-off/pick-up voltage of close and trip coils.
e) Healthiness of limit switch contacts.
f) Spring charging motor functional checks.
g) Verification of phase sequence and checking of clearances of busbars between phase to phase and phase to earth.
h) Measurement of milli-volt drop across busbar joints
i) Torque tightness test.
j) High voltage test on busbar.
k) Measurement of CT/PT polarity, ratio and knee point voltage.
l) Electrical and mechanical interlock checks.
m) Secondary injection of all protection relays by using service settings and simulation of all protection functions.
n) Secondary injection of all metering circuits.
o) Functional tests to demonstrate the specified control and interlocks

1.13.26.5.3 Test Witness

[The tests shall be carried out in presence of the Owner's representative, for which a minimum 7 days' notice shall be given by the Bidder. The Bidder shall obtain the Owner's approval for the type test procedure before conducting the type test. The test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.]

1.13.26.5.4 Test Certificates:

Certified copies of all tests carried out at works and at site shall be furnished in requisite no. of copies for approval of the Owner. The equipment shall be dispatched from works only after receipt of Owner's written approval of shop test reports.

1.13.26.6 Drawing & Documents

a) Drawings, data & manuals for the motors shall be submitted as indicated below
b) [General Arrangement drawings and cross-section showing constructional features & cable entry with bottom view with opening.
c) Bill of Materials.
d) Technical Data sheet and Catalogue.
e) Foundation drawing details with bottom view of switchgear.
f) Descriptive write-ups and literature for the main equipment offered including relays, meters, etc.
g) Control Schematics & Wiring diagram.
h) Inspection and Test Plan (ITP).
i) Suggestive list of protective relays.
j) Transport/shipping dimensions and weights].

1.13.26.7 Ratings & Requirements

415V switchgears, MCC and DB shall comply with the particulars indicated in the following tables.

Table- 2.0

S. No.	DESCRIPTION	UNIT	DATA
1.0	General		
1.1	Name of Manufacturer		

S. No.	DESCRIPTION	UNIT	DATA
1.2	Place & Country of manufacture		
1.3	Specifications and Standards		
2.0	Switchgear Details		
2.1	Rated voltage, phases & frequency		415 Volts, 3 Phase, 4 wire 50 Hz.
2.2	System neutral earthing		Solidly earthed
2.3	Voltage & frequency variation	%	+/-10%, -5%to +3% Hz.
2.4	Rated frequency	Hz	50Hz
2.4	One minute power frequency Voltage For power Circuits For Control Circuits		2.5kV 1.5kV
2.5	Continuous current rating of busbars under site reference ambient temp.		As Required
2.6	Reference ambient temperature		45°C
2.7	Maximum temperature of bus bars and droppers/connectors under site conditions specified		900C for busbars having non-silver plated joints 1050C for busbars having silver plated joints
2.8	Short circuit current withstand for busbars and droppers		
a	Short time	kA (rms)	50 for LT Panel, 20 for LDB
b	Dynamic Rating	kA (peak)	105

S. No.	DESCRIPTION	UNIT	DATA
2.9	Whether busbars have been insulated	Yes	Required
2.10	Type of insulation		[By Bidder]
2.11	Material of bus bar supports		[By Bidder]
2.12	Switchgear designation		
2.13	Bus bar material		Al
2.14	Fully draw out (FD)/ Fixed (F)		FD for Switchgear/MCC; F for DBs.
2.15	Entry –Top (T)/Bottom (B)		bottom for cables
2.16	Degree of protection		IP 52
2.17	Colour finish shade	Interior Exterior	RAL 7032 (Siemens Gray)
2.18	Earthing bus	Material	GS
2.19	Minimum clearances in air of live parts	mm	As per standard
3.0	Starters		
3.1	Type	DOL	DOL
3.2	Contactor rated duty		AC3 for DOL
3.3	Single phasing preventer required.	Yes / no	Yes
3.4	Thermal overload relay reset	Manual / Auto	Settable for either to Manual or Auto
4.0	Circuit breakers		
4.1	Maker's name		[By bidder]
4.2	Voltage, frequency & no.of phases , poles		415 V, 50 Hz, 3 Ph, 4 Pole
4.3	Rated operating duty		O-0.3sec-CO- 3min –CO

S. No.	DESCRIPTION	UNIT	DATA
4.4	Circuit breakers type		ACB
4.5	Short circuit withstand current for 1 sec. Duration	kA	50
4.6	Rated making current	kAp	105
4.7	Rated current at site reference ambient temp	A 0C	[By bidder]
4.8	Type of operating mechanism		Spring charged motor and manual
4.9	Minimum no. of auxiliary Contacts for purchaser's use		6 NO, 6 NC
4.10	Control voltage		
a	For Spring charging motor	V AC/DC	230V AC
b	For closing/tripping	V AC/DC	110V DC
4.11	Limits of voltage for satisfactory operation of the following devices as a % of normal voltage		
a	Operating mechanism	%	As per IS
b	Closing at normal voltage	%	As per IS
c	Trip coil	%	As per IS
4.12	Power required for closing at normal voltage	W	[By bidder]
4.13	Power required for tripping at normal voltage	W	[By bidder]
4.14	Spring charging motor details:		
a	Rating	kW	[By bidder]

S. No.	DESCRIPTION	UNIT	DATA
b	Rated voltage	V, AC/DC	[By bidder]
c	Spring charging	Sec.	[By bidder]
	Electrical and mechanical anti-pumping features been provided	Yes/No	Required
5.0	MCCBs/MPCBs		
5.1	Voltage, frequency, no. of phases & poles		415 V, 50 Hz, 3phase & 3 P for outgoing, 4P for incoming and supply feeders
5.2	Rated operating duty		As per IS
5.3	Rated breaking capacity	kA (rms)	50
5.4	Rated making current	kA (Peak)	105
5.5	On/off operation		
5.6	Manual	Yes/No	Yes
5.7	Over-load inverse time, short circuit and earth fault	Yes/No	Yes
5.8	Auxiliary contacts required	Yes/No	Yes
6.0	MCBs		
6.1	Voltage, frequency, no. of phases & poles		240 / 415 V, 50 Hz 3Phase & 4 Pole
6.2	Rated operating duty		
6.3	Rated breaking capacity	kA (rms)	10 at 415V AC

S. No.	DESCRIPTION	UNIT	DATA
6.4	Rated making current	kA (Peak)	17 at 415V AC
6.5	On/off operation		
6.6	Manual	Yes/No	Yes
6.7	Over-load inverse time, Over Current, short circuit and earth fault		Over Current and Short Circuit only
6.8	Auxiliary contacts required	Yes/No	No
7.0	Contactors		
7.1	Make		[By Bidder]
7.2	Rated duty	AC3/AC 4	AC3 for DOL
7.3	No of poles		3
7.4	Utilization category		[By Bidder]
7.5	Rated voltage of auxiliary contacts	V	[By Bidder]
7.6	Rated voltage of coil	V	[By Bidder]
7.7	Rated breaking capacity	Factor of rated current	[By Bidder]
7.8	Rated making capacity	Factor of rated current	[By Bidder]
7.9	Limits of operation		As per IS/IEC
a	Supply voltage variation		[By Bidder]
b	Supply frequency variation for closing		[By Bidder]
c	Drop out voltage		[By Bidder]

S. No.	DESCRIPTION	UNIT	DATA
7.10	No of auxiliary contacts:		
a	Normally open		
b	Normally closed		
8.0	Instrumentation transformers		
8.1	Voltage Ratio		[415/sqrt(3)/110/sqrt(3)]
8.2	CT Ratio		Primary current/1A
8.3	Measuring CTs		Cl - 1.0 instrument safety factor 5.0
8.4	Protection CTs		Cl 5P20
8.5	Measuring VTs		(min)/phase Cl1.0
8.6	Protection VTs		Cl 3P
9.0	Control transformers		
9.1	Make		[By Bidder]
9.2	Type		Dry Type
9.3	Applicable standards		As specified in the specification
9.4	Ratio		[415/sqrt(3)/110/sqrt(3)]
9.5	Class of insulation		Class-B or Better
9.6	Rated output	VA	50
10.0	Fuse (if applicable)		
a	Type		
b	Voltage rating		
11.0	Instantaneous over current relay		
11.1	Application (phase fault or earth fault)		[By Bidder]
11.2	Make		[By Bidder]

S. No.	DESCRIPTION	UNIT	DATA
11.3	Type designation		[By Bidder]
11.4	Setting range		[By Bidder]
12.0	Inverse time and thermal overcurrent relay		
12.1	Application		[By Bidder]
12.2	Make		[By Bidder]
12.3	Type		[By Bidder]
12.4	Current setting range		[By Bidder]
12.5	Time setting range at 10 times the current setting	Sec	[By Bidder]
13.0	Under voltage relay		
13.1	Make		[By Bidder]
13.2	Type		[By Bidder]
13.3	Voltage rating	V	[By Bidder]
13.4	Setting range	V	[By Bidder]
14.0	Auxiliary relays and timers		
14.1	Make		[By Bidder]
14.2	Type		[By Bidder]
14.3	Coil voltage	V	[By Bidder]
15.0	Control/selector switch		
15.1	Make		[By Bidder]
15.2	Type designation		[By Bidder]
16.0	Meters		
16.1	Applicable Standards		As specified in the specification.

S. No.	DESCRIPTION	UNIT	DATA
16.2	Accuracy Class		Class 1.0 or Better
16.3	Make		[By Bidder]
16.4	Type		Multi function with RS 485 connectivity
17.0	Voltmeter		
17.1	Make		*[By Bidder]
17.2	Type		Moving coil
17.3	Applicable standards		As specified in the specification.
17.4	Accuracy class		Class 1.0
18.0	Ammeter		
18.1	Make		As specified in the specification.
18.2	Type		Moving coil
18.3	Applicable standards		As specified in the specification.
18.4	Accuracy class		Class 1.0
19.0	Indicating lamps		
19.1	Make		As specified in the specification.
19.2	Type		Clustered Led
19.3	Voltage	V	As specified in the specification.

S. No.	DESCRIPTION	UNIT	DATA
19.4	Wattage of lamp	W	As specified in the specification.
20.0	Push buttons		
20.1	Make		As specified in the specification.
20.2	Type designation		As specified in the specification.
20.3	Contact rating	A	As specified in the specification.
21.0	Space heater		
21.1	Make		As specified in the specification.
21.2	Type		As specified in the specification.
21.3	Rated voltage	V	As specified in the specification.
22.0	Wiring and terminal blocks		
22.1	Voltage grade		1.1 kV
22.2	Insulation		[By Bidder]
22.3	Minimum size of conductor for:		
A	Power wiring	Sq.mm	2.5 for CT & PT 1.5 for Others
B	Control wiring	Sq.mm	1.5 for Others
22.4	Type of terminal blocks:		
	I) For Withdrawable Type		Sliding type

S. No.	DESCRIPTION	UNIT	DATA
	II) For Fixed Type		Stud & nut type
22.5	Minimum current rating of terminal blocks	A	10

1.13.27 ..... LV TRANSFORMER (DRY TYPE/OIL TYPE)

1.13.27.1 General

This specification is intended to cover [design, Engineering, manufacture, assembly, testing at manufacturer's works, supply in properly packed condition for transport to site, Erection, site testing and commissioning] of LV Transformers (Dry type/Oil type)

The system shall be complete in all respect including all accessories required for efficient and trouble-free operation of Atal Puram Township, Agra

1.13.27.2 Codes and Standards

All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) / IEC as given below except where modified and/or supplemented by this specification.

CODE	NAME OF STANDARD
IS:334	Dimensions for porcelain Transformer bushing
IS:335	New insulating oil for transformers and switchgears
IS:1271	Classification of insulating materials for Electrical Machinery and apparatus in relation to their stability in service.
IS 2026	Specification for power Transformer (all parts)
IS:2071	Method of high voltage testing
IS:2099	High voltage porcelain bushings
IS:2147	Degree of protection.
IS:2705	Current transformers

IS:3202	Code of practice for Climate proofing of electrical equipment
IS:3637	Gas operated relays
IS:3639	Fittings and accessories for power Transformers
IS:5561	Electric Power connectors
IS:6600	Guide for loading of oil immersed transformers
IS: 11171	Dry type transformers
IS:10028	Code of practice for selection, Installation and maintenance of transformers Part I, II and III
CBIP	Manual on transformers
IEC60076	Power Transformer
IEC 60214	Tappings
IEC 60726	Dry-type power transformers
IEEE C57.12.01	General Requirements for Dry-Type Distribution and Power Transformers Including Those with Solid Cast and / or Resin-Encapsulated Windings
ANSI C57.12.51	Requirements for Ventilated Dry-Type Power Transformers, 501 KVA and Larger, Three-Phase with High-Voltage 601 to 34 500 Volts, Low Voltage 208Y/120 to 4160 Volts
ANSI C57.12.55	Dry-Type Transformers in Unit Installations, Including Unit Substations –Conformance Standard
ANSI/IEEE C57.98	Impulse Tests, Guide for Transformer (Appendix to ANSI/IEEE C57.12.90)
ANSI/NFPA 70	National Electrical Code
IEEE C57.12.91	Test Code for Dry-Type Distribution and Power Transformers

IEEE C57.94	Recommended Practice for Installation, Application, Operation and Maintenance of Dry-Type General Purpose Distribution and Power Transformers
IEEE C57.96	Guide for Loading Dry-Type Distribution and Power Transformers
NEMA ST 20	Dry Type Transformers for General Applications
CEA	CEA Regulations

Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

The electrical installation shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

1.13.27.3 Design Criteria

a) The transformers shall be dry type (AN) for indoor location and shall be oil type (ONAN) for outdoor location.
b) The oil type transformer shall be installed in hot, humid and tropical atmosphere with ambient temperature equal to 45oC. All equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.
c) The transformer shall be capable of continuous operation at specified rating under the following condition:
   - Voltage variation - ±10%
   - Frequency variation - [+3% ,-5%]
   - Combined voltage and
   - frequency variation (absolute sum) - [10%]
d) The transformer shall be capable of withstanding the short circuit stresses due to a terminal fault on one winding with full voltage maintained on the other winding for minimum period of two (2) seconds.
e) The noise level shall be limited to the value specified by NEMA Standard Publication No. TR-1-1993 when measured in accordance with conditions outlines in ANSI/IEEE C57.12.90-1999/IS13964/CBIP publication.

f) The design shall be such as not to cause any undesirable interference with radio or communication circuits.

g) Transformers shall accept without injurious heating, combined voltage and frequency variation which produce an over fluxing condition of 120% for one (1) minute.

h) Each transformer shall be sized based on actual load with 10% margin and considering voltage regulation factor. It shall be sized by considering 100% load connected on the bus considering other transformer outage. An appropriate load factor of 0.9 for continuous and 0.2 for intermittent shall be considered.

i) The impedance of the transformers shall be chosen such that the fault level on the LV switchgear does not exceed 50kA including the motor contributions and also voltage dip while starting the motor does not exceed 15% at motor terminal.

1.13.27.4 Specific Requirements of Transformers

1.13.27.4.1 Enclosure (for dry type)

a) The encapsulated cast resin transformer shall be housed in naturally ventilated floor mounted cold rolled sheet steel cubicle with louvers backed by fine brass wire mesh. The enclosure shall be of bolted type fabrication and degree of protection shall be at least IP32. The minimum sheet steel thickness shall be 2 mm.

b) Enclosure shall be provided with lifting lugs and grounding terminals at both ends. Further, the enclosure door shall have pad locking provision.

c) The enclosure door shall be interlocked with service transformer incoming breaker such that.

- The door can be opened only when the service transformer HV side circuit breaker is in Test/Isolated position.
- 11 kV side circuit breaker can be closed only when the doors are closed.

d) Necessary illumination with controls shall be provided in the enclosure.

e) Thermostatically controlled space heater inside the enclosure of suitable rating shall be provided, if necessary.

1.13.27.4.2 Tank (for oil type)

For LV transformers, the tank shall be of conventional type.

Tank shall be made from good commercial grade low carbon steel and shall be of welded construction.

Tank shall be designed to permit lifting, by crane or jacks of the complete transformer assembly filled with oil. Suitable lugs and bosses shall be provided for this purpose.

Tank together with radiators, coolers, conservator, bushings vessel and other fittings, shall be designed to withstand full vacuum without permanent distortion.

The transformer top shall be provided with a detachable tank cover with a bolted flanged gasket joint. Lifting lugs shall be provided for removing the cover. The surface of the cover shall be suitably sloped so that it does not retain rain water.

The material used for gaskets shall be cork-neoprene or approved equivalent. Gasketed joints for tank and manhole covers, bushings and other bolted attachments shall be so designed that the gasket will not be exposed to the weather. Spare gaskets shall be provided for all openings as shipping gaskets will not be reused.

Tank shall be provided with all necessary valves.

Tank shall be provided with a pressure release device which shall operate at a pressure below the test pressure for the tank and radiators. This device shall be of sufficient size for rapid release of any pressure that may be generated in the tank and which may result in damage to the equipment. The device shall be rain proof after blowing and shall be provided with a device visible from ground to indicate operation. An equaliser pipe connecting the pressure relief device to the conservator shall be supplied. This device shall be provided for all transformers. Pressure relief device shall be equipped with remote monitoring/alarm contacts

1.13.27.4.3 Core

The transformers shall be three phase core type. The core shall be built up with high grade, non-ageing, low loss, high permeability grain oriented cold rolled silicon steel laminations especially suitable for core material. Laminations shall be annealed in a non-oxidizing atmosphere to relieve stresses and restore the original magnetic properties of CRGO sheets after the cutting and punching operations.

CRGO sheets shall be coated with insulation varnish. Insulation shall be able to withstand the curing temperature and shall reduce eddy current to minimum. The core shall be protected from corrosion with a rust-resistant coating.

The core clamping brackets shall be designed to provide an even distribution of clamping forces to the core, yokes and legs and shall be rigidly braced to reduce sound levels and losses.

1.13.27.4.4 Winding

The coils shall be manufactured from electrolytic copper conductor with sufficient number of radial supports and fully insulated for rated voltage.

Insulating material shall be of proven design, Coils shall be so insulated that impulse and power frequency voltage stresses are minimum. The insulating material for dry type transformers shall be glass fibre reinforced conforming to class `F'. Coils shall be so insulated that impulse and power frequency voltage stresses are minimum and are suitable to withstand even the severest of temperature fluctuation.

Coil assembly shall be suitably supported between adjacent sections by insulating spacers and barriers. The windings shall be arranged to ensure a free circulation of the air and to reduce the hot spots in the winding.

All leads from the windings to the terminal board and bushings shall be rigidly supported to prevent injury from vibration or short circuit stresses. Guide tube shall be used where practicable.

The core and coil assembly shall be securely fixed in position so that no shifting or deformation occurs during movement of transformer, under short circuit stresses, switching or other transients.

All coils rated 1200V or higher shall be subjected to partial discharge tests to ensure a properly cured and void free casting.

1.13.27.4.5 Encapsulation (for dry type)

HV and LV coils shall be separately cast under vacuum in fibre glass reinforced epoxy resin compound. The insulation shall be fire resistant, non-inflammable, non-hygroscopic and resistant to temperature fluctuations.

The epoxy shall contain filler material providing characteristics superior to unfilled epoxy including higher temperature rating, better heat conductivity, better arc resistance and adhesion to the conductor, plus a coefficient of expansion closer to that of the conductor material. The epoxy resin shall be self-extinguishing.

Encapsulated winding shall be free of internal voids, surface irregularities, etc. No surface finishing of encapsulated winding shall be undertaken after the process of encapsulation.

1.13.27.4.6 Insulating Oil (for oil type)

The transformer shall be filled with mineral insulating oil suitably inhibited to prevent sludging.

The quality of oil to be supplied for the transformer shall conform to the parameter specified in IS: 335 with latest amendments. No inhibitors shall be used in oil. Prior to filling oil shall be tested as per IS: 335 for tan delta, specific resistivity, breakdown voltage, moisture content etc.

Transformer shall be dispatched oil filled. 10% excess oil for topping up shall be supplied in non-returnable container suitable for outdoor storage.

Oil preservation shall be by means of conservator tank complete with silica gel breather and oil seal.

Oil preservation shall be by means of bellows/ diaphragm sealed conservator tank with silica gel breather to avoid direct connection between atmosphere and transformer oil. It shall be complete with level gauges, pipes , drain valve etc. The level gauges shall be so placed that same can be readable standing from ground.

Necessary device shall be kept to provide annunciation in the event of rupturing of bellow.

1.13.27.4.7 Tappings (OCTC)

Off-circuit taps as specified shall be provided on the high voltage winding.

The transformer shall be capable of operation at its rated KVA on any tap provided the voltage does not vary by more than ±10% of the rated voltage corresponding to the tap.

The winding including the tapping arrangement shall be designed to maintain electromagnetic balance between HV and LV windings at all voltage ratios.

A warning plate indicating that switch shall be operated only when the transformer is de-energized shall be provided.

Off circuit tap changer switch where provided shall be 3 phase, hand operated, by an external handle with position markings and pad locking facility and mechanical stops to prevent over cranking beyond extreme positions.

Arrangement shall be such that switch can be operated at standing height from ground level.

The operating handle can be padlocked at any tap position. The design shall be such that the lock cannot be inserted unless the contacts are correctly engaged. The mechanism shall be provided with a mechanical tap position indicator with pad locking facility.

1.13.27.4.8 Fittings and Accessories:

a) The following fittings and accessories shall be provided :
   Earthing pads: Two earthing pads of copper or other non-corrodible material shall be welded at the bottom corners of the transformer tank and supplied with clamp type terminals suitable for the purchaser's earthing conductors. Suitable earthing terminals on cable boxes shall also be provided.
b) Terminal marking and rating plates shall be as per the specified standard.
c) In case of oil type, the conservator shall be of sufficient volume to maintain the oil seal from the minimum ambient temperature of – 5oC up to an oil temperature of 100^{o}C, with oil level varying within the minimum and maximum visible levels with necessary accessories.
d) In case of oil filled type, Valves shall be supplied on the transformer tank and radiators.
e) Pressure relief device: Pressure relief device shall be provided for transformers rated 2 MVA and above which shall be of sufficient size for rapid release of any pressure that may be generated within the tank and which may result in damage of the equipment
f) Gas and Oil Actuated Relay (Magnetic Reed Type Gas & Oil Relay):
   A double float type magnetic reed type gas and oil relay as per applicable standard shall be provided for all oil filled transformers. All gas evolved in the transformer shall collect in this relay. The relay shall be provided with a test cock suitable for a flexible pipe connection for checking its operation. The device shall be provided with two electrically independent ungrounded contacts, one for alarm on gas accumulation and the other for tripping on sudden rise of pressure. These contacts shall be wired up to the transformer

marshalling box. The relay shall be provided with shut off valves on the conservator side as well as the tank side.

g) Temperature Indicators

- Oil temperature indicator (OTI)

All oil type transformers shall be provided with a 150 mm dial type thermometer for top oil temperature indication. The thermometer shall have adjustable, electrically independent ungrounded alarm and trip contacts, maximum reading pointer and resetting device. The contacts shall be rated minimum 0.5A making and 0.2A breaking at 110V DC.

Winding Temperature Indicator (WTI):

A device for measuring the hot spot temperature of the winding shall be provided. The accuracy class of winding temperature indicator shall be ± 20oC or better.

- Oil Level Indicator:

A magnetic type oil level indicator shall be provided to indicate oil level in the tank.

- RTD/transducers for remote annunciation:

In addition to the above mentioned indicators, the Oil and winding temperature measurement, RTDs / transducers shall be provided for remote indication in the DCS. RTDs shall be duplex platinum type with nominal resistance of 100 ohms at zero degree centigrade.

h) Bushing Current Transformers for stand by earth fault protection shall be provided in the neutral bushing and lead shall be brought to Marshalling box.

i) Radiator (oil filled type): Tank mounted radiators banks shall have bolted flanged connections and pipe extensions to permit withdrawal of transformer tank without disturbing the radiators. Flexible joints shall be provided in the interconnecting pipes (unless otherwise approved) to facilitate erection and dismantling and reduce transfer of vibrations from tank to radiator. The interconnecting pipes shall be provided with drain plug and air release vents.

j) Conservator (For oil filled type): The transformers rated below 7.5MVA shall be provided with conventional single compartment conservator with dry air filling the space above the oil.

1.13.27.4.9 Bushings

a) The bushing shall conform to the requirements of IS:2099 and IS:3347.
b) All transformer bushings shall be of porcelain (for oil filled)/ epoxy (for dry type).
c) The neutral terminal of 433V winding shall be brought out on a bushing along with the 433V phase terminal to form a 4 wire system for the 433V. Neutral CTs shall be located in the lead coming out of the winding and location of these CTs shall not be inside the tank.
d) The neutral terminal of secondary shall be brought out through an outdoor. Further this neutral terminal shall be connected by a GS of size 50 mm x 6mm, which shall be brought down upto 100 mm above ground. The GS shall be insulated and supported from the tank body.

1.13.27.4.10 Terminal arrangement

Cable boxes

i. Wherever cable connections are specified, suitable cable boxes shall be provided and shall be gas insulated.
ii. Cable boxes shall have drilled gland plate of adequate size to receive cables and to allow easy termination.
iii. Removable drilled gland plates shall be provided in the cable boxes.
iv. The additional supports for the cable boxes shall be galvanised iron.
v. The contractor shall provide earthing terminals on the cable box, to suit 50mmx6 mm GS flat.

Marshalling box

i. A sheet steel weather, vermin and dust proof marshalling box shall be furnished. The sheet steel used shall be at least 2.0 mm (CRCA) thick. The box shall be free standing floor mounted/tank mounted type and have a sloping roof. The degree of protection shall be IP-55 in accordance with IS:2147.
ii. The marshalling box shall have a glazed door of suitable size for convenience of temperature indicators reading.
iii. All incoming cables shall enter the marshalling box from the bottom.

Wiring

i. All control, alarm and indication devices provided with the transformer shall be wired up to the terminal blocks.

ii. Wiring shall be done with 650V PVC wires in conduit or PVC armored cable. Minimum wire size shall be 1.5 sq.mm stranded copper. Not more than two wires shall be connected to a terminal. 20% spare terminals shall be provided.

iii. Multi-way terminal block complete with mounting channel, binding screws and washers for wire connections and marking strip for circuit identification shall be provided for terminating the panel wiring. Terminals shall be stud type, suitable for terminating 2 nos. 2.5 mm2 stranded copper conductor and provided with acrylic insulating cover.

iv. All devices and terminal blocks shall be identified by symbols corresponding to those used in applicable schematic or wiring diagram. Each wire shall be identified, at both ends, with interlocking type permanent markers bearing wire numbers as per Bidder's Wiring Diagrams. AC / DC wiring shall have separate colour-coding.

v. Wire termination shall be made with crimping type connectors with insulating sleeves. Wires shall not be spliced between terminals.

Painting

i. All steel surfaces shall be thoroughly cleaned by sand blasting and / or by chemical agents, as required to produce a smooth surface free of scales, grease and rust.

ii. The external surfaces, after cleaning, shall be given a coat of high quality red oxide or yellow chromate primer followed by filler coats.

iii. The transformer finished with two coats of epoxy based powder coated paint. The paints shall be carefully selected to withstand tropical heat, rain etc. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling.

iv. Painting shade shall be subject to owner’s approval.

v. Sufficient quantity of touch-up paint shall be furnished for application at site.

Name Plate

Nameplates of approved design shall be furnished at each cubicle (one no. each at front as well as at backside of cubicle) and at each instruments & device mounted on or inside the cubicle. The material shall be lamicoid or approved equal, 3 mm thick with white letter on black background. Self-tapping screws shall hold the nameplate. Nameplate size shall be minimum 20 x 75mm for instrument/device and 40 x 150mm

for panels. Caution notice on suitable metal plate shall be affixed at the back of terminal Box.

1.13.27.5 Tests

1.13.27.5.1 Type Tests

For each type & rating of LV Transformers, the Bidder shall submit for Owner's approval the reports of all the type tests as per relevant standards and carried out within last five years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been conducted at an independent laboratory.

In case the Bidder is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Bidder shall conduct all such tests under this contract free of cost to the Owner and submit the reports for approval.

The following shall constitute the type tests:

- Temperature rise test
- Dielectric test

1.13.27.5.2 Routine Tests

All equipment shall be completely assembled, wired, adjusted and routine tested as per relevant IS / IEC Standards at manufacturer's works in the presence of consultant /purchaser or his representative.

The following tests shall be performed on each transformer as a minimum:

- After assembly, each core shall be pressure tested for one minute at 2KV (r.m.s.) A.C. between all bolts, side plates, structural steel works and the core.
- The wiring for auxiliary power and control circuitry shall be subjected to withstand one minute power frequency test with 2.0KV (r.m.s.) to earth
- Measurement of winding resistance
- Measurement of voltage ratio and check of phase displacement
- Measurement of short circuit impedance and load loss
- Measurement of no load loss and current

1.13.27.5.3 Dielectric routine tests

- Excitation loss and current measurements shall be made at 90%, 100% and 110% of the rated voltage as routine test.
- Partial discharge test
- Tan delta test

1.13.27.5.4 Test Witness

[The tests shall be carried out in presence of the Owner's representative, for which a minimum 7 days notice shall be given by the Bidder. The Bidder shall obtain the Owner's approval for the type test procedure before conducting the type test. The test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.]

1.13.27.5.5 Test Certificates

- Certified copies of all tests carried out at works and at site shall be furnished in requisite no. of copies for approval of the Owner.
- The equipment shall be dispatched from works only after receipt of Owner's written approval of shop test reports.

1.13.27.6 Drawings/ Data and Manuals

- Drawings, data, and manuals for the transformers shall be submitted as indicated below:
- [General Arrangement Drawing
- Dimensioned general arrangement drawing showing enclosure, core coil assembly, terminal arrangement, marshalling box and various fittings.
- Transport/shipping dimensions with weights, wheel base detail etc.
- Foundation plan & loading.
- Bus duct/cable termination arrangement.
- Control schematics and wiring diagrams.
- Test reports and QAP
- Any other relevant drawing or data necessary for satisfactory installation, operation and maintenance.

Instruction manuals on Transformer and its various fittings The manual shall clearly indicate method of installation, checkups and tests to be carried out before commissioning of the equipment.]

Note: The drawings, data and manuals listed are minimum requirement only. The Bidder shall ensure that all other necessary write-ups, curves and information required to fully describe the equipment offered are submitted.

1.13.27.7 Ratings and Requirements

11/0.433 kV DRY TYPE TRANSFORMER

		Dry Type	Oil Type
1.	Application	DISTRIBUTION	DISTRIBUTION
2.	Location	Indoor	Outdoor
3.	Type	Dry Type: epoxy cast resin transformer	Oil type transformer
4.	Reference standard	IS 11171	IS 2026
5.	Rated power (indicative)	500 kVA	[As per project requirement]
6.	Rated winding voltage ratio (line to line)	11.0/0.433 kV	11.0/0.433 kV
7.	Number of phases	3	3
8.	Winding	2	2
9.	Rated frequency	50 Hz	50 Hz
10.	Type of cooling	AN	ONAN
11.	Insulation Class	Class F or Better	Class F or Better
12.	Temperature rise Over ambient temperature of 45oC		

11/0.433 kV DRY TYPE TRANSFORMER

		Dry Type	Oil Type
13.	For Winding by resistance method	90oC or lower as permissible for class of insulation offered	60oC
14.	For Oil by Thermometer method	Not Applicable	55 oC
15.	Insulation level (LI/AC)		
16.	HV- (LI/AC)	70 KVp/28 kVrms	70 KVp/28 kVrms
17.	LV- (LI/AC)	KVp/3KVrms	-KVp/3KVrms
18.	Vector group	Dyn11	Dyn11
19.	Short-circuit impedance on principal tap	4 %	[As per project requirement]
20.	Parallel operation of transformer	Momentarily	Momentarily
21.	Type of taps provided	OCTC, full capacity	OCTC, full capacity
22.	Taps provided on	H.V. winding	H.V. winding
23.	Range of taps	+/- 5 % in steps of 2.5%	+/- 5 % in steps of 2.5%
24.	Method of Tap charge control-		
25.	Manual local	Yes	Yes
26.	Electrical local	No	No
27.	Electrical remote	No	No
28.	Automatic	No	No
29.	System earthing		

11/0.433 kV DRY TYPE TRANSFORMER

		Dry Type			Oil Type
30.	H.V.	Non-effectively earthed			Non-effectively earthed
31.	L.V.	Effectively earthed			Effectively earthed
32.	Terminal arrangement				
33.	H.V.	11.0kV(UE) Cable/ Cable			[As per project requirement]
34.	L.V.	Cable			Cable
35.	Neutral for earthing	GS flat connector			GS flat connector
36.	Transformer bushing	HV	LV	LV - N	Same as Dry type transformer
37.	Voltage class KV(r.m.s.)	12	1.1	1.1	
38.	Creepage distance mm	25mm/kV			25mm/kV
39.	Min. Ph-Ph/ Ph-E clearance mm	As per Standard			As per standard
40.	System fault Level				
41.	HV Side	18.3 KA (r.m.s.)			18.3 KA (r.m.s.)
42.	LV Side	50KA (r.m.s.)			50KA (r.m.s.)
43.	Max. Noise level	As per NEMA std. TR-1			As per NEMA std. TR-1
44.	Auxiliary supply	415 V, 3 ph, 3 wire AC, 50 Hz 110V +10%, -15% 2 wire DC(if required)			415 V, 3 ph 3 wire AC, 50 Hz 110V +10%, -15% 2 wire DC(if required)
45.	LV neutral side current transformer for standby earth fault protection	Yes			[As per project requirement]

11/0.433 kV DRY TYPE TRANSFORMER

		Dry Type	Oil Type
46.	Guaranteed no load loss (kW)	[By Bidder]	[By Bidder]
47.	Guaranteed load loss (kW)	[By Bidder]	[By Bidder]
48.	Efficiency		
a	At full load	[By Bidder]	[By Bidder]
b	At 75% load	[By Bidder]	[By Bidder]
c	At 50% load	[By Bidder]	[By Bidder]

1.13.28 ..... Lighting & Small Power System

1.13.28.1 General

This specification is intended to cover the [design, Engineering, manufacture, assembly, testing at manufacturer's works, supply in properly packed condition for transport to site, Erection, site testing and commissioning] of Lighting & Small Power System.

The system shall be complete in all respect including all accessories required for efficient and trouble-free operation of Atal Puram Township, Agra

1.13.28.2 Codes and Standards

All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) / IEC as given below except where modified and/or supplemented by this specification.

Code		Name of Standard
IS 1913	:	Electrical lighting fittings- General and safety requirements
IS 2418 - Part I	:	Tubular fluorescent Lamp
IS 3480	:	Flexible steel conduits for electrical wiring

Code		Name of Standard
IS 3646 (Part I to III)	:	Code of Practice For Interior Illumination
IS 4012	:	Dust proof electric lighting fittings
IS4013	:	Flame proof enclosure
IS 6665	:	Code of practice for industrial lighting
IS 5077	:	Decorative light fittings
IS 9537 - Part II	:	Rigid steel conduits for electrical installations
IS 9583	:	Emergency lighting units
IS 10322	:	Luminaries for street lighting
CBIP Manual	:	Substation Equipment, Illumination and Layouts
IES (Illuminating Engineering Society of North America)	:	Application and Reference Volume
IEC 60598	:	Luminaries
CEA		CEA regulations and standard technical specification.

Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted subject to approval of the Owner. In such case, copies of the English version of the standards adopted shall have to be submitted along with the bid.

The electrical installation shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Codes of Practice. In addition, other rules and regulations applicable to the work shall be followed.

1.13.28.3 Design Criteria

All illumination systems shall be suitable for an ambient temperature of 45 °C and relative humidity of 87%. The illumination systems shall be suitable for operation in a highly polluted environment.

Lighting fixtures shall be suited for the following range of frequency and voltage variations:

Voltage Variation	:	±10%
Frequency Variation	:	50Hz (+)3% to (-)5%
Combined Variation of Voltage & Frequency	:	10% (absolute sum)

The design of the lighting systems shall be such that it shall ensure average lux levels specified for different areas.

The illumination system shall comprise of the following:

- Normal AC lighting
- Normal cum emergency lighting system (Through UPS)

1.13.28.4 Specific Requirements

1.13.28.4.1 Scope of work

The scope of work shall include design, preparation of Lighting design and manufacture, supply, unloading at site, storing, laying, fixing, jointing/termination, erection, testing and commissioning of equipment associated with Lighting system for following areas Listed below but not limited to the following:

- [Note: With reference to particular package, scope of work shall be modified.]
- Substation Building:
- Control room
- Switchgear room
- Battery room
- Admin. Office
- Staff room
- Locker room
- Pantry
- Toilets
- Transformer area
- All roads within substation.
- Perimeter and boundary illumination of the above premises.
- Any other area/premises not specifically mentioned here

1.13.28.4.2 Illumination System Description

The substation illumination system shall comprise of the following categories:

Normal AC lighting

In this system, the lighting circuits shall be fed by the 3 phase, 4 wire normal AC supply from the normal lighting distribution boards (LDB). All the lighting fixtures connected to this system shall be available as long as the 415V station / unit auxiliary service supply is available.

Normal cum emergency lighting system

Certain lighting fixtures considered essential shall be connected to this system. In this system the lighting circuits shall be fed from lighting distribution board connected to 415V Normal cum Emergency DB fed from UPS.

Exit lights

Emergency escape signs shall be provided at the exit doors, escape routes, intersection corridors, at different floor levels/directions, windowless rooms, toilets, firefighting equipment, lifts, control rooms, switchgear rooms and the areas considered necessary by bidder. [8W LED] lamp shall be used for exit lamps.

The contractor shall design emergency exit lighting system based on substation layouts and install escape lights at suitable locations considering the various escape routes. Emergency exit lights will be fed from normal-cum-emergency lighting panel, wherever available, [and will be with in-built battery (Ni-Cd) back up of 2 hours operation.]

1.13.28.4.3 Illumination Calculation

a) Standard Lumen method shall be adopted for interior and exterior lighting in order to determine the number of lighting fixtures for obtaining the desired average level of illumination.
b) The coefficient of utilization shall be considered to take care of Lumen loss due to:

- Effect of room dimensions.
- Absorption of light in luminaries.
- Absorption of light at various room surfaces i.e. ceiling wall etc.
- Floor cavity, ceiling cavity.
- Mounting height.

c) Moreover a maintenance factor shall also be considered to account for the fall of illumination due to aging, pollution like dust deposits etc.

d) Voltage drop at the fixture terminals from the LDB shall [not exceed 3%]. Circuit loading of each lighting Panel shall be done in such a way that almost balanced loading in all the phases i.e. R, Y and B is achieved. At least two sub circuits shall be used for illumination of a particular area. Sub circuit loading of each lighting panel shall be restricted to 2000 Watts.

e) Design of lighting system shall be such that the average lux level as specified is achieved. The Bidder shall submit illumination calculation/layout for the purchaser's review.

1.13.28.4.4 Lighting Distribution System

a) Separate lighting transformers shall be provided inside the lighting distribution boards located at required location. Lighting distribution system shall be distinct and separate from the LV main distribution. Lighting transformers shall be encapsulated cast resin dry type.

b) AC lighting panels shall have 240V single-phase, 2 wire incomer controlled by RCBO (Residual current circuit breaker with over-current protection) and number of single phase outgoing circuits controlled by MCBs. The lights connected to a circuit or few circuits shall be 'ON' automatically through photocell for outdoor lighting. Provision shall be made for switching 'ON' the rest of the lights. Lighting fixtures in indoor areas shall be controlled from the respective lighting panels

c) Normal 240 V AC Lighting System
For this system, lighting points shall be supplied at 240 V AC through 415 V, 3-phase, 4-wire, 50 Hz, LDB. The supply shall be derived from 415 V, 3-phase, 4-wire, 50 Hz switchgear through delta/star lighting transformer. The secondary of lighting transformer shall be connected to respective 415 V, 3-phase, 4-wire AC lighting distribution board (LDB). The LDBs shall be provided with number of outgoing circuits controlled by double pole MCBs to feed the lighting panels distributed in and around the substation. Different circuits shall be used from different source. The whole lighting network shall be balanced as far as possible.

d) Normal/Emergency 240V AC System
For these systems, the distribution shall be by 415V, 3-phase, 4-wire, 50 Hz supply. This supply shall be derived from 415 V, 3-phase, 4-wire, 50 Hz UPS.

1.13.28.4.5 Illumination levels and choice of lighting fixtures

The area-wise distribution of average illumination levels and type of luminaries shall be as indicated below:

[Note: These are indicative only. However as per specific Existing project, Bidder may refer section I of this specification for exact details of type of fixtures.]

Sl. No.	**Area/Structure**	**Average Illumination Level in Lux**	**Type of Fixture**	**Type of Luminaries**
A -	SUBSTATION BUILDING			
1.1	Admin. Office	300	Decorative recessed type LED with adjustable reflector	40 W LED
1.2	Control room	300	Decorative recessed type LED with adjustable reflector	40 W LED
1.3	IT room	300	Decorative recessed type LED with adjustable reflector	40 W LED
1.4	Pantry, Staff Room, Lockers, toilets, wash rooms, Cafeteria, etc.	150	RECESSED TYPE LED	40 W LED
1.5	HVAC room	150	SURFACE MOUNTED LED	40 W LED
1.6	Switchgear room	150	SURFACE MOUNTED LED	40 W LED
1.7	Battery rooms	150	Corrosion-proof SURFACE MOUNTED LED	40 W LED
1.8	Corridors, walkways, , etc.	100	RECESSED TYPE LED	40 W LED
B -	OUTDOOR SUBSTATION AREAS			

1.1	Building periphery lighting	30	Industrial well glass with integral mounted control gear/industrial bulk head with integral mounted control gear/ flood light fittings with timer control	60W LED
1.2	Transformer yard and Switchyard	50 on equipment, 20 general	Street weatherproof fixture with timer control	100 W LED
1.3	Street lighting	15	Street weatherproof fixture with timer control	45 W LED

1.13.28.4.6 Lighting System Design

The lighting system design shall comply with the acceptable norms and the best engineering practices. The system design shall consider principles of lighting specified in following paragraph. The lighting layout shall be designed to provide uniform illumination with minimum glare. The layout design shall meet all the statutory requirement, local rules etc.

a) Indoor Lighting

The recommended values of illumination level for various areas in the substation are indicated in the table above. Lighting layouts shall be designed such that the ratio of minimum to average illumination shall not be less than [0.3]. Following factors shall be considered while arriving at the utilization factor to determine the number of fixtures for each area/buildings in the substation.

- Maintenance Factor:
  - Air conditioned clean interiors like office rooms, Laboratories, Auditoriums : 0.8
- The working plane shall be considered at 0.76 m from the floor level.
- The value of the ratio of spacing (S) to mounting height (H) shall be commensurate with the type of fittings selected and uniformity of illumination. The suspension height for suspended fixtures shall not exceed 1 meter.

b) Outdoor Lighting

- The recommended illumination levels for outdoor areas are indicated in the above table.

- Mounting height, spacing of flood lights shall be based on lamp wattage, uniformity of illumination and vertical angles. Ratio of minimum to average illumination shall not be less than 0.3 and for minimum to maximum shall not be less than 0.05.
- Maintenance factor shall be generally 0.8 under average conditions.
- For road illumination inside the boundary limit lighting poles shall be provided and the distance between the poles shall not exceed 30m.

c) The circuit loading on each circuit shall be restricted to 80% of the MCB rating.

d) The voltage drop from LDB and any fixture shall not exceed 3%.

e) All lighting design calculations, layouts, conduit wiring diagrams, LDBs and LPs drawings and technical data sheets etc. shall be furnished for Owner/ Owner's consultant's approval.

1.13.28.4.7 Lighting system equipment

a) Lighting Distribution Boards (LDB) & Lighting Panels (LP)

- The Lighting Distribution board shall be fed through 415V/415V lighting transformers with off circuit taps ± 5% in steps of 2.5%. The lighting transformer shall be cast resin dry type, vector group of [Dyn11], class F insulation with temperature rise limited to class F and shall be housed in a suitable enclosure. In general, the transformers shall confirm to the specification covered under 'Service transformers. The lighting distribution boards shall consist of RCBO incomer and required number of double pole MCB controlled out going feeders to LPs. The LDB shall be designed for the required short circuit level of [20] kA. All the distribution boards shall be sheet steel clad, dust and vermin proof, cubicle type with degree of protection conforming to IP-52. Outdoor panels shall be weather proof type with IPW-55 protection. The thickness of sheet steel enclosures shall be CRCA, 2 mm minimum for load bearing and 1.6 mm for other members.
- Number of outgoing feeders in each LDB shall be provided as per requirement including the minimum 3 nos. spare feeders for "Purchaser use". Each outgoing MCB in LDB's shall be of 15 A, but load to be limited to 2 kW or maximum 20 nos. fittings to be connected to one MCB
- Individual control in office buildings shall be through single pole flush type switches/MCBs. In those areas where group controls are required, rotary switches shall be provided

- External area lighting shall be fed from separate boards located at suitable places. Automatic switching ON/OFF of these circuits shall be done through timers/photo cell.
- In high bays, walkway shall be provided for maintaining light fittings. At other places suitable ladder / platform / approach shall be provided for maintaining / replacement of light fittings.
- Each of the LDBs shall be provided with voltmeter and ammeter along with selector switches, "SUPPLY ON" indicating lamps, etc. The switch boxes, receptacle boxes etc. shall be made up of 18 SWG sheet steel.

b) Lighting Fixtures and Lamps

- LED Fixtures shall be generally provided for a room height upto 5m. For areas with false ceiling, recessed mounted decorative fixtures with mirror optic louvres shall be used. In control room / computer rooms, decorative mirror optic LED light fittings with antiglare features shall be provided. The surface finish shall be smooth, unobtrusive and scratch resistant.
- Reflector shall be of sheet steel or aluminium, minimum 20 SWG thick and securely fixed by fastening device of captive type.
- Fixture shall be suitable for 20 mm conduit entry and 16 SWG GI earth wire connection.
- Fixture shall be furnished complete with lamps and integrally mounted accessories. These shall include holders, ballast, capacitor, starter, ignitors (separate type) etc.
- For corrosive areas, corrosion proof lighting fixture shall be provided. For hazardous areas, light fittings, conduits, junction boxes etc. shall have to meet the corresponding area classification requirement.
- All type of LEDs shall be bi-pin rotary type and either cool daylight or white.
- Lamps shall be suitable for use in position and capable of withstanding small vibrations.

c) Switches, Receptacles

i. In the substation areas, the lighting circuits shall be controlled directly from the MCBs in the lighting panels. Wherever the lighting panel is not in the same area, separate switches shall be provided. For cabins, rooms, etc., separate switches shall be provided for each point. Similarly for entrances, building periphery lighting separate switches shall be provided

ii. 240V, 50 Hz, 3 pin Power Receptacles (6A, 16A) shall be provided in all building/areas of the substation. Inside a building, receptacles shall be

provided at interval of 30m or part thereof for hand tools, water coolers, exhaust fans etc. Inside each cabins at least two receptacles shall be provided and the same shall be indoor/outdoor/flameproof as per the location. Minimum 2 nos of 6/16A receptacles shall be provided in each room. Receptacles shall be heavy duty, complete with individual plug and switch as described below:

S.No.	Type	Description
1	RPA	6A/16A, 240V AC, 50Hz, Single Phase 5 PIN Duplex Power receptacles (surface mounted).
3	RPD	63A, 415V, 50Hz, 3 P+N+E with Disconnecting Switch Welding Receptacles, IP55 (WEATHERPROOF)

d) Cables and Wiring

i. Wiring from lighting DBs/panels to individual fixtures, plug points, fans, etc. shall be of single core, 2.5sq.mm, 1100 V grade PVC stranded copper conductors through surface mounted or concealed medium duty GI conduits confirming to IS 1239 with earth wire. The wires in the conduits shall not exceed 60% of the conduit area.

ii. The control cables shall be 1100 V grade, multi core, stranded annealed high conductivity copper with extruded PVC insulated inner sheath, armoured and overall sheath with extruded Flame Retardant Low Smoke (FRLS) PVC compound (Type ST-1).

iii. 1100V grade stranded copper conductor, PVC insulated, colour coded, wires laid in GI conduits shall be used for lighting in non-hazardous area. In the hazardous area, outdoor areas like transformer yard and road lighting, cabling shall be adopted.

iv. Minimum size of wires in case of conduit wiring shall be 2.5sq.mm copper in case of lighting and 4sq.mm copper in case of receptacle wiring.

v. Wires of different phases shall be run in separate conduits. However, wires of same phase but having different circuit nos. can be run in same conduit. Wires of lighting and power receptacles shall be carried out in separate conduits and on separate circuits. Wires of AC and DC lighting system shall be carried out in separate conduits.

vi. For outdoor lighting, the cable shall be buried at a minimum depth of 750 mm from ground level or run in cable trays. The buried cables shall have suitable bedding, protective covers and markers.

vii. Material used for saddles, clamps, JBs, etc. shall be galvanized.

viii. Office buildings, laboratory buildings shall have concealed wiring with 2.5sq.mm wires using PVC conduits. In heat zones, i.e. in the areas where ambient temperature is 600 C and above, heat resistant control cables shall be used in hot dip galvanised rigid steel surface mounted conduits.

e) Lighting poles and towers

i. Lighting poles for substation outdoor lights shall be of swaged and welded steel, pole of height 7M/9M and shall conform to relevant standard. Poles shall be hot dip galvanized internally and externally after fabrication as per IS 2629 / IS 2633 / IS 4759 standards. The Poles shall be designed to withstand the maximum wind speed as per IS 875. The steel sheet used to manufacture steel poles shall be of minimum thickness of 3 mm and shall conform to relevant standard . Junction boxes shall be provided with weather proof flush doors and locking facility. Bidder shall design and furnish the foundation drawings for the poles to withstand basic wind speed of minimum [50 meter/sec].

ii. The supply of poles/Towers shall be complete with base plate, foundation bolts, hot dip galvanized brackets / necessary pipe reducer for fixing the fitting and also include the necessary associated pole mounted junction boxes.

iii. Towers for mounting flood lights shall be e of continuously tapered polygonal cross section and shall be supplied with all acesssories. Steel structure for towers shall be made of hot dip galvanized steel. A steel ladder and platform at the top shall be provided. The length of each step of the ladder shall be at least 300 mm and spacing between two adjacent steps not more than 300 mm. The structure shall be suitable for mounting the required number of flood lights, weights of maintenance crew and specified wind pressure. The factor of safety shall be [2] for each part and section. The Contractor's structural design drawings shall be approved by the Purchaser before fabrication.

1.13.28.4.8 Name Plate

Name plates shall be furnished for identification of devices and circuits. All switches, controls and indications shall be permanently and legibly marked in English regarding the functions.

1.13.28.4.9 Painting

All surfaces shall be sand blasted, pickled and grounded as required to produce a smooth, clean surface free of scale, grease and rust.

After cleaning, the surfaces shall be given a phosphate coating followed by 2 coats of high quality primer and stoved after each coat.

The equipment shall be finished in approved color shade by owner with two coats of epoxy based powder coated paint. The coating shall be done electro statically followed by stoving.

Sufficient quantity of touch-up paint shall be furnished for application at site.

1.13.28.5 Tests

1.13.28.5.1 Type Test

The Bidder shall submit for Owner's approval the reports of all the type tests as per relevant standards and carried out within last[five] years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been conducted at an independent laboratory.

In case the Bidder is not able to submit report of the type test(s) conducted within last [five] years from the date of bid opening, or in case the type test report(s) are not found to be meeting the specification requirements, the Bidder shall conduct all such tests under this contract free of cost to the Owner and submit the reports for approval.

1.13.28.5.2 Routine Test

All equipment shall be completely assembled, wired, adjusted and routine tested as per relevant IS / IEC Standards at manufacturer's works/site in the presence of consultant /purchaser or his representative.

Tests on Lighting Distribution Boards / Panels shall include:

- Wiring continuity tests.
- High voltage and insulation tests.
- Operational tests.

1.13.28.5.3 Test Witness

[The tests shall be carried out in presence of the Owner's representative, for which a minimum 7 days notice shall be given by the Bidder. The Bidder shall obtain the

Owner's approval for the type test procedure before conducting the type test. The test procedure shall clearly specify the test set-up, instruments to be used, procedure, acceptance norms, recording of different parameters, interval of recording, precautions to be taken etc. for the type test(s) to be carried out.]

1.13.28.5.4 Test Certificates

Certified copies of all tests carried out at works and at site shall be furnished in requisite no. of copies for approval of the Owner.

The equipment shall be dispatched from works only after receipt of Owner's written approval of shop test reports.

1.13.28.6 Drawings, Data & Manuals

- Drawings, data & manuals for the motors shall be submitted as indicated below:
- [Lighting panels & distribution boards.
- Receptacles & Junction boxes.
- Street light poles & towers.
- Lighting fixture complete with lamps and accessories.
- Non-integral/separate type control gear box for lighting fixtures, as applicable.
- Lux level calculations for each area.
- Data sheets for lighting fixture, lamps, accessories with light distribution curves, co-efficient of utilization charts etc. Type and routine test certificates of transformer and cables.
- Control schematic and wiring diagram of 415V AC lighting panel, 415V normal AC Street/area lighting panel with automatic ON/OFF feature.
- Technical leaflets and data sheet on each piece of equipment/ device such as MCB, switch, fuse, receptacle etc. Type and routine test certificates of transformer and cables.
- QAP and relevant test certificates
- Lighting layouts showing the disposition of fixtures, lighting panels/boards, circuit distributions, conduit & wire routing.
- Key Single Line Diagram for lighting distribution, board wise single line diagram with feeder loading, cable schedule and interconnection chart, design calculation for lighting.]

1.13.28.7 Rating and Requirements

Major technical parameters of motor are listed below. However, Bidder may also refer to Volume-III, technical schedule in order to submit technical data of equipment along with their technical proposal.

S. No.	DESCRIPTION	UNIT	DATA
1.0	GENERAL		
1.1	Normal Supply Voltage, Phase and Frequency	AC	240V, 1Ph, 50Hz
1.2	Variation in Supply		
	a) Voltage	%	±10
	b) Frequency	%	±5
	c) Combined voltage & frequency	%	10
1.3	Design Ambient Air Temperature	ºC	45
1.4	System Short-Circuit Level		
	a) At 415V AC (LDB)	kA(rms)	20KA for 1 sec
1.4	Luminaries Earthing Terminal Suitable for		
a	Conductor material		G.I
b	Conductor size	SWG	12
2.0	Lighting Distribution Board and Lighting panel		
2.1	Manufacturer Name		[By bidder]
2.2	Rated Voltage, phase and Frequency	AC	415V, 3phase, 4 wire, 50Hz
2.3	One Minute Withstand Voltage	V	2500
2.4	Mounting Type		

S. No.	DESCRIPTION	UNIT	DATA
	a) LDBs		Wall Mounted
2.5	Type and no of circuits & feeder rating		[As per project requirement]
2.6	Colour shade		[RAL 7032]
2.7	Lighting Transformer		
	Type		Epoxy cast resin dry type
	Voltage Ratio	V	415/415V
	Taps	%	-
	Vector Group		[Dyn11]
	Impedance	%	[5%]
	Rating	KVA	[As per project requirement]
3.0	Fixture details:		
3.1	Name of Manufacturer and Country		[By Bidder]
3.2	Luminaries		[By Bidder]
	a) LED		
3.3	Applicable Standards for		[By bidder]
	a) Luminaires		
	b) Accessories		
3.4	Manufacturer's type and Catalogue No.		[By bidder]
	a) Luminaires		
	b) Accessories		
4.0	Schedule of fitting and Accessories		[As per project requirement]
5.0	Technical details of luminaries		[By bidder]

S. No.	DESCRIPTION	UNIT	DATA
5.1	Lamps		
a	Maximum permissible supply voltage variation	±%	
b	Luminous output		
	After 100 burning hours	Lumens	
	After 1000 burning hours	Lumens	
c	Average burning hour life	Hours	
5.2	Ballasts & Starters		[By bidder]
a	Maximum permissible supply voltage variation	±%	
b	Power loss at nominal working voltage		
c	Maximum hot spot temperature of ballast		
d	Conductor material of ballast		
e	Insulation class of ballast winding		
f	Average life of		
	i) Ballast	Hrs.	
	ii) Starters	Hrs.	
5.3	Capacitors		[By bidder]
a	Power factor		
5.4	Luminaries		[By bidder]
a	Weight of luminaries	Kgs	
b	Earthing terminal		

S. No.	DESCRIPTION	UNIT	DATA
	i) Material		G.I
	ii) Suitable upto conductor size	SWG	12
c	Internal wiring size	Sq.mm	
d	Terminal block suitable for conductor size	Sq.mm	
e	Sheet steel thickness of		
	i) Housing	SWG	
	ii) Reflector	SWG	
f	Wire guard thickness	mm	
g	Descriptive catalogues enclosed	Yes/No	
6.0	Miniature circuit breaker		[By bidder]
6.1	Make		
6.2	Type		
6.3	Literature enclosed	Yes/No	
7.0	RCBO		[By bidder]
7.1	Make		
7.2	Type		
7.3	Leakage Current I N	mA	
7.4	Literature enclosed	Yes/No	
8.0	Relays (if any provided)		[By bidder]
8.1	Make		
8.2	Type		
8.3	Voltage Rating	V	
8.4	Setting Range	%	
8.5	No. of Contacts		

S. No.	DESCRIPTION	UNIT	DATA
	a)Normally open		
	b)Normally closed		
8.6	Literature enclosed	Yes/No	
9.0	Receptacle units		[By Bidder]
9.1	Make		
9.2	Decorative		
9.3	Industrial		
9.4	Flame proof		
9.5	Literature Enclosed	Yes/No	
10.0	Lighting wires		[By Bidder]
10.1	Make		[Point wiring with respect to different length shall be furnished]
10.2	Applicable Standard		
10.3	Voltage Grade	V	
10.4	Conductor Material	Cu/Al	
10.5	Size	Sq.mm	
10.6	No. of Strands		
10.7	Colour Coding		
11.0	Conduits		[By bidder]
11.1	Make		
11.2	Rigid Steel		Galvanized
11.3	Rigid Non-metallic		
11.4	Sizes offered and wall thicknesses		

S. No.	DESCRIPTION	UNIT	DATA
11.5	Supply of necessary couplings, bends, tees, necessary for conduit routing included	Yes/No	
11.6	Literature Enclosed	Yes/No	
12.0	Junction boxes		[By bidder]
12.1	Make		
12.2	Material and Gauge		
12.3	Galvanised		Yes
12.4	Dimensioned Drawings Enclosed	Yes/No	
12.5	Weather Proof Construction Required	Yes/No	
12.6	Flame Proof / Non-flame proof		
13.0	Lighting poles/towers		[By bidder]
13.1	Make		
13.2	Type of Poles/Towers		
13.3	Dimensioned Drawing/Particulars of Flood Light Tower enclosed	Yes/No	
13.4	Junction Box with Pole	Yes/No	

1.13.29 ..... Smart Meters

1.13.29.1 General

This specification is intended to cover the [design, Engineering, manufacture, assembly, testing at manufacturer's works, supply in properly packed condition for transport to site, Erection, site testing and commissioning] of Class 0.2s accuracy class static 3 phase -4 wire CT operated three-vector energy meter. The meter shall be suitable for measurement of energy and power, demand requirement in an AC balanced / unbalanced system over a power factor range of zero lag to unity. These meters should have communication port to interface for remote meter reading.

The system shall be complete in all respect including all accessories required for efficient and trouble-free operation of Atal Puram Township, Agra.

1.13.29.2 Service Condition

The meter shall be suitable for satisfactory continuous operation under the following tropical conditions:-

a)	Maximum ambient temperature	:	45 °C
b)	Maximum ambient temperature in shade	:	45 °C
c)	Relative Humidity	:	87%

1.13.29.3 Applicable Standards

The CT operated energy meter shall be of accuracy Class 0.2S for active/ reactive / apparent energy and conform to relevant clauses of following standards or report: -

IS 14697: 1999	Specification for A.C Static Transformer operated Watt Hour & VAR – Hour meters, class 0.2S,0.5S and 1.0
CBIP Technical Report No. 304	Specification for A.C. Static Electrical Energy Meters.
IS 15959 (Companion specification)	DLMS Indian Companion Standard – Category 'C' for Consumer metering.

Unless otherwise specified elsewhere in this specification the static meters shall conform to the latest version available of the standard as specified above.

1.13.29.4 General Technical Requirement

Application	:	3 phase 4 wire
Rated Secondary Voltage	:	63.5 volts (Phase to Neutral)
Rated secondary Current (I Basic)	:	5 Amps
Rated Frequency	:	50 Hz.
Accuracy class	:	0.2s as per meter category
Power Factor	:	Unity to Zero (all power factor lag / or lead)

The meter shall start and continue to register on application of 0.1% of basic current at Unity P.F., as per relevant standards and shall work satisfactorily up to maximum continuous current of 2 times rated basic current with the following supply system variation:

Voltage	:	Vref ± 30%
Frequency	:	50 Hz ±5%

Temperature: The standard reference temperature for performance shall be 27 °C. The mean temperature co-efficient shall not exceed 0.03%.

The reactive accuracy class of the meter shall be same as the active accuracy class

1.13.29.5 Influence Quantities:

The meter should be designed and protected such that all external effects and influences shall not change its performance & shall work satisfactorily within guaranteed accuracy limits, as specified in IS 14697: 1999 / CBIP technical report – 304, under the presence of influence quantities.

1.13.29.6 Construction:

The case, winding, voltage circuit, sealing arrangements, registers, terminal block, terminal cover & name plate etc, shall be in accordance with the relevant standards. The meter should be compact & reliable in design, easy to transport & immune to vibration & shock involved in the transportation & handling. The construction of the meter should ensure consistence performance under all conditions especially during storms/heavy rains/very hot weathers. The insulating materials used in the meter should be non-hygroscopic, non-ageing & have tested quality. The meter should be sealed in such a way that the internal parts of the meter become inaccessible.

The meter should employ latest technology such as Application Specific Integrated Circuit (ASIC) to ensure reliable performance. The mounting of the components on the PCB should be Surface Mounted Technology (SMT) type except some power supply related component. The electronic components used in the meter should be of high quality.

1.13.29.6.1 General Mechanical Requirements

The construction of the meter shall be rigid & suitable to withstand shock & vibration involved in transportation & handling, as specified in IS 14697. Meter shall be designed

and constructed in such a way as to avoid introducing any danger in normal use and under normal conditions, so as to ensure especially personal safety against electric shook, safety against effect of excessive temperature, protection against spread of fire, protection against penetration of solid objects, dust and water. The design of meter shall conform to IP51 class degree of protection against dust and moisture as per relevant standards.

1.13.29.6.2 Tropical Treatment

All parts, which are subject to corrosion under normal working conditions, shall be protected effectively. Any protective coating shall not be liable to damage by ordinary handling or damage due to exposure to air, under normal working conditions. Meters shall withstand solar radiation. The meters shall be suitably designed and treated for normal life & satisfactory operation under the hot and hazardous tropical climatic conditions as specified. The meter shall work from -10°C to +55°C and RH 95% non-condensing type.

1.13.29.6.3 Meter Case

The housing of the meter shall be safe high-grade Engineering plastic or any other high quality insulating material and shall be very compact in design. All the insulation materials used in the construction of meter shall be non-hygroscopic, non ageing & of tested quality, capable of withstanding resistant to heat & fire. The construction of the meter offered shall be such that it can be sealed independently and the cover cannot be removed with the use of a tool, without breaking the seal. The case of offered meters shall be so constructed that any non-permanent deformation shall not prevent the satisfactory operation of the meter. The meter shall have a transparent cover and opaque base with seamless ultrasonic welding.

1.13.29.6.4 Terminals -Terminal Block

The base of the meter shall have a terminal block at the bottom made out of high grade engineering plastic so as to facilitate bottom connection and houses solid nickel plated brass terminals having capability to carry maximum value of current.

The material of the terminal block shall be capable of passing the tests given in IS 14697: 1999.

The terminal holes in the insulating material shall be of sufficient size to accommodate the insulation of the conductors. The diameter of the terminal hole for current terminals

shall not be less than 5.0 mm & shall be of adequate length in order to have proper grip of conductors / crimping pins with the help of two screws.

The terminal block shall satisfy all the conditions such as clearance & creepage distance between terminals & surrounding part of the meter as specified in relevant clause of IS 14697: 1999.

The manner of fixing the conductors to the terminals shall ensure adequate and durable contact such that there shall have no risk of loosening or undue heating. Screw connections transmitting contact force and screw fixing which may be loosened and tightened several times during the life of the meter shall be such that the risk of corrosion resulting from contact with any other metal part is minimized. Electrical connections shall be so designed that contact pressure shall not be transmitted through insulating material.

1.13.29.6.5 Terminal Block Cover

The terminals block cover for the energy meters shall be extended transparent type, which can be sealed independently of the meter cover. The ETBC shall have a clear space of min 40+5mm, thus allowing sufficient clearance space for inserting cables. ETBC shall have a top side hinge arrangement for easy access of terminal for wire termination. The terminals, their fixing screws and the insulated compartment housing them shall be enclosed by extended terminal cover in such a way that no part of meter or accessories at terminal block shall be accessible from the front of the meter. There shall be provision of fixing of seals so that screws cannot be loosened without breaking the seals.

The terminals shall not be accessible without removing the seal(s) of terminal cover when energy meter is mounted on the meter board.

1.13.29.6.6 Window

The energy meter cover shall be made of high-grade engineering plastic with one window. The window shall be of transparent material ultrasonically welded with the meter cover such that it cannot be removed undamaged without breaking the meter cover seals.

1.13.29.6.7 Quality

Overall the quality of the meter should be good and the service life of the meter shall be more than the guarantee period. The material, components used for manufacturing the meter shall be of premium quality. The LCD display shall not fade with time and

the display annunciators should be visible. Functionality of the meter shall not be affected by the harsh environmental conditions. Quality meters shall be given preference and the performance of previous installed meters shall be analyzed before awarding the tender. Aesthetically, the meter shall be of premium quality.

1.13.29.7 Communication

Meter shall be able to communicate to MDM through existing fibre optical cable, all required arrangement shall be provided in the meter for the same.

1.13.29.7.1 Load Control

Meter should be able to send signal to control room (at remote location) in case power consumption is more than pre-defined load value for a consumer. Tripping of VCB shall be initiated from control room auto/ manual.

Load Control limits shall be programmable.

1.13.29.7.2 Local Communication Port

The energy meter shall have a galvanically isolated IEC 1107 optical communication port located in front of the meter for data transfer to or from a hand held Data Collection Device. The sealing provision should be available for optical port.

1.13.29.7.3 Remote Communication Port

Meter shall have an additional communication port (RS 232) in the form of RJ11 port to interface external modem for remote data collection. RS 232 (RJ11) port shall be located under the terminal cover.

Both the ports will support communication on DLMS and should be accessible through a DLMS compliant HHU

1.13.29.8 Data Downloading Capability

Meter shall support a minimum band rate of 9600 on optical port as well as RS 232 remote communication port. It shall be possible to read selective data from the meter as specified in the companion standard.

1.13.29.9 Display Of Measured Value:

The measured value(s) shall be displayed on seven segments, seven digit Liquid Crystal Display (LCD) display unit/register, having minimum character height of 10 mm.

The data should be stored in non-volatile memory. The non-volatile memory should retain data for a period of not less than 10 years under unpowered condition. Battery back-up memory will not be considered as NVM.

It should be possible to easily identify the single or multiple displayed parameters through symbols/legend on the meter display itself or through display annunciators.

Meter shall have Scroll Lock facility to display any one desired parameter continuously from display parameters.

The register shall be able to record and display starting from zero, for a minimum of 1500 hours, the energy corresponding to rated maximum current at reference voltage and unity power factor. The register should not roll over in between this duration.

The principle unit for the measured values shall be Wh/kWh/MWh for active energy, VArh/kVArh/MVArh for reactive energy & VAh/kVAh/MVAh for apparent energy based on secondary current. Bidder shall mention the scale in which the meter displays the energy values.

Required display list will be given at the time of order. However it will be in line with companion standard such as:

- Real Time
- Date
- Line currents
- Phase to Neutral Voltages
- Phase wise Power Factor
- Frequency
- Active, Reactive and Apparent Power
- Cumulative tamper count
- Cumulative MD reset Count
- Cumulative active forwarded energy
- Cumulative reactive lag forwarded energy
- Cumulative reactive lead forwarded energy
- Cumulative apparent forwarded energy
- Universal active maximum demand with date and time
- Universal apparent maximum demand with date and time
- Present PT status

- Present CT status
- Other status
- Last occurred and restored tamper with date and time
- High resolution active forwarded energy
- High resolution reactive lag forwarded energy
- High resolution reactive lead forwarded energy
- High resolution apparent forwarded energy

Above listed displays shall be configurable in three different pages in push mode for easy access in mains on condition. First page should contain the instantaneous parameters, second page, for energy and demand values, and third page for tamper related displays.

The meter should have visual quadrant representation on the LCD for energy measurement. Relevant quadrant in which metering is taking place should be in on state for ease of understanding.

Parameter value with relevant OBIS code should also be simultaneously available along with the respective values on the display.

1.13.29.10 Electromagnetic Compatibility

The static energy meters shall conform to requirements listed in relevant standards and shall also be protected against radiated interference from either magnetic or radio-frequency source.

1.13.29.10.1 Immunity To Electromagnetic Disturbance

The meter shall be designed in such a way that conducted or radiated electromagnetic disturbance as well as electrostatic discharge do not damage or substantially influence the meter and meter shall work satisfactorily under these conditions as per relevant standards

NOTE: the disturbances to be considered are: -

- Harmonics
- Voltage dips and short interruptions
- Conducted transients
- D.C. and A.C. magnetic fields
- Electromagnetic fields
- Electrostatic discharges

1.13.29.10.2 Radio Interference Suppressions

The meter shall not generate noise, which could interfere with other equipment, and meter shall work satisfactorily as per relevant standards

1.13.29.10.3 Influence Of High Magnetic Field

The meters shall be provided appropriate magnetic shielding so that any external magnetic field (AC/DC electromagnet) as per CBIP Technical Report no. 304 applied on meter would not affect the proper functioning of the meter and meter shall work satisfactorily as per relevant standards.

1.13.29.11 Starting Current

The meter shall start and continue to register at the current 0.1% of Ib.

1.13.29.12 Running With No Load

When the 115% of rated voltage is applied with no current flowing in the current circuit, the meters shall not register any energy and test output of the meter shall not be more than one pulse/count on "no load".

1.13.29.13 Power Consumption

The active and apparent power consumption in each voltage circuit of the CT Operated meters at reference voltage; temperature and frequency shall not exceed 1.0 W and 4 VA per phase respectively.

The apparent power consumption in each current circuit for the CT Operated meters at basic current, reference frequency and reference temperature shall not exceed 1.0 VA per phase.

1.13.29.14 Calibration & Test Output

All the meters shall be tested, calibrated and sealed at works before dispatch. Further, no modification of calibration shall be possible at site by any means.

However, it shall be possible to check the accuracy of energy measurement of the meter in the field by means of LED output on meter. Meter should have two calibration LEDs for accuracy measurement for different energies. Out of these, one should be kept fixed on kWh and other one shall be configurable for rest two (kVArh, kVAh). Resolution of the test output shall be sufficient to enable the starting current test in less than 10 minutes.

1.13.29.15 Connection Diagram

The connection diagram of the meter shall be clearly shown for 3 phase 4 wire system, on the terminal cover. The meter terminals shall also be marked and this marking should appear in the above diagram.

1.13.29.16 Quantities To Be Measured:

The meter shall be able to provide the following data in line with Category 'C' type as per IS 15959 - Indian Companion Specification.

- Instantaneous Parameters.
- Block Profile / Load Survey data.
- Abstract quantities
    - Name Plate Details
    - Programmable parameters
- Event Conditions.
- Billing profile parameters.
- Time of day registers.

The meter shall be able to measure and provide the parameters listed in the guideline document. The OBIS code for each parameter shall be as identified as per DLMS /COSEM protocol in line with Indian companion standard.

1.13.29.17 Abnormality Events Detection:

The meter should have features to detect the occurrence and restoration of, at least, the following common abnormal events:

Missing Potential: The meter shall be capable of detecting and recording occurrence and restoration with date and time the cases of Potential failure (one phase or two phases). All potential missing cases shall be considered as power failure.

Current imbalance: The meter shall be capable of detecting and recording occurrence and restoration with date and time of Current unbalance (for more than a defined persistence time).

Current Reversal: The meter shall be capable of detecting and recording occurrence and restoration with date and time if the current is flowing in reverse direction in one or more phases. The meter shall continue to record in forwarded direction even in case of CT reversal.

Power on/off: The meter shall be capable to record power on /off events in the meter memory. All potential failure should record as power off event.

Magnetic Influence: The Meter shall be capable of detecting and recording of presence of abnormal magnetic influence near the meter, if the magnetic influence affects the meter functionality. The meter should record at Imax on account of magnetic influence. Separate legend for magnet event shall be made available on LCD. This legend shall remain in on state till meter reading so that it will come in to notice of meter reader.

Voltage unbalance: Meter shall detect voltage unbalance if there is unbalance in voltages.

Over Current: When load condition at any phase i.e. Line current at any phase goes more than defined limit , this will be detected as Over current condition.

CT Open: The meter should detect phase wise current circuit open when the circuit is opened from meter side.

CT Bypass: The condition should be detected whenever the current terminal is bypassed in the meter

Neutral Disturbance: The meter should detect neutral disturbance if any spurious signal is applied at the meter's neutral.

High and Low Voltage: The meter should detect under and over voltage events respectively if voltage falls / rise from defined limits.

Cover Open: The meter shall be able to detect cover open occurrence event if cover is opened in mains on or off condition. Separate legend for cover open event shall be made available on LCD. This legend shall remain in on state till meter reading so that it will come in to notice of meter reader.

The above shall be selectable and will be in line with IS 15959: Data Exchange for Electricity Meter Reading, Tariff and Load Control – Companion Specification.

The meter shall keep records for the minimum last 300 events (occurrence + restoration) for above abnormal conditions. Each event shall be logged with date and time of occurrence/restoration with snapshot of voltage, current power factor and active energy (except cover open, power on-off). It shall be possible to retrieve the abnormal event data locally using a hand held unit (HHU) through the meter's optical port & same

can be viewed / analysed at base computer end in simple and easily understandable format.

1.13.29.18 Abnormal Voltage/Frequency Device Test:

The accuracy of the meter would not be affected with the application of abnormal voltage/ frequency generating device having spark discharge of approximately 35KV. The meter will be tested by feeding the output of this device to meter in any of the following manner for 10 minutes:

- On any of the phase or neutral terminals.
- On any connecting wires of the meter.
- Voltage discharge with 0-10 mm spark gap.
- Spark on meter body.
- Spark on the optical and RS 232 port.
- At any place in load circuit.

The accuracy of the meter will be checked before and after the application of above device.

1.13.29.19 Load Survey: -

Meter should support parameters as mentioned in IS-15959 for Category “C” .

Following parameters shall be made available for last 60 days with integration period of 15 min. Out of which the utility should be able to select any five parameters

- Real time clock , date and time.
- Current, Ir
- Current, Iy
- Current, Ib
- Voltage ,V Rn
- Voltage ,V Yn
- Voltage ,V Bn
- Active forwarded Energy
- Reactive lag forwarded energy
- Reactive lead forwarded energy
- Apparent Energy

These load survey can be retrieved with the help of Meter Reading Instrument on local interrogation or remotely using the remote communication interface.

1.13.29.20 MD Reset

The meter shall have any of the following MD resetting options: -

Automatic reset at the end of a certain predefined period (say, end of the month)

Manual resetting arrangement (MD reset button) with sealing facility.

MD reset through authenticated transaction

1.13.29.21 Time Of Day Registers

The meter shall have support of eight TOD registers and rate registers for demand and energy monitoring in peak and off peak time zones. TOD rate and MD registers are required for active and apparent energy channels.

Billing Parameters

The meter shall generate these parameter for each billing cycle and should store in the memory. The set of data for last 6 cycles shall be stored in the memory. And the parameter should be as per table 29 of IS-15959.

1.13.29.22 Self Diagnostic Feature

The meter shall be capable of performing complete self-diagnostic check to monitor the circuits for any malfunctioning to ensure integrity of data memory location at all time. The meter shall have indication for unsatisfactory/non-functioning/malfunctioning of the following:

- Time and date on meter display
- All display segments on meter display
- Self-diagnostic (RTC, NVM information) on display

1.13.29.23 Other Salient Features Of Meters

i. It should be possible to check the healthiness of phase voltages by phase indicator available on meter display.
ii. The meter shall have provision of reading in the absence of power through an internal battery. It shall be possible to access the display in power off condition. It shall also be possible to do meter data download through MRI under power off condition.

iii. The meter should work accurately irrespective of phase sequence of the supply.

1.13.29.24 Test And Test Conditions

Acceptance test: All acceptance tests as per relevant standards shall be carried out in the presence of utility representatives.

Routine Test: All the routine tests as per – IS 14697 shall be carried out and routine tests certificates shall be submitted for approval of purchaser.

1.13.29.25 Guaranteed Technical Particulars For 3 Phase 4 Wire Ct Operated Trivector Energy Meter For Consumer Metering

Sl No.	Item	Bidder's data
1.	Type	
2.	Application	
3.	Rated Voltage	
4.	Rated Current	
5.	Frequency	
6.	Minimum starting current in % of base current	
7.	Power loss in potential circuit	
8.	Power loss in current circuit	
9.	Change in error due to	
10.	Variation in frequency	
11.	Variation in voltage	
12.	Accuracy Class	
13.	Total Weight of meter	
14.	Details of case	
15.	Standard to which the meter confirm	
16.	Type of Energy Registration Mechanism.	
17.	MD Reset Mechanism	

Sl No.	Item	Bidder's data
18.	MD reset button with sealing provision	
19.	Two LEDs for accuracy measurement	
20.	Working range	
21.	Voltage	
22.	Current	
23.	Display details	
24.	Display Cycle (page mode display)	
25.	Period of display of each parameter	
26.	Display scroll-lock facility	
27.	Backlit LCD	
28.	Relevant OBIS codes for parameter	
29.	Legend for Cover open detection	
30.	Legend for Magnet event	
31.	Power on in absence of mains	
32.	Internal / External Battery	
33.	Display access	
34.	Reading (Data downloading)	
35.	Total Events (300 nos)	
36.	Load Survey	
37.	Parameter Logged	
38.	Logging interval	
39.	No. of days of Load Survey	
40.	Capability for fraud Prevention & detection	
41.	Time of the day Zone	
42.	Sealing and Locking Arrangement	

Sl No.	Item	Bidder's data
43.	Type of communication Local- Optical port IEC 1107 RS 232 port for remote comms	
44.	Event Logging Current Related events: CT reversal (phase wise) Current imbalance Over Current CT open (phase wise) CT Bypass Voltage related events PT missing (phase wise) Voltage unbalance High and low voltage Others: Magnet Neutral Disturbance Low Power factor Non Rollover events Front Cover open Power on-off events	

1.13.30 ..... SMART GRID SYSTEM

1.13.30.1 GENERAL

This specification is intended to cover the [design, Engineering, manufacture, assembly, testing at manufacturer's works, supply in properly packed condition for transport to site, Erection, site testing and commissioning] of Smart Grid System which includes-

- Advanced metering infrastructure (AMI), with two way communication and Meter Data Management Systems
- Distribution Automation and Substation Automation Systems, Supervisory Control and Data Acquisition Systems (SCADA)
- Advanced Distribution Management Systems (ADMS)
- Automation of the substations with modern switchgear and numerical relays
- Customer portal
- Enterprise IT network covering all substations and field offices with reliable communication systems
- Electronic billing systems and customer care systems
- Enterprise Resource Planning (ERP)/Asset Management Systems,
- Integration of all smart grid systems.

The System should be capable to integrate following system if required in future-

- Outage management system (OMS)
- Demand response
- Renewable integration.

The system shall be complete in all respect including all accessories required for efficient and trouble-free operation of Atal puram Township, Agra.

Following Automation is proposed for controlling, monitoring and metering of complete Electrical System within township from a Control Centre (CC) located at Main Receiving Sub Station (MRSS).

- 3 nos. of 33/11kV Distribution Substation Automation through RTUs & Intelligent Electronic Devices (IEDs) like Numerical relays, Bay Control Units (BCU), Tap Changer Controller (TCC) etc and SCADA system compatible for communication with IEC 60870-5-104.

- 33 & 11kV Distribution Ring Network automation through IEDs, Fault Passage Indicators (FPI), Self-Healing System and FRTUs
- 415V Switchgear automation including Utilities through smart panels like Intelligent MCCs.
- Local field control of breaker and isolator will be done only during maintenance and testing.

Parameters to be monitored and control of 33/11kV substation, including Power & distribution transformers, 33 & 11 kV switchgears, RMUs, CSS placed at different locations-

- Incoming Phase Voltage, Phase Current, Active Power, reactive Power, Power Factor.
- Outgoing Phase Voltages, Phase Currents, Neutral Float condition, Active Power, reactive Power, Power factor, efficiency.
- FPI (Fault Passage Indicator), Oil temperature, Levels if any, Bus bar palm temperature.
- Controlling of motorized circuit breaker, etc.

1.13.30.2 Codes & Standards

All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) / IEC as given below except where modified and/or supplemented by this specification.

S.No	Activity	Standards
1.	CIM Standard	IEC 61970
2.	CIM Standard for Distribution	IEC 61968
3.	Communication Network for Substation Automation	IEC 61850
4.	ICCP	IEC 60870-6
5.	Cyber Security Standard	IEC 62351-1-7
6.	Electricity Metering; data exchange for metering, tariff and load control	IEC 62056
7.	Grid Connectivity	IEEE 1547 MNRE Guidelines
8.	International Telecommunications Union	-

S.No	Activity	Standards
9.	National Electricity Manufacturers Association (NEMA).	-
10.	The institute of Electrical and Electronic Engineers (IEEE).	-
11.	Instrument Society of America (ISA).	-
12.	American National Standards Institute (ANSI).	-
13.	Deutsche Industries Norman (DIN).	-
14.	International Telecommunications Union (ITU-T) Telecommunication Standardization Section [formerly International Consultative Committee on Telephone and Telegraphy (CCITT)]	-
15.	Verin Deutschar Eisecnhuttenleute (VDE).	-

Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted. In such case, copies of the English version of the standard adopted shall be submitted along with the bid.

The electrical installation shall meet the requirements of Indian Electricity Rules as amended up to date and relevant IS Code of Practice. In addition, other rules and regulations applicable to the work shall be followed.

1.13.30.3 System Requirements

Smart Grid system shall include the following:

- Connectivity with the State Load Dispatch Centre (SLDC) for the exchange of information regarding Load Management & Forecast, AT&C losses, Outages etc. for township. The system shall be compatible with the existing IT/ ERP systems of the Utility Supply Company.
- The proposed system shall be capable of Data acquisition, validation, processing, and data archiving /storage of the electrical network within township in order to control and manage the Load including forecasting and outages, billing, and interface with end consumers through various portals.

- The system shall be capable to interface with the Substation Automation system appropriately for On-line monitoring, controlling and operation of the network elements and parameters to achieve optimal results and fulfillment of the scope objective.

1.13.30.4 Advanced Metering Infrastructure

AMI will help in improving billing efficiency, demand side management for reduction of energy use, provide the utilities and consumers with better outage management, provide load profile data, and quality data to improve power quality that can be charged a premium price and to gauge customer perception and Atal Puram Township benefits.

This project will be similar to AMI for Residential pilot but will have a more sophisticated meter for capturing additional parameters like for power quality and demand control by way of load curtailment from remote end.

AMI shall support the following:

i. Meter data reading at configurable intervals
ii. Time of day (TOD)/TOU metering
iii. Alarm/Event notification
iv. Load control
v. Net-metering
vi. Remote firmware upgrade
vii. Integration with other systems like ERP, IVRS/Call centre, billing & metering software, GIS mapping, consumer indexing.
viii. Security features to prevent unauthorized access to smart meter & meter data and to ensure authentication for all AMI elements.

AMI shall constitute of the following major components;

a) Smart Meters – Refer Smart meter specification
b) Network for connecting the meters and communications.
c) Meter Data Acquisition System/ Head End System (MDAS/HES)
d) Meter Data Management System – MDMS
e) Data analysis and reporting system
f) Consumer interface system
g) Integration of AMI system to SCADA system

1.13.30.4.1 Head End System (HES)

HES is the critical interface to the field devices, which shall support Meter Data Acquisition, Two way communication, poll meters for data collection, send remote firmware upgrades/programmable parameter inputs to meters, send Load Curtailment signals, Connect/Disconnect and sending of pricing and other signals as generated from the MDMS/Other Applications to the Smart meter. This will interface with MDMS over SOA/Web services, and the data exchange models and interfaces shall comply with CIM/XML / IEC 61968/62056.

There would be 2 ways in which data would reach the Head end System.

Push:

This would mean that the meter would send the data to the HES. The HES would acknowledge the receipt of the data. In case the Meter / DCU is not able to send the data to the HES, the Meter would store the data and re-transmit the same to the HES whenever the connectivity is available. The Metering system should also send the reason for the failure of transmission.

Pull:

This is when the HES would request for data from the Meter. The following data should be provided by the meter as and when requested from HES:

1) Meter Information

2) Load Survey

3) Tamper information

4) Billing Data/ Billing History.

1.13.30.4.2 Meter Data Management System (MDMS)

MDMS is the warehouse of all the data and most critical part of AMI. The system requirements of the MDMS systems are;

The system shall be designed based on open standards, Service Oriented Architecture principals and adequate importance to cyber security and controls. It shall be designed based on distributed architecture philosophy with following distinct tiers

Client tier: The client tier will be the interface of the software with the Power Supply Company's operations/dashboard user. The client tier will provide all the user

interfaces for the operational and supervisory activities involved in meter data acquisition, processing and analysis.

Business Logic tier: It service the requests made by the client tier. These requests could be automated, based on user-defined schedules or on demand from the user.

Database tier: shall be designed to maintain the relationships between meter and network assets, network topology, user privileges, service points, customer accounts and other entities.

The database tier should be optimally designed to exploit both normalized as well as multidimensional data models. The database should also maintain a time-series repository that stores the data collected and processed from meters, including meter readings, register reads, interval usage data, outage and restoration events and event logs as well as derived or computed data such as billing determinants, aggregations and asset performance indicators like load factor and load duration curves.

Meter reading data in repository should be fully versioned and maintained with audit trails and traceability to the originating data source(s) as well as support database partitioning to achieve highly scalable performance even with extremely large data stores.

The repository should support, store, and available on-line i.e. 13 to 36 months of meter readings, including daily meter register reads, interval data reads, meter event logs and computed or derived data.

The offered system shall be able to receive, upgrade, validate, record and present all the meter based data including electrical and power quality data, abnormal event data, import and export of energy data, all alarms and service request data; process the data as required like demand and billing calculation and analysis of data on the basis of time and generation of reports with enterprise class reporting tool.

All the Meters should record and store energy, load profile, metering and event data and send it to Control Center thru appropriate communication technology that can be RF/GPRS/OFC etc. Data from various meters in a subsystem can be collated by DCU (if required) that polls meters reporting to it for data aggregation and then sending it to Control Center, Control Center will facilitate data repository, Synchronization and aggregation as per network hierarchy, Time clock of each node in the system i.e. meter Control center etc. should be time synchronized

The system shall be scalable to accommodate the future requirements of residential and commercial consumer meters without any degradation in the performance.

The system shall be able to receive, record and present data from non-meter sources, including power equipment, distribution automation devices, Renewable Energy sources, Network components configurable for different pricing plans including TOU/CPP.

The system shall enable energy accounting including generation of report for accounting and auditing of energy at AMI ends, feeder ends and at Data concentration unit; calculation of AT&C losses on periodical basis and analysis of demand and losses for different section of consumers.

The system shall be capable of calculating and generating bills for specified time based rates of power supplier, distributor or State Electricity Board as the case may be.

The system shall include the Load Research application which will assist the power provider to forecast their load and network augmentation.

The system shall include prepaid metering; prepayment schemes and prepayment alerts.

Meter Data Acquisition System shall be provided for two way communication between meters and control centre MDMS through various field interface devices to help Remote data acquisition, load management, connection & disconnection of meters, remote up gradation of meter data and programs, sending price data and other signals. This communication interface shall be as per IEC61968/62056.

The system shall further facilitate manual entering of meter readings and other associated data during meter change with appropriate authentication; automatic configuration of meters, DCUs and other field elements in the network; exchange of network elements with seamless transfer of data; synchronize the date and time of all the field equipments to a common fixed reference and stamp the data with the same for audit purpose.

The system should provide management (create, remove, update, delete) and visualization of all data related to devices and support open communications platform for the future integration of meters for other energy carriers/media

The system should able to capture and maintain the electrical network topology, i.e. substations, feeders, transformers and consumers.

The AMI system shall be scalable to the full capacity of the requirement including residential and commercial consumers. The operating life of the meters shall be 20 years and that of the system shall be 10 years but should be able to remain in service for another 10 years with relevant and adequate up-gradations. In order to increase the reliability of the system, it shall proactively track all the components of the AMI system so as to predict any abnormalities and raise alarm for taking remedial actions. The system shall be self-healing and be provided with hot redundancy to limit the disruption because of any component failure to a time period set by the power supply provider.

For meter Specification Please refer Smart Meter Specification.

1.13.30.4.3 Communication Feature

Smart Meter shall communicate with HES by using communication module supplied by the contractor. The communication module used in smart meters shall work satisfactorily on communication infrastructure developed by contractor. The communication module should be inside the meter either in-built or pluggable type. In case of GPRS based smart meter, meter shall communicate with the HES in a secure manner. Provision of limited access to utility to change only the SIM card in case of GPRS based meter shall be given. Smart Meter shall accommodate SIM card from any service provider.

1.13.30.4.4 Network Security

The Network shall have adequate cyber security measures as detailed below:

Secure Access Controls: The system shall include mechanisms for defining and controlling user access to the operating system environment and applications. Measures such as password strength, password aging, password history and reuse prevention must be implemented.

Authorization Controls: A least-privilege concept such that users are only allowed to use or access functions for which they have been given authorization shall be available.

Logging: Logs must be maintained for all attempts to log on (both successful and unsuccessful), any privilege change requests (both successful and unsuccessful), user actions affecting security (such as password changes), attempts to perform actions not authorized by the authorization controls, all configuration changes etc. Additionally, the

access to such logs must be controlled in accordance to the least-privilege concept mentioned above, so that entries may not be deleted, accidentally or maliciously.

Hardening: All unnecessary packages must be removed and/or disabled from the system. Additionally, all unused operating system services and unused networking ports must be disabled or blocked. Only secure maintenance access shall be permitted and all known insecure protocols shall be disabled.

Malicious Software Prevention: Implementation of anti-virus software and other malicious software prevention tools shall be supported.

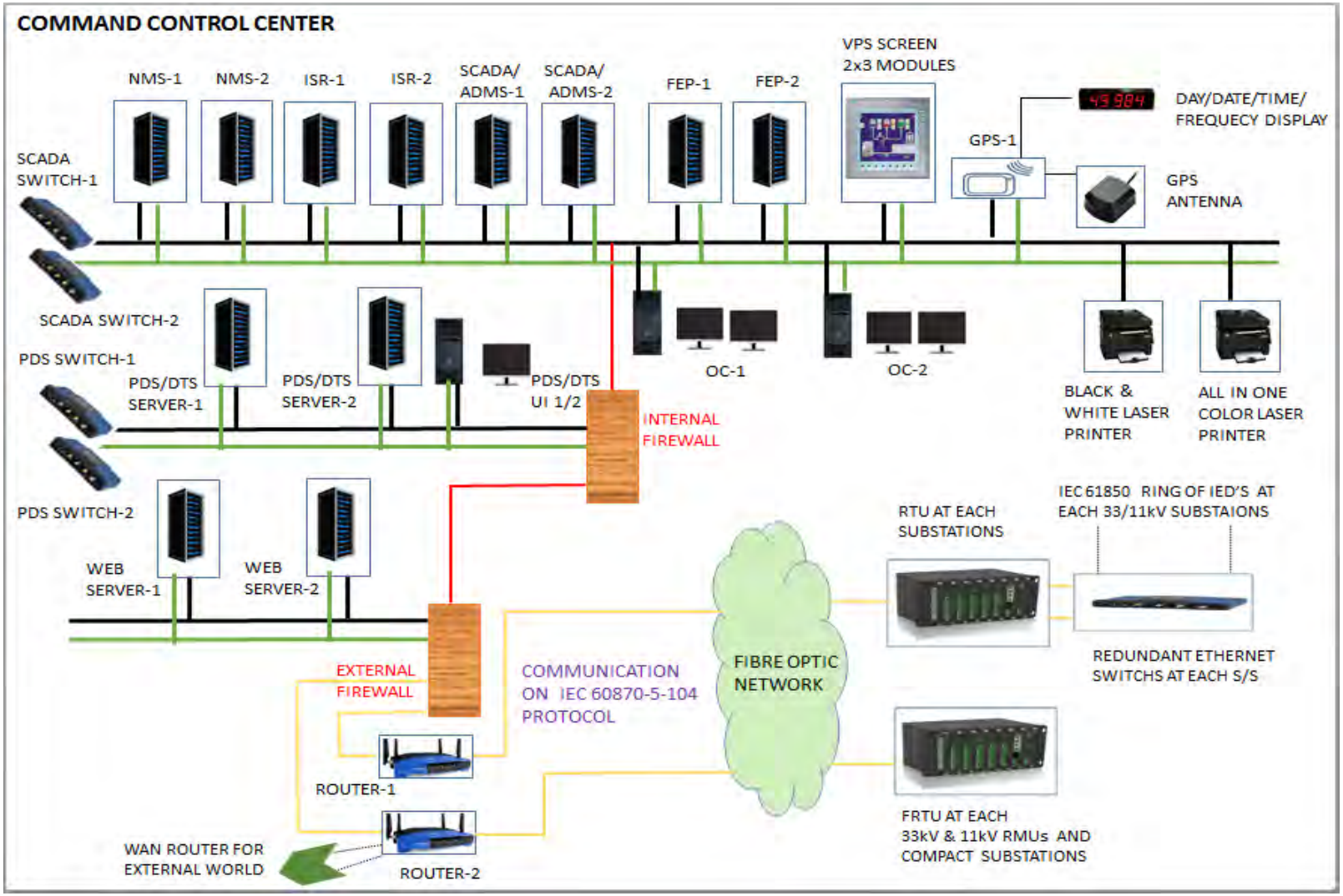
Network Security: The network architecture of the HES must be secure with support for firewalls and encryption. The system shall also allow host-based firewalls to be configured, as an additional layer of security if the network firewall were to fail.

1.13.30.5 Scada Architecture & Elements

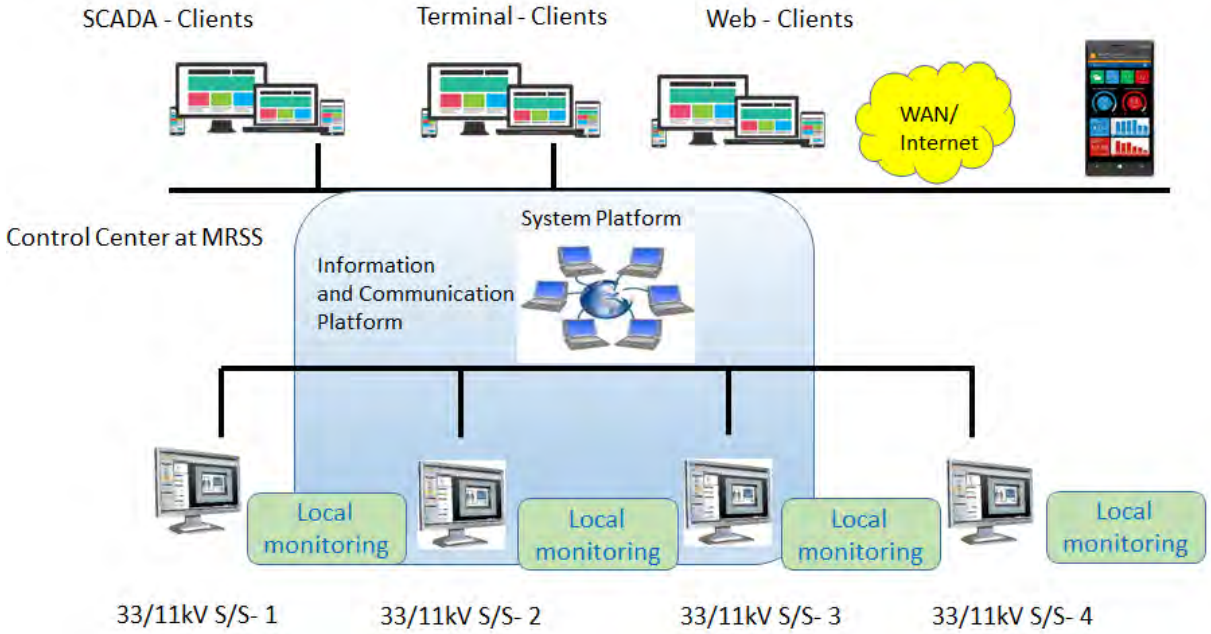
- The following SCADA functions are envisaged under this specification.
- Data Acquisition from RTUs at S/S , FRTUs at RMUs /sectionalizer & FPIs
- Time synchronization of RTUs, FRTUs & FPIs (if time synch is supported in FPI)
- Data Exchange (in specified format (OPC / CIM-XML / ICCP / ODBC Format) Model & Data Exchange over IEC 61968-1 Enterprise SOA Based BUS)
- Data Processing
- Continuous real-time data storage and playback
- Sequence of event processing
- Supervisory Control
- Fail-safe capability
- Remote database downloading ,diagnostics & configuration
- CIM compliance IEC61968
- GIS adaptor (GIS Landbase data, network model using GIS engines/adaptors supporting Native Adapters , CIM/XML Model for Distribution / Power System, using Model Exchange & Data Exchange over IEC 61968-1 Enterprise SOA Based BUS)
- Information Storage & Retrieval (ISR)
- Data recovery (DR)

The SCADA system shall have capability to accept data from the following sources

- Telemetered data received from RTUs, FRTUs & FPIs
- Data exchange
- Calculated data
- Pseudo-data (Manually entered data)
- GIS land base data, network model using GIS engines/adaptors



POWER SYSTEM AUTOMATION – OVERALL ARCHITECTURE



LOCAL MONITORING AT EACH SUBSTATION

1.13.30.5.1 Communication protocol

SCADA system shall use the following protocols to communicate

- for RTU - IEC 60870-5-104 protocol also 101 to communicate when acting as data concentrator with slave devices
- for FRTU- IEC 60870-5-101 /104 protocol
- for FPIs - IEC 60870-5-101 /104 protocol
- for MFTs – MODBUS
- for DR & Other any other SCADA system - ICCP/TASE.2 in specified format (OPC / CIM-XML / ICCP / ODBC Format) Model & Data Exchange over IEC 61968-1 Enterprise SOA Based BUS)
- for IT Systems - (in specified format (OPC / CIM-XML / ODBC Format) Model & Data Exchange over IEC 61968-1 Enterprise SOA Based BUS)
- In case existing system uses DNP3.0 protocol, the same shall be used for integration of existing RTUs.

1.13.30.5.2 Design Requirements of SCADA System

Design requirements of the system shall take into consideration following criteria:

- Fail Safe Design
- System Availability
- Equipment Reliability
- Expandability
- User friendly to operate and maintain
- Fault Monitoring and Diagnostic Capability
- Redundancy Requirement
- Time synchronization

The above requirements are elaborated further as follows:

Fail Safe Design

The hardware and software modules, subsystems and total system shall be designed so as to be fail safe and shall take into account IEC defined interference levels which are normally present in power system network. In no case, shall a device or software failure or a combination of failures jeopardize the integrity of the power system or the

safety of personnel. Checks back before execute and SCADA permissive features shall be incorporated.

System Availability Requirements

- All equipment and systems covered in this specification shall be designed for maximum reliability and availability.
- All equipment and systems shall be of proven design using material with well established physical and chemical properties and as appropriate to the service intended.
- Adequate redundancy shall be built in at various levels to increase the system availability and reliability.
- The system shall be designed with extensive self-diagnostics and troubleshooting features. Adequate facility shall be provided for quick repair/maintenance and on-line replacement of faulty modules. This shall not result in spurious trips. Where a major equipment/circuit status change is likely to occur when the card is pulled out, it shall be identified by CONTRACTOR.
- Components used in the equipment and systems shall be designed with higher rating than required for the normal operating conditions in order to have higher availability of the system.
- Control system failure shall avoid system upsets and subsequent loss of application.
- Easy access shall be provided for all components in the equipment and systems offered to reduce the maintenance period.

Equipment Reliability

All equipment furnished shall be of good manufacturing quality and of high reliability. Equipment showing poor reliability record during system development and prior to final acceptance should be replaced.

Expandability

The system must be expandable with respect to all subsystems in order to allow growth of the power system network due to addition of new circuit (s)/ equipment(s).

The system supplied shall be easily configurable to allow changes at site.

All software functional modules shall be reconfigurable without requiring hardware additions or modification. CONTRACTOR shall state if any restrictions are imposed on the proposed configuration regarding:

- . Type of Controller card
- . Type of I/O card.

CONTRACTOR shall state if any constraints are imposed by the initially proposed system as regards to future expansion including:

- . Addition of controllers,
- . Addition of drive modules,
- . Addition of operator interface equipment,
- . Increase of communication capacity on data bus and communication equipment,
- . Connection to additional computer systems,
- . Addition of I/O system.

User Friendly

The system shall be provided with bulletin help functions and be operator friendly for easy man-machine communication. It shall be possible for a control engineer without any software knowledge to program the system for any complex application easily, Debugging aids shall be provided for software testing and maintenance of the system and sub-system components/parts.

Fault Monitoring and Diagnostic Capability

- All equipment shall continuously monitor itself for internal faults.
- Every Individual system shall have a self-checking facility for the reliable operation of its components.
- A comprehensive fault monitoring system shall be provided to signal individually all types of internal faults of the control equipment at card level.
- Signaling and indication of faults shall include common alarms and individual alarms including interlock signals.

Redundancy Requirement

- Redundancy shall be provided at the following levels as detailed below:

Processing Level

Control engineers communication and monitoring system shall be fully redundant

The communication equipment between the Data Bus System (DBS) and Control Engineers Interface Equipment (CEIE) shall be fully redundant

- Non-SCADA based independent permissive interlock logic back-up for all plant equipment

Communication Level

- Redundant main data bus for control Engineer/ Process communication.
- Redundant communication controllers.
- Redundant data bus controller, if applicable.
- Redundant control engineer's communication system.

Operator Interface Level

- Assignable control VDUs
- Assignable printers for alarms/events , graphics and logs/reports.

Power Supply system

Power supply modules and distribution of auxiliary power supply to various equipment may be specified as standalone or fully redundant depending upon the reliability of power supply.

Time synchronization

GPS system should be installed in the MRS control room and all the SCADA equipment are to be time synchronized through the system supplied by the SCADA Contractor, which is going to be the common system.

1) System to Be Furnished

The SCADA system shall have sub-systems shall be complete in all respect with hardware, software, control cubicles, control desk, all primary elements like transducers/sensors, junction boxes and all prefabricated and interconnecting network efficiently, reliably and safely from the control room. In addition to the items specified above, following items shall also be provided as specified elsewhere in the specification.

i. Back-up Control Panel (CP)
ii. Indicating/Recording meters and operational hard wares like control switches along with mimic diagrams mounted on back-up Control Panel (CP).

SCADA system supplied shall be capable of total integration of all subsystems/functions. A brief description of the various subsystems of SCADA system is given below:

1.13.30.5.3 Data Acquisition & Monitoring System (DAMS)

SCADA system shall acquire data from Remote Terminal Units (RTUs), FRTUs &FPIs. RTU & FRTU: The type of data to be acquired through RTUs, FRTUs includes analog values, digital status data (Double point and single point indications) and SOE data from the substation, RMUs etc. Analog values like P, Q, F, each phase V, each phase I, each phase pf, and energy values (Export/Import KWh and KVARh) is collected by the RTU, FRTUs from the MFTs. Analog values such as station battery voltage, oil temperature, winding temperature, tap changer, weather transducer data etc. is acquired through RTU using analog input modules & suitable transducer.

FPIs: Digital status in the form Fault protection indication viz O/C & E/F & in case also analog data such as Fault settings are remotely. The actual point counts & type of data acquired are given in the RTU, FRTU specification.

Acquisition Modes

The following modes of data acquisition shall be supported:

- **Enable** - When RTU/FRTU/FPI is enabled, the data is scanned in normal fashion and control command execution is allowed
- **Disable** - When RTU/FRTU/FPI is disabled, the data scanning & control execution is disabled.
- **Test /Maintenance** - **Placing** an RTU/ FRTU in test mode shall generate an appropriate event message. When an RTU/FRTU is in the test mode, the real-time database shall retain the last value from all points collected via the RTU/FRTU before it was placed in the test mode. The points shall be marked in the database with a quality code indicating that their source RTU/FRTU is in the test mode. All system displays, programs, data links, and other devices shall use this value. Supervisory control of points that are in the test mode shall not be permitted. When an RTU/FRTU is removed from the test mode, a message shall be generated, the test mode quality code shall be removed from all points assigned to the RTU/FRTU, the database values shall resume updating on each scan, and any controls for the RTU/FRTU shall be enabled.

1.13.30.5.4 Data Processing

The SCADA system shall prepare all data that they acquire for use by the power system operations and other applications. The data processing requirements shall apply to data collected from all specified sources. Data acquired from

RTUs/FRTUs/FPI/IT system, as well as data received from the DMS and the existing control centers if any, shall be processed and placed in the Real-Time Database as soon as it is received.

Data processing involves a value which has been converted to internal form and analyzed for violations of limits. The data processing shall set various data attributes depending on the results of the checks and shall trigger any additional processing or calculation. The SCADA system shall prepare all the acquired data for use by the power system applications. The SCADA system shall have capability to accept data from the following sources:

Real-time (also referred as telemetered) data received from control Centre/IT system (data Centre, customer care, DR Centre and RTUs/FRTU/FPI etc.)

- Calculated data
- Manually entered data
- Sequence of events data
- Alternate data sources

1.13.30.5.5 Analog Data Processing

Analog data processing shall be performed according to the requirements listed below.

- Conversion to Engineering Units

Analog points that are transmitted to SCADA system in raw data format shall be converted to engineering units before being stored in the database. This conversion function shall include, as a minimum, the capability to perform the following conversion algorithm:

Value = (A * scanned valued) + B, where A and B are programmer-adjustable constants assignable as database attributes on a per point basis.

- Zero dead band processing

The SCADA system at control Centre shall process each analog input for dead band zone processing. The acquired value, if falls between the dead band range around zero then it shall be considered as clamped zero value else the actual value shall be considered.

- Reasonability Limit Check

The reasonability limits shall represent the extremes of valid measurements for the point's value. All analog values shall be compared against defined high and low reasonability limits. The comparisons shall be performed at the scan rates of the analog values. An alarm shall be generated the first time a reasonability limit violation is detected. The last valid value of the variable shall be maintained in the database and marked with a quality code indicating the 'reasonability limit violation'. When data returns to a reasonable value, the new value shall be accepted and a return-to-normal message shall be generated.

- Limit Monitoring

For bi-directional quantities (positive or negative) there shall be a set of three limits for each direction. For unidirectional quantities there shall be a set of three limits in one direction. These limits will represent increasing levels of concern and shall be named as "Operational", "Alarm" and "Emergency" limits. These three limits shall be set within the boundaries of reasonability limit. Generally, any alarm can be assigned as audible alarm but emergency limit shall necessarily be assigned as audible alarm.

All telemetered and calculated analog point shall be compared against above sets of high and low limits each time the value is scanned or calculated. Whenever a monitored point crosses a limit in the undesirable direction a limit violation alarm message shall be generated. Whenever a monitored point crosses a limit in the desirable direction, an exit alarm message shall be generated. If multiple limits have been crossed since the last check, each limit crossed shall be reported.

All limit monitoring shall preclude annunciation of multiple alarms when a value oscillates about an alarm limit by utilizing a programmer-adjustable alarm dead-band for each point.

The user shall be able to temporarily override any of the above limits (which are in use) by entering a new value. When the user overrides a limit, it shall be marked with a 'limit override quality code' on all displays. The override value shall be recognized, and any display, report, or log containing the value of the overridden limit shall include it as such. An override value shall be used instead of the permanent value until the user removes the override condition or system is reinitialized. Any change in alarm states resulting from a change in limit value shall be reported. Contractor shall finalize & take approval from utility for limit values.

Rate of change /Gradient

All telemetered and calculated analog points shall be also processed for rate of change of / gradient processing, if defined that point for such processing in the database. An Alarm for over shoot & event message for return to normal shall be generated.

The rate of change shall be calculated periodically for each assigned point, by dividing the point's values at the beginning and the end of the period into the length of the period. Filtering shall be applied so that single scan excursions do not cause an alarm. The result shall be saved as a non-telemetered database point. All the requirements that apply to calculated points, such as limit checking

Sign Conventions

The sign conventions for the display, data entry and reporting of active and reactive power flow shall be used universally by all SCADA functions. All imports to bus bars shall be represented with + sign and all exports from bus bars shall be with –ve sign.

Accumulator Processing

The system shall be able to store accumulator history. Storing accumulator history shall be provided with a method in which that stores data only once per hour and in other method that stores data each time new data enters the system.

It shall be possible to use the two methods concurrently for any pulse accumulator, making it possible to maintain two records for data that are read more than once an hour.

1.13.30.5.6 Digital Input Data processing

Each state of a digital input point shall be associated with the state of an actual device. The number of bits that will be used to define the state of a device is defined in the RTU/FRTU Specification. A status point shall be defined as being either legal or illegal, and normal or abnormal:

- Illegal state: The first check on a new input to a digital status point is the legality check. If the new state is illegal, then the old value shall be left in the database and marked old with relevant quality code such as telemetry failure etc.
- Abnormal state: If the new state is legal, it shall be checked to see if it is among the normal states defined for the point. If not, the status point shall be marked as abnormal. While abnormal, it shall appear in the summary display of abnormal conditions/ off-normal summary

- Alarm checking: Each new value shall be checked to see if transitions into that state are to be alarmed. If so, and if no control action is pending on the status point, then an alarm action shall be triggered.

The following digital input data types shall be accommodated as a minimum:

Two-state points: The following pairs of state names shall be provided as minimum :

- Open/Closed
- Tripped/Closed
- Alarm/Normal
- On/Off
- Auto/Manual
- Remote/Local
- On Control/Off Control

Three-state points: Any of the state combinations listed in (a) above shall be supported with a third, typically, in-transit state which is the case for slow operating devices such as isolator. If a device remains in this state for a period more than a threshold value, the same shall be alarmed.

Commanded changes initiated by supervisory control shall not be alarmed but shall generate an event message. All other status changes in the state of telemetered, calculated digital input points & uncommented changes shall be alarmed. Each CB, isolator switching device etc shall have normal & off normal positions states defined. In the event of off normal positions, the same shall be reflected in the off normal summary list

Calculated Data processing

SCADA system shall be capable of performing calculations and storing the result in the database as calculated data available for display. The database variables to be used for arguments and the mathematical/statistical/logical functions to be used as operations shall be definable interactively at a console as well as by the programmer using database creation and maintenance procedures.

Calculated analog values shall use database points as the arguments and mathematical and statistical functions as the operations. Functions such as addition, subtraction, multiplication, division, maximum value, minimum value and average

value, count, integration, square root extraction, exponentiation, trigonometric functions, logarithms and logical & comparative operators etc. shall be provided.

It shall be possible to calculate running maximum value, minimum value and average value over a time interval (time interval configurable from 5 minutes to 60 minutes). The value shall be reset after the elapse of defined time interval. These values shall be stored with time of occurrence for maxima and minima and the time for averaging.

Calculated status values shall use database points as arguments and combinational logic functions that include the logical, comparative operators such as AND, inclusive OR, exclusive OR, NOT, Less Than, Greater Than, Less Than or Equal To, Greater Than or Equal To, and Equal To ,If , else if etc. Suitable rules or operators (such as multi-level parentheses) shall be provided to indicate the sequence of operations in the calculation.

Substation Topology Processing

The SCADA system shall be provided with a Substation topology processor function. This function shall be capable of analyzing the open/closed status of switching devices, such as breakers and disconnections, in order to define the configuration of the substation for display. The energization of lines, transformers, bus sections and generating units shall be determined so that the associated displays may correctly show the status of these power system elements. The configuration shall be re-evaluated and updated whenever a switching device status change & analog value change beyond dead band is detected.

Alternate source for data

The system shall have capability to accept multiple data sources by defining as main & secondary. Normally, data from normal source will be considered. In the event of non-availability of primary source, data from secondary source shall be considered & once primary source is healthy, it shall switch back to primary source. There shall be an indication for primary /secondary source in displays, reports etc. Suitable alarm shall be generated in the event to change from primary to secondary & vice versa. Alternate source of data can be defined for certain critical points in the database

1.13.30.5.7 Telemetry Failure

If data is not received from an RTU/FRTU/ FPI after a user-adjustable number of retries, each affected point in the SCADA system shall be marked with a ‘telemetry failure quality code’ and an alarm shall be generated. Telemetry failure of data can be

due to failure of communication link, failure of complete RTU/, FRTU/FPI or RTU/ FRTU module or MFT etc. Only a single alarm shall be generated if an entire RTU/ FRTU or its communication channel fails.

In the event of telemetry failure, the last good value/status shall be retained in the database for each affected point. When telemetry returns to normal, the associated SCADA system shall automatically resume updating the database with the scanned data.

The user shall be able to substitute a value in the database for any point that is experiencing telemetry failure which shall be marked with 'manual replaced' quality code in addition to the 'telemetry failure' quality code. The user shall also be able to delete any point (or entire RTU/FRTU/FPI) from scan processing. All deleted points shall be marked with a 'delete-from-scan' quality code.

1.13.30.5.8 Polling method

Digital status data from RTU shall be reported by exception and shall be updated and displayed within 4 seconds. Digital status data from FRTU & FPI shall be also be reported by exception and shall be updated and displayed within 6 seconds. Digital status data shall have higher priority than the Analog data. The system shall have dead band for data by exception.

All analog values except energy values shall be reported by exception from the RTU, FRTU & FPI. The analog value, when reported by exception, shall be updated & displayed within 5sec from S/S & 10sec from RMU/sectionlizer locations at the control Centre. An integrity scan of all status & Analog values shall also be made every 10 minutes (configurable).

The provision shall also be made to report analog values & status data periodically at every 10sec (user configurable), if required by the user.

The time skew at SCADA control Centre, S/S, RMU, FPI shall not be more than 0.1sec at each location & latency shall not be more than 0.5sec for status. For analog data the time skew shall not be more than 1sec & latency shall not be more than 1sec for analog as per IEEE C37.1.Energy values of 15 minute blocks shall be collected periodically from the RTU, FRTU at scan rate of 15 minute/1 hour (configurable upto 24 hours). Alternatively the energy values shall be calculated for each 15 minute/1 hour blocks at SCADA level from the acquired energy values of MFTs through RTU & FRTU.

The contractor must assess & take the network delay into consideration while designing the system so that the update time in normal & peak level of activities are met.

The SCADA computer system shall also be able to collect any and all analog & digital data from its RTUs/FRTU/FPI on demand. Apart from the periodic integrity scan, the integrity scan shall also be initiated automatically for an RTU/ FRTU/ FPI whenever the following situations arise:

1. Upon startup of the system
2. RTU/ FRTU/ FPI status change is detected such as RTU/ FRTU/ FPI restart, Communication Link restoration
3. On demand by SCADA functions
4. On request by the user

The TCP/IP Communication for RTU, FRTU, and FPI on public network shall be encrypted over SSL Security / VPN & the equipment should take control command from designated Master IP address only and no other IP. The RTU, FRTU, FPI & all TCP/IP devices that are on Public Network shall form a private VPN network with the SCADA Front End, through which encrypted data gets exchanged.

1.13.30.5.9 Supervisory Control

It gathers data on the process and sends commands (control) to the SCADA system. The operator shall be able to request digital status control, set-point control and raise/lower control on selected points and analogs using Select check before operate (SCBO) Sequence. Supervisory control shall allow the SCADA system to remotely control switching devices. A control action shall require a confirmation-of-selection-prior-to-execution response. Initiation of the control execute step shall occur after the dispatcher confirms that the correct point and control action have been selected. After the dispatcher/DMS function initiates control execution, the RTU/FRTU shall be addressed for verification that the correct point has been selected at the RTU/FRTU and then the control action shall be executed. It shall also be possible to reset the flag in FPI through a command. It shall be possible to issue control commands as a group control from SCADA where switching devices pertaining to different RTUs/FRTU or a RTU/FRTU may be controlled as a group. The SCADA system shall send the control commands sequentially (without dispatcher intervention), if the commands pertain to switching devices in the same RTU/FRTU, using the Selection Check before operate (SCBO) of prior–to-execution. The control commands pertaining to different RTUs

/FRTUs may be executed in parallel. If, after selecting a point, the user does not execute the control action within a programmer-adjustable time-out period, or if the user performs any action other than completing the control action, the selection shall be cancelled and the user be informed.

If the communication to the RTU /FRTU is not available, the control command shall be rejected and shall not remain in queue. The user shall not be prevented from requesting other displays, performing a different supervisory control action, or performing any other user interface operation while the SCADA system waits for a report-back on previously executed control actions. The system shall process supervisory control commands with a higher priority than requests for data from the RTU /FRTU /FPI data acquisition function. Functional requirements for the various types of supervisory control are given below. A supervisory control request shall be sent from control Centre only after the controlled point was checked for proper conditions. The request shall be rejected by the System if:

- The requested control operation is inhibited by a tag placed on the device;
- The device or S/S in local manual control mode
- An Uninitialized, Telemetry failure, delete from scan, manual replaced , Test/maintenance , or Manually Entered data quality indicator is shown for the device
- Time out after selection
- The device is not subject to supervisory control of the type being attempted
- Rejection of a control request from control Centre shall occur before any transmission is made for control purposes. A control rejection message shall be displayed for the Dispatcher.

1.13.30.5.10 Digital Status Control

Digital Status Control Output results in the activation of an output relay in a RTU. Different commands shall be possible for this digital status control:

Successful completion of the control request shall be recorded as an event. Failures to complete shall be handled as specified in UI section. Control requests shall be canceled and the selection of the point shall be terminated when the user cancels a request, does not perform the next step of the control procedure within the selection time-out period from the previous step of the procedure, or the request is rejected.

1.13.30.5.11 Breakers

The user shall be able to select and operate the two state controllable switching device i.e. Circuit breakers/ isolators (in case of RMUs)

1.13.30.5.12 Capacitor Banks

The user shall be able to control capacitor devices. The procedure for controlling these devices shall be the same as that of a switching device except that any supervisory control action must be inhibited for a programmer-adjustable time period after the capacitor/ reactor device has been operated. A message shall appear if an attempt is made to operate the device prior to expiration of that time period & dispatcher is required to give command after expiration of inhibited time period.

1.13.30.5.13 Tap Changing Transformers

SCADA system shall have the capability to raise and lower the on load tap position of the transformers from SCADA control Centre through supervisory commands.

Depending on system conditions, the user may raise or lower the tap positions of On Load Tap Changing (OLTC) transformers. OLTC's tap position needs to be monitored if supervisory control action is to be exercised. OLTC tap position input shall be acquired as an analog value. Tap excursions beyond user-specified high and low limits shall cause the master station to generate an alarm.

Supervisory control of OLTCs shall only be permitted when the transformer's control mode is Supervisory. All attempted invalid control actions shall be rejected.

For supervisory operations, the initial selection and control of the transformer for a raise/lower operation shall follow the (SCBO) Sequence. Upon receipt of the raise/lower command, the RTU will immediately execute the control action. It shall not be necessary for the user to re-select the transformer for additional raise/lower operations; the user shall only have to repeat the desired number of raise/lower commands, which shall be executed immediately. Normal scanning functions shall not be suspended between the times that repeated raise/lower commands are issued.

The user shall be able to cancel the operation or have it automatically cancelled by the master station after a programmer-adjustable time period elapses after the last raise/lower command. This multi-step procedure as described below

The RAISE and LOWER pushbuttons shall be displayed.

The command shall be launched as soon as RAISE or LOWER is selected. The Raise and Lower buttons shall not be replaced by a single Execute button. The RAISE/LOWER pushbuttons shall continue to be displayed, and it shall be possible to initiate these controls repeatedly without reselection of the controlled point, provided that the execution of the previous control command has successfully been completed.

The RAISE/LOWER pushbuttons shall remain available until either (a) the dispatcher clicks the CANCEL button.

1.13.30.5.14 Set Point Control

The SCADA shall provide the capability to issue set point control using SCBO procedure to field equipment The SCADA shall transmit a numerical value to the device being controlled, to indicate the desired operational setting of the device.

1.13.30.5.15 Auto Execution sequence/ Group Control

The Auto execution sequence function shall permit multiple supervisory control commands to be programmed for automatic execution in a predefined sequence. The dispatcher shall be able to execute this sequence. Commands to be supported shall include:

- Time delayed
- Pause & until a user commanded restart or step execution
- Jump to other sequence on certain conditional logic
- Manual Entry.

After executing a supervisory control action, the SCADA shall pause to obtain an indication of a successful control completion check. If the control completion check is not received, or does not have the expected value, the SCADA shall terminate the execution of the sequence and shall declare an alarm. Apart from waiting for control completion checks, and unless there is an explicit command for a delay, such as a “Pause” or “Stop” command, the SCADA shall not introduce any other delays in the execution of an sequence. No limit shall be placed on the number of Auto execution sequences, which may execute in parallel.

At any time during the execution of a list, the user shall be able to stop further execution via cancel feature.

1.13.30.5.16 Control Inhibit Tag (Tagging)

A user shall be able to inhibit or enable supervisory control on any device. A tag symbol indicating the control inhibit conditions shall be displayed next to the device on all displays where the device is presented. The programmer shall be able to define up to 4 tag types with the following attributes for each:

- Type of controls that shall be inhibited by the tag (e.g., open only (Green tag) close only (Yellow tag), open and close (Red tag), or information only - no control inhibit (White tag). Tags shall be preferably identified by colors. However, distinct symbols /shapes after approval from employer may also be used.
- Tag priority - Further the user shall be able to place at least 4 tags per device. Only the highest priority tag shall be displayed. Any combination of tags shall be supported, including multiple tags of the same type. The combined effect of multiple tags shall be to inhibit a type of control if it is inhibited by any of the tags. When a tag is placed on a device, the user shall be prompted to enter tag number and comment. An event message shall be generated each time a control inhibit tag is placed or removed with information on user ID, type of tag, time of placement or removal of tags.

1.13.30.5.17 Information Storage and Retrieval

Information Storage and Retrieval (ISR) function shall allow collection of data from real-time SCADA system and storing it periodically in a Relational database management system (RDBMS) database as historical information (HI) data. This includes storing of data such as SOE, status data, Analog values, calculated values, Energy values etc. Programmer shall also be able to set storage mode as by exception in place of periodic storage. Subsequently, the data shall be retrieved for analysis, display, trending and report generation.

All stored data shall be accessible from any time period regardless of changes made to the database after storage of that data (e.g., it shall be possible to retrieve stored data for a variable that no longer exists in the SCADA computer system through back ups on storage medias viz. tapes /MO disks etc and initialise study-mode DMS functions with stored data on the corresponding power system model). The addition, deletion, or modification of data to be collected and processed shall not result in loss of any previously stored data during the transition of data collection and processing to the revised database. It should be able to compress data, and should have 100%

retrieval accuracy. However, the retrieval of compressed historical streams should be of the same performance levels as normal SCADA retrieval. The ISR should be able to interface over ICCP, OPC, ODBC and CIM/XML to external systems for analytics over SOA / ESB for Integration with IT Systems, over the Enterprise Services Bus & SOA Architecture provided as part of IT SRS. The ISR system shall act as the real interface between SCADA and IT System, where-by the real-time operational system is not affected with a transaction processing system like IT, and the IT Integration efforts will not in any way effect the real-time operationally of SCADA System.

ISR should also support ad-hoc queries, and define display and report formats for selected data via interactive procedures from operator workstations. Formatted reports and responses to user queries shall be presented in alphanumeric or graphical format on either operator workstations or printers at the option of the user. Procedure definition facilities shall be provided for activities that will be frequently performed. SQL-based language shall be used for selecting, retrieving, editing, sorting, analysing, and reporting ISR data stored. The selection and sorting criteria shall include time tags and ranges, station names, point names, equipment types, status values, text string matches on selected data fields etc and combinations of these criteria. It shall be possible to reload any IS&R archival media that has been removed from IS&R and access the archived data without disturbing the collection, storage, and retrieval of IS&R data in real-time.

Circuit breaker status Table

The ISR function shall maintain a table in RDBMS database where real-time status of all Circuit breakers, in case of RMU isolators also along with the associated quality codes shall be stored. The change of status of any breaker shall be updated in this table as soon as the change is detected by the SCADA system. This table shall contain additional information such as date & time of tripping, cause of tripping, Expected duration of outage etc. Some of the causes of tripping could be Supervisory control by user, Protection tripping, Tripping / closing by DMS applications. Information on expected duration of outage shall be taken from schedules for DMS application such as Load shed application etc. For expected duration of outages due to protection tripping, the same shall be user enterable field.. Such daily tables for two months duration shall be stored on auxiliary memory. Tables for the previous day shall be backed up to Magnetic tape by the user at 10AM daily. The ISR function shall transfer the information available in the "Circuit breaker status table" as defined above, to the Customer Care centre. The complete Circuit Breaker Information shall be transferred

to Customer care centre on demand & by exception along with the associated quality codes and additional information associated with the CB.

Real-time Database Snapshot Tables

At the end of each 5 minutes, the following real time snapshot data shall be stored in RDBMS in Real-time Database Snapshot tables:

- All telemetered analog values and Calculated values for all tele-metered analog points (atleast maxima & minima with associated time and average values). Energy values are not envisaged for storage in Data snapshot tables
- All status values with time stamp

All the above values as specified above in (a) & (b) shall be stored alongwith their associated quality code. The periodicity of the snapshot shall be user adjustable to include 5, 15, 30, and 60 minutes. Data Snapshot tables shall be created on daily basis. Such daily tables for two months duration shall be stored on auxiliary memory. Tables for the previous day shall be backed up to Magnetic tape/ MO disk by the user at 10AM of every day. The ISR function shall prompt the user through a pop-up window to inform the user for taking the backup. The pop-up window shall persist till user acknowledges the same. In addition to that data can be stored on offline storage device . The user shall also be able to initialize the study-mode power system analysis functions from stored snapshot data.

Hourly Data tables

At the end of each hour information as defined below shall be included in the hourly data tables, in RDBMS database form:

- Selected analog values alongwith their associated quality codes
- Selected status values alongwith their associated quality codes
- Results of hourly calculations for selected analog points (atleast maxima & minima with associated time and average) alongwith their associated quality codes.

In addition to above a separate hourly energy data table exclusively for energy values (Export and Import Active and reactive Energy values for each feeder) shall be created in ISR along with their associated quality codes.

Hourly data tables shall be created on daily basis. Such daily tables for two months duration shall be stored on auxiliary memory. Hourly data table for the previous month shall be backed up to Magnetic tape /MO disk by the user on the 10th of every month. The ISR function shall prompt the user through a pop-up window to remind the user

for taking the backup. The pop-up window shall persist till user acknowledges the same.

Missed Hourly Data Storage

The programmer shall be able to independently assign any one of the following processing for each hourly value to be executed when the value is missed and cannot be acquired prior to the storage of hourly values.

- Store zero and a telemetry failure quality code for each missed hour.
- Store the last good data value, with a questionable data quality code, for each missed hour.
- Temporarily store zero with a telemetry failure code for each missed hour. When the next good hourly value is obtained, divide that value by the number of hours since the last good value was obtained and insert this value, with a questionable data quality code, for all hours with missed data and the first hour that good data was obtained as is the case for energy values.

Hourly Data Calculations

The programmer shall be able to define calculated values using stored hourly data and constants as operands. The calculations shall allow the carry-forward of data from one day, week, or month to the next. The results of all calculations shall include quality codes derived from the quality codes of the operands. The following calculations shall be provided:

- Addition, subtraction, multiplication, and division
- Summation of an hourly value by day, week, and month: The running total of the summation for the current day, week, and month shall be updated each hour and made available for display
- Maximum and minimum of a value over a programmer-definable time period, and the time the maximum or minimum occurred
- Average of a value over a programmer-definable time period

Daily Energy Data table

The daily energy data table shall be generated for storage of daily energy values for 15 minute blocks / one hour blocks of a day & shall be stored for each feeder on daily basis alongwith quality codes. This daily energy data shall be exchanged with the Billing system on daily basis and on demand. This table shall be created on daily basis. Such daily tables for two months duration shall be stored on auxiliary memory. Daily

Energy data table for the previous month shall be backed up to Magnetic tape by the user on the 10th of every month.

Load priority table

ISR system shall maintain a Load priority table containing information such as breaker name, number of consumers connected to each Breaker and Load priority of each Breaker. This table shall be updated by the Billing system. SCADA control centre operator can also assign priorities in load priority table & the priorities assigned by the Billing system. There shall be suitable alarm/event message including user ID for such activity. The table information shall be used by various DMS applications.

SOE data table

ISR system shall maintain SOE data table which shall store the SOE data for complete distribution system. It shall be possible to sort the table by Time, Date, Substation name/, feeder/line name, device name etc. using SQL commands. This table shall be made on daily basis. Such daily tables for two months duration shall be stored on auxiliary memory. For the purpose of sizing of table, daily 4 changes per SOE point may be considered. All CBs, protection and alarm contacts shall be considered as SOE. Tables for the previous day shall be backed up to Magnetic tape/ MO disks by the user at 10AM of every day.

1.13.30.5.18 Playback and Root Cause Analysis

- The SCADA system shall be capable of being configured to provide a complete picture of the electrical system from the stored data. This includes playback of a previously recorded monitored data, calculated system parameters, sequence of events, and message log.

- SCADA shall include an Event Log, Playback Historian and Playback Console and shall utilizes archived data for root “cause and effect” investigations, improvement of system operations, exploration of alternative actions, and replay of “What if” scenarios.

- The event log shall be synchronized and displayed while the playback is in progress. It shall allow the operator to determine, at a specific time, what events were occurring in the power system, what was being reported to the operator, and what operator action resulted, if any.

- The playback historian shall provide seamless retrieval of data from the SCADA system historian for any events from any real-time console. The playback data is stored in an ODBC/SQL database and can be transferred to any user with the appropriate authorization.

- The playback console shall allow the system operator to control playbacks to re-run at original or accelerated speeds, single-step, fast-forward, or rewind through the message log. Playback resolution is operator controlled and determined by the scan rate of field devices. Full simulation capabilities shall be available to the system operator at any point during the replay; the operator shall be able to explore the effects of alternative actions at any point of recorded data.

- The Operator Console shall provide a complete historical (archiving) subsystem providing the user the capability to capture and analyze historical data.

- The system shall allow selection of any point in the system to be added and configured for archiving.

- The archiving system shall utilize a Microsoft SQL real-time relational database for storage of all process related data. Flat file or internal proprietary databases will not be accepted.

- The archiving system shall be configured using standard tools provided by the system to facilitate the display and editing of archive rates, archive types, etc. from graphical and tabular data displays.
- The system shall support the online addition of new tags to the historical database without interrupting operations.
- The historical subsystem shall promote the visualization of historical data in both tabular and graphical form. This includes the capability to view historical data via a web-enabled interface.
- The historical subsystem shall provide the ability to define archiving rates in increments of seconds, minutes, hours, or days.
- The historical system shall allow an individual archive rate to be programmatically modified and/or utilized as part of the Control Logic/Scripting requirements specified above.
- The system shall support archiving of up to 20,000 different variables per historical server.

- The system shall supply tools for automatically backing up the database to removable media or to an alternate storage location. The backup utility shall execute the database backups automatically based on either of the following configurable criteria:

a) Based on the size of the database (e.g. after the size reaches 1 Mbyte)
b) Time-based (e.g. every 24 hours)

1.13.30.5.19 Data Exchange with Customer Care System

The ISR function shall transfer the information available in the "Circuit breaker status table" as defined in this chapter, to the Customer Care centre using SOA/Enterprise Service Bus over CIM/XML Models, or CIM/XML OPC/ICCP /ODBC Adapters / Interfaces. The complete Circuit Breaker Information shall be transferred to Customer care centre on demand or Changed Information shall be send along with the quality codes and additional information associated with the CB.

1.13.30.5.20 Data Exchange with GIS system

SCADA Systems over CIM/XML Models using GID to IEC 61968-1 will be used by SCADA & other IT Systems for getting network information, customer and interconnection information. The GIS will interface using CIM/XML adapters to other applications. SCADA will have model aware adapters to read from GIS network model repository, and update its own models. The system shall utilize an IEC 61970 and IEC 61968 compliant interface.

The system shall enable export of all data via a CIM-XML interface per IEC 61970-452 and IEC 61970-552-4 and shall utilize modeling from IEC 61968-11 as appropriate. Data exchange shall be over model neutral messaging services and CIM/XML data exchange for real-time or RDBMS will be used. The following standards as applicable will be used to achieve the above requirements: Messaging interfaces shall be based on model neutral interfaces based on the IEC 61970-40X series for access to real-time and historical data and use the IEC 61968-3 and IEC 61968-9 standards for messaging interfaces that are model dependent for network operations and metering respectively The Graphic data import from a GIS systems shall support native formats of GIS systems which shall be potentially used for data import. All Technological addresses (TAs) shall be automatically assigned within the system to the tags linking the graphic data to the attribute data in the GIS, the attribute data shall be loaded into the SCADA data base and the display diagrams shall be generated.

The Graphics exchange between GIS and SCADA should happen over IEC-61970-453 Scalar Vector Graphic based XML representation

The complete network model including data of electrical network e.g. line (i.e. length, type of conductor, technical particular of conductor & transformer etc, land-base data. Suitable GIS interface adaptor to enable the compatibility with GIS software/ data format /model shall be provided. The Graphic data import from a GIS systems shall support native formats of GIS systems which shall be potentially used for data import. The data shall be transferred on global & incremental basis on manual request & automatically, once in a day The DMS shall automatically move elements that overlap one another in congested areas so that the operator can clearly see each segment of the network in the geographic view. In addition, the system shall automatically move and scale annotation text that come from GIS so that it is visible the user's current display SCADA in the geographic view. The system shall include tools to edit annotations /text & symbology placements in geo –referenced displays, substation and

distribution network. It shall be possible to import related reference layers such as streets, buildings, poles etc and other background information.

All Technological addresses (TAs) shall be automatically assigned within the system to the tags linking the graphic data to the attribute data in the GIS, the attribute data shall be loaded into the SCADA data base and the data /text shall be displayed on SCADA diagrams if viewed in GIS mode shall display GIS in background with zoom ,pan , scaling & UI navigation techniques in synch with SCADA system displays. The GIS Network Model shall be exposed to the IT and SCADA Systems over CIM/XML Models using GID to IEC 61968-1 Enterprise Bus. This model repository will be the single model authority for the entire Utility network to be used by both IT & SCADA Systems under R-APDRP. This repository is maintained by the GIS System, and will be used by SCADA & other IT Systems for getting network information, customer and interconnection information.

1.13.30.5.21 Historical Information

The data stored in the ISR system shall support the following retrieval capabilities:

The user shall be able to view and edit HI data on displays/Forms and reports. The user shall be able to edit HI data, request recalculation of all derived values, and regenerate and print any daily, weekly or monthly HI report for the current and previous month.

The user shall be able to view tabular trend and graphical trend of multiple data points simultaneously by specifying the start date and time, the end date and time, and the time period between displayed samples. The duration of viewable tabular trend and graphical trend could be up to 24 hours. The features of Tabular/graphic trend are mentioned in the specification for User interface.

The HI retrieval shall expose the ISR Data over SOA / Enterprise Services BUS Supplied by ITIA, over CIM/XML, ICCP or OPC ODBC Interfaces / Adapters.

The retrieval shall provide 100% accuracy and fidelity of data

1.13.30.5.22 System Message Log Storage and Retrieval

System message log, which shall consist of the chronological listing of the SCADA computer system alarm messages, event messages and user messages shall be stored for archival and analysis. Each entry shall consist of time tag and a text containing user and device identification as displayed on the Alarm Summary or Event

Summary displays. The System message log data storage shall be sized for up to 20,000 entries per month.

System message log data shall be stored in daily tables & shall be available for minimum two months on auxiliary memory. System message log data for previous months shall be Backed up on Magnetic tapes/ MO disks by the user for which ISR function shall prompt the user every hour with suitable message to remind user for taking the backup on the 10th of every month. This message shall be disabled once the backup is taken. Facilities to sort and selectively display and print the contents of the system message log shall be provided. The user shall be able to select the display of system message log entries based upon Alarm type, Events, User generated messages, Device, and Time period.

1.13.30.5.23 Auxiliary Power System (APS)

CONTRACTOR shall provide 240 VAC or 110V DC power supply system for complete instrumentation, telecommunication and control equipment of SCADA system. The voltage supply required for the SCADA system shall be derived from the above power supply system by the CONTRACTOR. Necessary power pack with redundancy shall be used at all stages for the SCADA system equipment. CONTRACTOR may be required to provide Battery, Battery Charger or Uninterruptible Power Supply System (UPS).

1.13.30.6 Advanced Distribution Management System (ADMS)

1.13.30.6.1 SCADA / ADMS Interfaces Overview

SCADA/ADMS will be in a single integrated system i.e. there will be no mapping or interfaces between SCADA & Distribution Management System and both functions will be on one platform solution.

1.13.30.6.2 Advanced Distribution Management System (ADMS)

This Section describes the Advanced Distribution Management System (ADMS) applications & other supporting applications that are required for SCADA/ADMS System. The ADMS applications shall utilize the data acquired by the SCADA application.

1.13.30.6.3 ADMS Functions

- Network Connectivity Analysis (NCA)
- State Estimation(SE)
- Load Flow Application (LFA)

- Voltage VAR control (VVC)
- Load Shed Application (LSA)
- Fault Management and System Restoration (FMSR)
- Distribution Load Forecasting
- Operation Monitor (OM)
- Load Management (LM)

1.13.30.6.4 Other Supporting Functions

- Dispatcher Training Simulator

1.13.30.6.5 Graphical & Tabular display Requirements

A network overview display of the distribution system with substations, feeders Colour coded by voltage shall be provided. This display shall present the distribution system in a graphic format. Telemetered and calculated values like active and reactive power flows etc. shall be displayed with direction arrow. Lines, Loads, transformers etc. that have exceeded their loading limits shall be highlighted. Stations shall be depicted by suitable symbols which reflect the presence of alarms. Cursor selection of a station symbol shall result in display of the associated Single line diagram for that station. "What if "analysis shall be included to visualize network & verify the impact before an action is taken by dispatcher. For all switching actions which dispatcher have to execute manually/step by step shall have the option to simulate switching operations in order to visualize the effect on the distribution network using what if analysis

- All DMS result tabular displays shall have capability for sorting by name and calculated parameters.
- The solution prescribed by DMS application shall consider & identify & sort the following as minimum-
  - Remote controllable circuit breaker with capability to interrupt fault currents
  - Non-remote controllable circuit breaker with capability to interrupt fault currents
  - Remote controllable circuit breaker with no capability to interrupt fault currents
  - Non-remote controllable circuit breaker with no capability to interrupt fault currents.
  - Remote controllable disconnector
  - Non remote controllable disconnector
  - Fuse

- Ground/ Earth switch
- Sectionlizer

1.13.30.6.6 Network Model

The DMS applications shall have a common model for the project area comprising of primary substation feeders, distribution network and devices with minimum 10 possible islands, which may be formed dynamically. All DMS applications shall be able to run successfully for the total distribution system with future expandability as envisaged under the specification. The following devices shall be represented in the model as a minimum:

- Power Injection points
- Transformers
- Feeders
- Load (balanced as well as unbalanced)
- Circuit Breakers
- Sectionalizers
- Isolators
- Fuses
- Capacitor banks
- Reactors
- Generators
- Bus bars
- Temporary Jumper, Cut and Ground
- Meshed & radial network configuration
- Line segments, which can be single-phase, two-phase or three-phase and make up a distribution circuit.
- Conductors
- Grounding devices
- Fault detectors
- IEDs
- Operational limits for components such as lines, transformers, and switching devices

All DMS applications shall be accessed from graphic user interface through Operator consoles as defined in this specification. Reports, results and displays of all DMS

application shall be available for printing at user request. Population and maintenance of the distribution network model should be possible by using the database maintenance tools to build the database from scratch.

The model should support multiple geographic coordinate sets for each device so that, if available, the network can be displayed in custom geo-schematic formats. The network views may also include various levels of detail depending on the zoom level. Information such as land-based data may also be displayed as required.

An interface with the already existing Geographical Information Systems (GIS) shall be developed using interoperability features between the DMS and the installed GIS. Each of the two systems shall keep its own specificity, and shall be used for what it has been designed: the SCADA for the real-time data acquisition, control and processing, the GIS for the maintenance of the network construction and geographic data.

The interface shall be developed in order to obtain a maximum benefit of the two systems use. It shall be implemented while maintaining the SCADA/ADMS and GIS integrity as individual systems. It is of the utmost importance that the two systems remain able to operate separately.

The required functionalities for this interface shall cover the two following aspects: The transfer of specific real-time data from the DMS into the GIS data-base. The possibility to navigate easily from one system to the other through the user's interface Data exchanges shall be made through the Control Center LAN/WAN.

1.13.30.6.7 Network Connectivity Analysis (NCA)

The network connectivity analysis function shall provide the connectivity between various network elements. The prevailing network topology shall be determined from the status of all the switching devices such as circuit breaker, isolators etc that affect the topology of the network modelled.

NCA shall run in real time as well as in study mode. Real-time mode of operation shall use data acquired by SCADA. Study mode of operation will use either a snapshot of the real-time data or save cases.

NCA shall run in real time on event-driven basis. In study mode the NCA shall run on operator demand.

The topology shall be based on -

- Tele-metered switching device status

- Manually entered switching device status.
- Modelled element status from DMS applications

It shall determine the network topology for the following as minimum -

- Bus connectivity (Live/ dead status)
- Feeder connectivity
- Network connectivity representing S/S bus as node
- Energized /de-energized state of network equipment
- Representation of Loops (Possible alternate routes)
- Representation of parallels
- Abnormal/off-normal state of CB/Isolators

The NCA shall assist operator to know operating state of the distribution network indicating radial mode, loops and parallels in the network. Distribution networks are normally operated in radial mode; loops and/or parallel may be intentionally or inadvertently formed.

A loop refers to a network connectivity situation in which there exist alternative power flow paths to a load from a single power source. A parallel refers to a topological structure in which a load is fed from more than one power source. Parallel paths often result in circulating currents and such operating conditions need to be avoided. All loops/parallels in an electrical network shall be shown by different colors in such a way that each is easily identifiable.

Abnormal state of CB/Isolators means these devices are not in their Normal OPEN or CLOSED position. Alarms shall be generated when presence of abnormal switches, De-energized components of network and of Network loops / parallels is detected.

Tracing

NCA function shall also have the capabilities of network tracing when requested by the dispatcher. Dedicated colors shall be used for feeder and circuit tracing and also when information available is not complete or inconsistent. The trace shall persist through subsequent display call-ups, until the operator explicitly removes it or requests another trace. In addition, at the bottom of the geographic view the number of transformers and customers passed by the trace are shown -

- **Feeder tracing** - This feature shall aid dispatcher to identify the path from a source to all connected components by same colour.

- **Circuit tracing**- This feature shall enable operator to select any device and identify the source and path by which it is connected through the same colour.
- **Between Tracings** - This feature shall enable the operator to select any two components of the network and shall able to trace all components connected in between them.
- **Downstream Trace** – from a selected circuit element the trace identifies all devices that are downstream of the selected element. In the case where a downstream trace is performed on a de-energized section of the network, the trace highlights all devices electrically connected to the element.

Temporary Modifications

The NCA will allow temporary modifications at any point in the distribution network to change the network configuration, to isolate faults, restore services or perform maintenance. A Summary shall list the jumpers, cuts and grounds that are currently applied. The function is performed by the NCA and is implemented locally within the client software and has no effect on the operations model or other clients viewing the network

Cuts

Cuts facilitated in any line segment in the network. The cut may be applied to one or more available phases of the conductor. The cut could also be applied as a temporary switch inserted in the line

- The cut must be given a name or id number for identification, which is displayed as a label on the geographic network view.
- It should be possible to select the position of the label relative to the cut symbol.
- The position can be altered after the cut has been placed

Once placed the cut symbol can be selected and switched on and off by the operator in the same way as a standard disconnect switch. Cuts can also be tagged.

Jumpers

Jumpers are a means of providing a temporary, switchable connection between two points on the network. The operator should be able to select two points and place the jumper with relevant details. The initial state of the jumper may be set to open or closed. The jumper popup automatically defaults to show the phases available for connection between the two points but other partial or cross-phase connections may be made if

required. The popup shall warn the operator about abnormal connections such as not all phases being connected or the nominal voltage being different at the two connection points. Once the jumper has been placed the switch symbol in the center can be selected and switched open or closed. The topology of the network model is updated accordingly. There is no restriction on the placement of jumpers between lines connected to different feeders or different substations.

Temporary connections between phases on the same line segment, known as a phase jumper shall be supported. This can be used in conditions where one phase is de-energized and it is desired to restore customers by energizing the dead conductor from one of the live phases.

Temporary Grounds

Temporary grounds should only be placed, for on de-energized sections of a line. These grounds represent the mechanical grounding of lines for safety purposes during maintenance or construction. A temporary ground may be placed on one or more of the available phases. It must be given a name and addition information can be included in the description field. If a line segment is re-energized while a temporary ground is still applied, the ground will be automatically removed.

Reports and Displays

The reports and displays shall be generated indicating the followings as a minimum -

- Abnormal switches in tabular display
- De-energized components of network in tabular display
- Presence of loops & parallels on network displays
- Un-served/ disconnected loads (loads affected due to tripping of CBs) in tabular displays
- List of temporary jumpers/cuts /grounds

1.13.30.6.8 State Estimation

SCADA shall utilize advanced functionality such as state estimation and the network topology to determine anticipated power system performance and behaviour.

The aim of the State Estimator (SE) shall be to define a complete and consistent set of data of the entire power network (both, observable parts and unobservable parts – lack of telemetered data; failure of RTU, communication links failure, etc.). The results of the SE are used by real-time power applications (real-time predictive simulation,

switching management, capacity planning, etc.) as input data and are displayed for the operator.

The State Estimation (SE) shall be used for assessing (estimating) the distribution network state. It shall assess loads of all network nodes, and, consequently, assessment of all other state variables (voltage and current phasors of all buses, sections and transformers, active and reactive power losses in all sections and transformers, etc.). The primary function is to determine network state where SCADA system monitoring is directly envisaged.

Firstly, the symmetrical (per phase) and asymmetrical (three-phase) load of all nodes in the radial or weakly meshed MV network, which are not remotely monitored, that is not directly covered by the SCADA System shall be using evaluated Load Calibration. SE represents the basic DMS function, because practically all other DMS Analytical Functions are based on its results.

This is the unique function dealing with the unobservable load of the actual network, which is not directly covered by the SCADA System. Function is used for balanced and unbalanced networks.

The function is based on an algorithm specially oriented towards distribution networks, with low redundancy of real time, remotely monitored data, the deficiency of real time data has to be compensated with historical data. Beside the parameters of network elements, the real time data consists of:

- Actual topology, transformers tap changer position, etc.
- Voltage magnitudes of supply point and other nodes in the network. Current magnitudes (active and reactive power) at feeder heads.
- Current magnitudes (active and reactive power) from the depth of the network.

The historical data of the network consists of:

- Daily load profiles – current magnitudes and power factors, or active and reactive powers for all load classes (types, for example: industrial, commercial, residential), for all seasons (for example: winter, spring, summer, autumn), for e.g. four types of days (for example: weekday, Saturday, Sunday and holiday).
- Peak-loads for all distribution transformers and/or consumers (peak-currents and/or peak powers) and/or monthly electric energy transfers across all distribution transformers (consumers).

SE function shall run in all cases from the range of networks where all historical data are known, but also in networks with no historical data available (based on parameters of the network elements).

Also according to users setting, the SE function shall be able to run:

- With or without verification of telemetered measurements
- With manual or automatically processing unobservable parts of network
- With or without fixed measurements

This shall have real time & Simulation mode both. In the first one, the function shall be used for estimation of the current state. In the Simulation mode, the function is used for estimation of the desired state (e.g. any state selected from the saved cases). The SE algorithm shall consider into account the non-availability of real time data and compensates them with historical data, pseudo and virtual measurements, to achieve the minimal set of input data necessary for running a consistent Load Flow.

The SE algorithm shall consist of the next important steps:

- Pre-estimation – It shall be based on the historical data of the network: daily load profiles, peak-loads for all distribution transformers and/or consumers, etc. This step shall give pre-estimated states of considered MV networks.
- Verification of measurements– It shall be obtained from artificially redundancy of measurements (too small number of measurements and notable main number of pseudo measurements obtained from first approximation). This step shall consider two sub-steps: (a) in sighting evidence bad measurements, (b) verification and/or correction all permanent measurements. In this step, incorrect measurements shall be corrected or discarded.
- Load calibration – The function shall distribute the load to the bus bars of the MV network on the basis of the set of verified measurements and historical data. Also, Load calibration shall deal with consumers specified directly through their current/time diagrams i.e. load curves as well as with consumers with constant consumption. The function shall run even any of these data are not available. It shall be designed in such a way that the quality of results of the function running increases directly with the amount of given data.
- Load Flow calculation – This shall be the next function in the specification based on the loads assigned in the previous step.

Input/ Output

Beside the network element parameters, main inputs for the functions consist of above noted real time and historical data. In the case of the function running in the simulation mode, the real time data must be replaced with the corresponding data from the saved cases or forecasted ones.

Main outputs of the function are estimation of:

- Voltage magnitudes in the entire network.
- Current magnitudes and power factors for all network elements
- Loads of all MV and LV consumption buses.
- Losses of active and reactive powers in the entire network, by each supply transformer or feeder.

Beside those results, output of SE function is tabular report, also. In this report measurement verification results are presented:

- Pre-estimated and estimated values of measurements.
- Minimal and maximal expected values of measurement.
- Quality of each measurement.
- Deviation measured values from estimated and pre-estimated values

1.13.30.6.9 Load Flow Application (LFA)

The LFA shall utilize information including real-time measurements, manually entered data , estimated data together with the network model supplied by the topology function, in order to determine the best estimate of the current network state. The Load Flow Application (LFA) shall determine the operating status of the distribution system including buses and nodes. The LFA shall take the following into consideration -

- Real time data
- Manual entered data
- Estimated data
- Power source injections
- Loops and parallels
- Unbalanced & balanced loads
- Manually replaced values
- Temporary jumpers/ cut/ grounds
- Electrical connectivity information from the real-time distribution network model

- Transformer tap settings
- Capacitor/reactor bank ON/OFF status value
- Save case data

System shall include real-time power flow analysis as part of predictive simulation. Real-Time Load Flow software shall perform power flow analysis and voltage drop calculations and include built in features such as automatic equipment evaluation, alerts and warnings summary, load flow result analyzer and customizable result annotations.

- Power flow simulation shall accommodate multiple loading & generation conditions
- Power flow simulation should automatically adjust transformer tap & LTC / voltage regulator settings
- User-controlled load flow calculation convergence parameters
- Compare & analyze multiple reports using load flow result analyzer
- Include effect of phase-shifting transformers
- View power flow results graphically
- Evaluate critical & marginal limit violations
- Simultaneously solve three-phase & single-phase system load flow
- Solve parallel power operation as well as looped system with unlimited elements

General Characteristics of LFA

The following general characteristics/ capabilities shall be provided as minimum -

- The LF model shall support the different kind of lines such as cable feeders, overhead/ underground lines and different kind of transformers having various vector groups & winding configurations.
- Unbalanced & balanced three phase loads connected in radial and non-radial modes.
- Compute voltages and currents and power factor for each phase for every node, feeder and network devices.

- Compute each phase active and reactive loads and technical losses for the distribution system as a whole, for individual substations and feeder wise with in telemetered zone.
- Use previous save-case to make new save case or use new snapshots to set the base case for LF.
- The results of the LF application shall reasonably match with the operating condition in which
- Distribution system is stable.
- The LFA function shall be executed in real time & study mode.
- It shall be possible to model load either as a percentage of system load or profile base load modelling
- It shall be possible to model individual component of load i.e. Active and Reactive part

Real Time Load Flow Execution

The Real-Time LF function shall be executed:

- on event trigger
- on periodic basis
- on demand basis
- on initiation by other DMS Applications functions
- On placement of Temporary Jumper, Cuts and Ground

The Event Triggered LF execution shall always have the highest priority. The study mode LF function shall be executed on a snapshot or save case with user defined changes made to these cases. The study mode execution of LF Function shall not affect the Real-time mode execution of LF function.

(a) Event Triggered Real Time LF Execution:

The LF function shall be executed by pre-defined events that affect the distribution system. Some of the events the dispatcher may choose for triggers shall include:

- Power system Topology Change i.e. Alteration in distribution system configuration
- Transformer Tap Position Change / Capacitive/reactor MVAR Change Feeder Over loadings
- Sudden change in feeder load beyond a set dead band

(b) Periodic Real Time LF Execution

The real-time distribution system load flow application shall be executed periodically as configured by the dispatcher. The function shall be executed periodically even if there are no significant changes in the operating conditions, as some of the power flow outputs shall be required to provide aggregate summaries (losses, etc.)

(c) On Demand Real Time LF Execution

Dispatchers may initiate the real-time LF function at any time through dispatcher command.

(d) Real Time LF Execution initiated by other DMS Applications

Other DMS functions may initiate the real-time LF function at any time as desired for the execution of the respective functions. Results from all kinds of LF Execution should be stored in logs.

Study Mode Load Flow Execution

It shall provide despatchers with estimates of kW, kVar, kV, Amps, power losses and the other information on the distribution system, but not necessarily reflecting its real-time state. In study mode the application should use the same data model and have direct access of the real time data as necessary. Study mode load flow shall be used to study contingency cases.

It shall be possible to prepare and store at least fifty cases along with the input parameters, network configuration and output results. The dispatcher shall be able to select the saved Case to be used as a Base case for LF execution and modify the base case. Possible changes, which the dispatcher shall be permitted to make, shall include:

- States of individual power system elements
- Values of specific parameters including nodal loads, bus voltages, connected kVA, power factor etc.
- The Study Mode shall calculate various values for each feeder and prepare summaries as LF output.

The Load Flow function shall provide real/active and reactive losses on:

- Station power transformers
- Feeders
- sections

- Distribution circuits including feeder regulators and distribution transformers, as well as the total circuit loss

Load Flow Output

The following output capability shall be provided:

- Phase voltage magnitudes and angles at each node.
- Phase and neutral currents for each feeder , transformers, section
- Total three phases and per phase KW and KVAR losses in each feeder, section, transformer ,DT substation & for project area
- Active & reactive power flows in all sections, transformers List of overloaded feeder, lines, bus bars, transformers loads etc. including the actual current magnitudes, the overload limits and the feeder name, substation name
- List of limit violations of voltage magnitudes, overloading.
- Voltage drops
- Losses as specified above

Display and Reports

All input and output data shall be viewed through tabular displays and overlay on the one line network diagram. Tabular displays shall consist of voltages, currents (including phase angles), real and reactive powers, real and reactive losses as well as accumulated total and per phase losses for each substation, feeder and project area. All the overloaded lines, busbars, transformers, loads and line shall start flashing or highlighted

The LF outputs shall be available in the form of reports. The report formats along with its contents shall be decided during detailed engineering

Alarms

The LFA shall warn the Despatcher when the current operating limits are exceeded for any element or when lines are de-energized. It shall also warn the Despatcher when any abnormal operating condition exists. Alarms generated during Study Mode shall not be treated as real-time alarms but shall be displayed only at Workstation at which the LF application is running in study mode.

1.13.30.6.10 Volt –VAR control (VVC)

The high-quality coordination of voltages and reactive power flows control requires coordination of VOLT and the VAR function. This function shall provide high-quality

voltage profiles, minimal losses, controlling reactive power flows, minimal reactive power demands from the supply network. The following resources will be taken into account for voltage and reactive power flow control:

- TAP Changer for voltage control
- VAR control devices: switchable and fixed type capacitor banks.

The function shall propose the operator solution up on change in the topology of the network switching. The function shall consider the planned & unplanned outages, equipment operating limits, tags placed in the SCADA system while recommending the switching operations. The functions shall be based on user configurable objectives i.e. minimal loss, optimal reactive flow, voltage limits, load balancing . These objectives shall be selectable on the basis of feeder, substation & group of substations or entire network. The despatcher shall have the option to simulate switching operations and visualise the effect on the distribution network by comparisons based on line loadings, voltage profiles, load restored, system losses, number of affected customers. The solution shall identify /sort the different type of switches that are required for operation i.e. remote /manual etc.

Modes of operation

The VVC function shall have following modes of reconfiguration process:

- Auto mode
- Manual mode

The despatcher shall be able to select one of the above modes. These modes are described below –

Auto mode

In auto mode, the function shall determine switching plans automatically and perform switching operations upon despatcher validation automatically.

Manual mode

In manual mode, the function shall determine switching plans automatically and perform switching operations in step-by-step manner. A filter for remote operable & manual switches shall be provided with switching plan

Reports

Detailed reports of complete switching sequence for VVC operation, including voltage / VAR levels before switching & after switching shall be presented.

Displays

- The User interface for VVC function shall have following summary displays as minimum:
- Network & tabular display to VVC switching
- Tabular display giving chronological sequence for VVC operation

1.13.30.6.11 Load Shed Application (LSA)

The load-shed application shall automate and optimise the process of selecting the best combination of switches to be opened and controlling in order to shed the desired amount of load. Given a total amount of load to be shed, the load shed application shall recommend different possible combinations of switches to be opened, in order to meet the requirement. The despatcher is presented with various combinations of switching operations, which shall result in a total amount of load shed, which closely resembles the specified total. The despatcher can then choose any of the recommended actions and execute them. The recommendation is based on Basic rules for load shedding & restoration.

In case of failure of supervisory control for few breakers, the total desired load shed/restore will not be met. Under such conditions, the application shall inform the dispatcher the balance amount of load to be shed /restore. The load-shed application shall run again to complete the desired load shed /restore process. The result of any Load Shed operation shall be archived in Information storage and retrieval (IS&R) system.

SCADA,DMS bidder should provide intelligent & User-Defined Knowledge Base (UDKB) load shedding system. UDKB will be created for each individual Substation based on goals and priorities provided by utility. The intelligence built in the UDKB tables will be based on 70% transient stability analysis and 30% load flow and optimum power flow studies. Hence the SCADA,DMS vendor to conduct the transient Stability & Load Flow analysis to create the load shedding priorities. utility required not only frequency or voltage based load shedding but also the above defined load shedding system.

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The real-time (operating values) generation, loading, and configuration of the system Load Priority Table – user- definable from the study case Controllers will be programmed to initiate the load shedding process immediately after receiving trigger signals from the system. Possible system contingencies

The system will be capable of fast load shedding that can dynamically manage the stability of the system. It shall calculate the minimum required MW to be shed for the entire electrical network and per each islanded subsystem according to the type and location of the disturbance, loading, configuration, load distribution, and process and operator priority.

The intelligent load shedding shall be capable of selecting the best combination of loads (CBs) that will satisfy this requirement. System response to a disturbance shall be no more than 100 milliseconds unless configured by the system engineer due to process constraints. Steady-state conditions such as overloads shall be handles after user-defined time delays as configured.

The intelligent load shedding will continuously predict system response if they were to happen at that particular instant of time. Its predictions will be monitored continuously from any of the SCADA/DMS consoles. Data will be displayed through the load shedding HMI as well as through the one-line diagram.

The intelligent load shedding shall be capable of providing the operator the capability to change the load shedding priority, logic, and schedules directly from

the DMS Consoles with user-friendly interfaces when having the correct access rights. For these changes, it will not be required to update the Load Shedding Controller/RTU programs.

In a case of a communication failure between the load shedding Server and the controllers, the controllers will activate intelligent load shedding logic and tables that will take over the load shedding system until the load shedding Server is activated

Load Shedding Validation Application: The intelligent load shedding should capable of providing the operator a method to Verify and Validate (V&V) the Intelligent Load Shedding logic and operation before uploading a new schedule to the Master controller, at any time during normal operation, and/or after a load shedding event has occurred.

The intelligent load shedding should be capable of providing:

- Reliable load preservation
- Fast response to disturbances
- Operator alerts for marginal operating conditions
- Display required minimum MW & selected loads
- Trigger & time dependent load shedding
- User-definable control logics & macros
- User-definable system triggers
- Operator-friendly interface
- Display operating & recommended spin reserve
- Display monitored data on the one-line diagram
- Predict system response after load shed
- Log & view load shedding actions & recommendations
- User-defined load priority & groups
- Option to simulate & test Load Shedding recommendations

Alarms/Events

All Load shed & restore operations executed shall be logged in the system as events. In case the supervisory control fails during the operation in predefined time, an alarm shall be generated with the possible reason for the failure.

Summary Report

Load shed application shall generate Summary Reports for project area on daily basis. These reports shall be available online for minimum period of two days. The following reports shall be made.

(a) Daily Load shed report indicating, substation name, feeder/device name, date/time, duration of load shed and amount of load shed, Number of consumers affected based on consumer indexing information, mode of load shed including planned outages of feeders/network equipments.

(b) Daily Alarm summary pertaining to LSA, substation wise.

(c) Substation wise daily Served, un-served power & energy for every 5 minute time block

(d) Served & un-served power for last seven days for every 5-minute time block to calculate Load forecast for the next day. The report shall contain a column to define weightage factor (multiplier) by Dispatcher to calculate Load forecast for the next day.

(e) The weightage factor is required to consider the type of the day such as holiday, festivals, rainy day, etc. Separate report for total load forecast of complete project area shall also be generated from above two reports.

Basic rules for load shedding & restoration

The load shall be shed or restored on the basis of following basic rules:

- By load priority: The LSA shall have a priority mechanism that shall allow the user to assign higher priorities for VIP or any other important load. The load assigned with the higher priorities shall be advised to be shed later and restore earlier than load with relatively lower priorities. Each load priority shall be user definable over the scale of at least 1-10.
- By 24 Hrs. load shed /restore history: The loads of equal priorities shall be advised for restoration in such a way that loads shed first shall be advised to be restored first. The application shall ensure that tripping operations is done in a cyclic manner to avoid the same consumers being affected repeatedly, however, priority loads shall be affected least.
- By number of consumers affected: The consumer with equal priority and similar past load shed history shall be considered by the application in such a way that minimum number of consumers are affected during the proposed load shed. The data for number of consumers connected to a feeder /device shall be taken from computerized billing system.

Modes of operation

The load-shed application shall operate in the following modes:

- Manual load shed
- Manual load restoration
- Auto load shed
- Auto load restoration

Each mode of operation can be enabled or disabled by operator independently. The load can be shed & restore in possible combination i.e. manually shed & auto restore vice versa or both operations in the same modes.

Manual Load Shed

In this mode operator specifies a load to be shed in a project area The software shall determine & propose all the possible combinations of switches to be operated for the requested load shed considering the basic rules for load shed & restoration.

In case more than one options are possible, then the application shall identify all such options with the priority of consumers along with the number of consumers are likely to be affected for the particular load shed option. The despatcher shall select & execute one of these options for affecting the load shed.

Manual Load Restoration

In this mode operator specifies the desired load to be restored. The software shall determine the switches to be operated for the requested load restore considering the basic rules for load shed & restoration.

In case more than one options are possible, then the application shall identify all such options with the priority of consumers along with the number of consumers are likely to be restored for the particular load restore option if chosen by despatcher. The despatcher shall select & execute one of these options for effecting the load restoration.

The Load shed Application shall maintain a load restore timer, which shall automatically start after tripping of CB due to manual load shedding. An alarm shall be generated to remind the operator to restore the loads when this timer expires. For manual mode of operation the dispatcher shall enter the value of load restore timer.

Auto Load Shed

This shall have two modes namely frequency based load shed & time of day based load shed as described below.

Frequency based Load Shed

The function shall execute the tripping of breakers based on the system frequency automatically considering the basic rules for load shed & restoration.

Time of day based Load Shed

The function shall operate to shed load at the predefined time of the day & load to be shed. The software shall automatically execute the switching operations considering the basic rules for load shed & restoration.

Auto Load Restoration

This shall have two modes namely frequency based load restoration & time of day based load restoration as described below:

Frequency based restoration

The function shall execute the closing of breakers based on the system frequency automatically considering the basic rules for load shed &restoration.

Time of day based restoration

The function shall operate to restore load at the predefined time of the day & load to be restored. The software shall automatically execute the switching operations considering the basic rules for load shed & restoration.

Alarms/Events

All Load shed & restore operations executed shall be logged in the system as events. In case the supervisory control fails during the operation in predefined time, an alarm shall be generated with the possible reason for the failure.

Summary Report

Load shed application shall generate Summary Reports for project area on daily basis. These reports shall be available online for minimum period of two days. The following reports shall be made.

- Daily Load shed report indicating, substation name, feeder/device name, date/time, duration of load shed and amount of load shed, Number of consumers affected based on consumer indexing information, mode of load shed including planned outages of feeders/network equipments.

- Daily Alarm summary pertaining to LSA, substation wise.
- Substation wise daily Served, un-served power & energy for every 5 minute time block
- Served & un-served power for last seven days for every 5-minute time block to calculate Load forecast for the next day. The report shall contain a column to define weightage factor (multiplier) by despatcher to calculate Load forecast for the next day. The weightage factor is required to consider the type of the day such as holiday, festivals, rainy day, etc. Separate report for total load forecast of complete project area shall also be generated from above two reports.

1.13.30.6.12 Fault Management & System Restoration (FMSR) Application

The Fault Management & System Restoration application shall provide assistance to the despatcher for detection, localisation, isolation and restoration of distribution system after a fault in the system. The FMSR function shall be initiated by any change in the network connectivity due to any fault. It shall generate automatic report on switching sequence depicting analysis of fault, location of fault & recommendations for isolation of faulty sections & restoration of supply.

Functional Requirement

The FMSR function shall include the following characteristics:

- FMSR shall be capable of handling phase-to-ground and phase-to- phase faults and shall not be restricted by their time of occurrence on one or more feeders. Thus, the ability to handle multiple faults of different types, on multiple feeders, shall be provided. It shall be capable to carry out restoration of large area after a occurrence wide spread faults amounting to substantial outages in the town.
- FMSR shall be capable of allowing the substitution of an auxiliary circuit breaker or line recloser that may temporarily function in place of a circuit breaker or line recloser that is undergoing maintenance.
- The Operator shall be able to suspend FMSR restoration capabilities by activating a single control point. Otherwise, FMSR shall continue to operate for fault detection and isolation purposes. The Operator shall be able to resume FMSR's normal operation by deactivating the same point.

- FMSR shall be capable of isolating faulty sections of network by opening any available line Circuit Breaker that may be necessary, however operating limitations on device such as control inhibit flag shall be respected.
- FMSR application shall utilize the results of LF for recommendations of switching steps for restoration where in it should guide the operator for amount of overloading in lines ,bus voltage violations and amount of load that can be restored for various options of restorations ,the operator shall have the privilege of selecting the best restoration option suggested by FMSR before it starts restoration .The operator shall also be to simulate the LF for the recommended switching actions ,so that the necessary violations can be displayed on graphical display also. If an overload condition is expected as a result of the proposed switching, it shall be displayed to the operator on a graphical display and proposed alternative switching sequence to avoid or minimize the overload.
- FMSR shall be capable of using data derived from substation RTUs/FRTUs /FPIs to recognize faults in substation transformer banks, any fault on the primary side of these banks that cause loss of outgoing feeder voltage and current or any fault occurred on 33kV & 11KV network.
- FMSR shall be capable to make Restoration plans with identification name and respective merit orders & its execution of Restoration plan using network Display and single line diagram of substation.
- FMSR shall be capable to find delay in the restoration of network beyond specified time (Despatcher configurable) and shall be able to report separately in the form of pending restoration actions.

Detection of fault

FMSR function shall detect the faulty condition of the network causing CB tripping due to protection operation or FPI indication. The Circuit breakers having auto-reclose feature, the FMSR application shall wait for programmer specified (setteable for individual feeders) duration before declaring the network as faulty. On detection of fault in the network, an alarm shall be generated to draw attention of the dispatcher.

Switching device tripping caused by SCADA/ADMS applications shall not be considered as a faulty condition. FMSR application shall also not be initiated if the quality flags such as, manually replaced value, Out of scan are set for a switching device.

Localisation of Fault:

Wherever protection signal or FPI indication is not available, FMSR function shall determine the faulty section by logically analyzing the telemetered data (status of CBs , analog values etc.) as acquired through SCADA system. Besides this, for such cases an iterative method for determining fault shall be used e.g. In case of fault, upstream breaker is tripped & long stretch of multiple sections are having no intermediate fault indicators & intermediate switches are not capable to trip on fault upto the closest NO (Normal open) point, the dispatcher can open the last switch before NO point & try to close breaker , if trips again fault is on further upstream & the same method is to be repeated else fault is located in the downstream section only. For the sections where protection signal or FPI indication is available, the same shall be derived through these telemetered signals. Network diagram identifying the faulty sections/components shall be displayed identifying the relevant section. and various configurations of switch type etc.) Minimum of following switch types shall be considered by FMSR system:

- Remote controllable circuit breaker with capability to interrupt fault currents
- Non-remote controllable circuit breaker with capability to interrupt fault currents
- Remote controllable circuit breaker with no capability to interrupt fault currents
- Non-remote controllable circuit breaker with no capability to interrupt fault currents.
- Remote controllable disconnector
- Non remote controllable disconnector.
- Fuse
- Ground/ Earth switch etc.

System isolation & restoration

Once faulty section is identified, the FMSR function shall determine the switching plan to isolate healthy area from unhealthy area. FMSR function shall suggest switching plans for restoration of power to the de-energized healthy sections of the network. It may done be by closing NO switch to allow the power from alternate source. In case more than one feasible switching plans exist, the despatcher shall be guided for most optimum plan based on the merit order i.e. minimum switching operations, minimum loss path, system operation within the safe limits of various network elements. The despatcher shall have the option to simulate switching operations and visualize the effect on the distribution network by comparisons based on line loadings, voltage

profiles, load restored, system losses, number of affected customers. The FMSR function shall have feature to attain the pre-fault configuration on despatcher's request after repair of faulty sections.

The FMSR function shall have following modes of restoration process:

- Auto mode of restoration - In auto mode, the FMSR shall determine switching plans automatically upon experiencing fault & proper isolation of unhealthy network from healthy part of the network and perform restoration actions upon despatcher validation automatically.
- Manual mode of restoration- In manual mode, the FMSR shall determine switching plans upon experiencing faulty state & proper isolation of unhealthy network from healthy part of the network. The switching plans shall be presented to despatcher for step by step restoration. Despatcher shall be allowed to introduce new steps.

A filter for remote operable & manual switches shall be provided with switching plan.

Reports

Detailed reports of complete switching sequence from outage to restoration, feeder-wise outage duration with Date & Time stamp, quantum of served & un-served load, number of consumers interrupted & restored and network parameters limits violations shall be generated by FMSR application

Displays

The User interface for FMSR function shall have following summary displays as minimum:

- Network & tabular display to identify faulty network
- Network & tabular display to identify remotely controllable devices
- Network Display to show plan for Isolation of faulty sections from the network using single line diagram of substation or network as selected by the despatcher.
- Tabular display for Restoration plans with identification name and respective merit orders & execution of Restoration plan using network Display, and single line diagram of substation

- Delay in the restoration of network beyond specified time (Despatcher configurable) shall be reported separately in the form of pending restoration actions in Tabular display.
- List of sections not restored with the reasons for non-restoration such as overloading and voltage limit violations etc. shall be shown in tabular display.

1.13.30.6.13 Distribution Load forecasting

Short-Term Load Forecasting (STLF)

Short-Term Load Forecasting (STLF) analytical function will be used for assessment of the sequence of average electrical loads in equal time intervals, from 1 to 7 days ahead. As noted above, the STLF function shall be based on different forecasting methods such as:

- Autoregressive.
- Least Squares Method
- Time Series Method.
- Neural Networks.
- Kalman filter
- Weighted Combination of these method

In the first step, training module is executed using load data series from the historical database and weather conditions. After appropriate training, Forecast module is executed for up to next 7 days including weather forecast. Results are available in tabular and graphical form. The user shall be able to make adjustments to the active forecast. The adjustments can also be done through weather conditional data parameters i.e. temperature, humidity, precipitation level, wind speed, wind direction acquired through telemetered sensors or manually.

STLF will be used for forecasting of loads for the next short-term period (up to 7 days), to provide planning of the (optimal) network operation at the daily level. in periodic time (15 min to 1hr) The user shall be able to save forecasts in save cases, one of which shall contain the active forecast that shall be available for study functions.

Similar day forecasting

A similar day forecast shall be used that is based on the normalized half-hourly load values stored for each of seven-day types. Provision shall be made for storing day types for the last 24 months. The storage shall be updated each day by replacing the oldest of the same day type with the most current actual load curve.

The similar day forecast shall search the 24-month file for the same day type whose weather conditions best match. It shall then present the user-entered and best-matched conditions, for user comparison, together with the chosen day's loads as the suggested forecast. The user shall be able to modify any of the forecast's loads manually. In addition, the user shall be able to scale the entire forecast by simply specifying an appropriate peak load value.

Multi-day forecasts shall be constructed by permitting the user to define the input data for each forecast day.

The results of the previous forecasts will be compared with the actual load realization. The performed differences will be used for updating the forecasting procedure parameters.

Long Term forecasting

In addition to the above, Long term load forecasting shall also be available for at least 1 year. The same shall be calculated based on the peak load values or energy consumptions on weekly/monthly basis for at least two preceding years, Array of forecasted peak loads imported from STLF/ entered manually.

The user shall be able to print and display the forecasts in both tabular and graphical form. This shall include the ability to display the active forecast with the actual loads of current and past days superimposed, energy consumption/peak load curves in the forecasting period.

Results of Function

Main input data for the LF will be: Historical Load measurements for specified network points, associated with corresponding weather conditions.

- Daily load curves & energy consumption from the past, for all type of days and seasons.
- Weather prognosis for the forecasting period.

Main output data of the STLF will be: Forecasted load for the forecasting period

1.13.30.6.14 Operation Monitor

The Operations Monitoring function shall track the number of operations made by every breaker, capacitor switch, recloser, OLTC, isolator and load break switch that is monitored by the System. Devices shall be identified by area of responsibility,

substation, feeder, and device ID to provide the necessary information for condition-based maintenance of these devices.

Each monitored device shall be associated with a total operations counter. This counter shall be incremented whenever the associated device changes state. When a multiple change (such as a trip-close-trip sequence) is reported by an RTU/FRTU, each transition shall be counted separately. In addition, a fault operations counter is required. This counter shall be incremented only for uncommanded trip operations. The date and time of the last operation shall be saved for each device when one of the counters is incremented.

An Operator with proper authorization shall be able to enter total operations and fault operations limit for each counter. An alarm shall be generated when a counter exceeds its limits. No additional alarms shall be generated if the counter is incremented again before it is reset. For each counter, the System shall calculate the present number of operations expressed as a percent (which may exceed 100%) of the corresponding limit.

The ability to reset individual counters shall be provided. In addition, a user shall be able to inhibit operations counting for individual devices. Such devices shall be included in summaries based on areas of responsibility. Resetting and inhibiting counters shall be permitted only for devices that belong to the areas of responsibility and resetting shall require the console to be assigned to an appropriate mode of authority. The user info, date and time , when each counter was last reset shall be saved.

1.13.30.6.15 Real Time Short Circuit

a) SCADA shall include real-time short circuit analysis as part of predictive simulation. Real-Time Short Circuit software shall analyze the effects of 3-phase, 1-phase, line-to-ground, line-to-line, and line-to-line-to-ground fault currents on electrical power systems.
b) Fault current short circuit duties should be calculated and compared in compliance with the latest editions of the ANSI/IEEE Standards (C37 series) and IEC Standards (IEC 60909 and others).
c) Short circuit software shall determine fault currents and automatically compare these values against manufacturer short circuit current ratings. Overstressed device alarms should be automatically displayed on the one-line diagram and included in short circuit study reports.
d) Automatic 3-phase device evaluation based on total or maximum through fault current
e) Automatically adjust conductor resistance & length (both lines & cables)

f) Global or individual device impedance tolerance adjustments for maximum & minimum fault currents
g) Include / exclude fault impedance modeling for unbalanced faults
h) Include / exclude shunt admittance for branches & capacitive loads (unbalanced faults)
i) Graphical or tabular bus fault selections
j) Automatically determine fault currents at motor terminals without the need to add additional buses
k) Consider effect of phase-shifting transformers
l) Grounding models for generators, transformers, motors, & other loads
m) Motor contribution based on loading category, demand factor, or both
n) Short Circuit software shall extract manufacturer published data from the libraries for thousands of devices
o) Short Circuit result analyzer shall compare and automatically determine the worst fault current values and/or violations.

1.13.30.6.16 Switching Sequence Management

SCADA software shall be capable of building a complete switching program using a graphical user interface and execute the switching plan all in one step. The switching sequence shall contain a list of switching devices and time of execution for circuit breakers, load disconnects, and ground disconnects.

Before any switching sequence is executed, the application verifies whether the sequence is compliant with safety switching procedures and requests confirmation during execution of each step before proceeding to the next step in order to avoid inadvertent switching.

The software shall be capable of configuring switching plans for automatic transfer of bus loads on double-ended bus configurations thus replacing the step-by-step method of switching for double-ended bus configurations that require manual bus load transfer. Switching sequences shall be ranked based on de-energized time, non-delivered energy, and the order of switching allowing easy comparison between different variations of the plan.

The switching management software shall include the following features:

- User-friendly switching plan builder
- Point & click selection of switching device from the one-line diagrams
- Graphical display of selected switching devices
- Multi-level switching request approval
- Assignment of user-definable & interlock logic per each switching device

- Checking of selected switching plans against forbidden or potentially hazardous actions
- Unlimited switching plans each with an unlimited number of switching actions
- Switching order reports include switching mode, start / stop time, & nature of work
- Simulate & evaluate switching plans in all states prior to execution

1.13.30.6.17 Load Management (LM)

The LM system shall offer the following functionalities.

a) Under LM the Power company shall be able to disconnect the supply to the consumer on account of a credit or payment default. Upon payment of the dues the system shall generate the list of such consumers. Power company shall resume the power to those consumers by reconnecting the supply either remotely or locally through representatives. All these events shall be recorded in the system.
b) Power company shall also be able to disconnect the supply to the consumer in case they exceed the contract demand and shall reconnect upon consumer request. The billing system shall be suitably informed regarding such defaults which in turn shall calculate and levy the charges due for such events based on tariff rules.

1.13.30.6.18 Predictive Simulation :

The SCADA software should be capable of real-time predictive simulation. SCADA shall contain integrated analytical tool or It should Integrate with System that have Simulation capability over OPC or with other protocol. Simulation shall provide prediction of system behavior in response to operator actions and events via the use of real-time and historical / archived data.

The system shall demonstrate analytical techniques and allow for prediction of vital electrical information at relevant locations on all buses:

c) Predict the strength and resilience of electrical system.
d) Predict the security of the electrical system including how adequate the protective devices are (in real-time) against predicted fault currents.
e) Predict the adequacy of the facility power system in startup of heavy consumers of power in order to maintain adequate voltage to support the sudden impact of the startup of such heavy loads on the system and associated critical processes.
f) Predict critical clearing time of circuit breakers so that facility stability is maintained.
g) Automatically provide an impact assessment of a number of different disturbances such as loss of loads, loss of generators, and transfer of loads from one source to another.
h) Predict the present power delivery capabilities of the electrical distribution system and remaining capacity available.
i) Predict the reliability of the power distribution system and its components including availability at all critical locations.

j) The above analytics shall be performed periodically (a user defined time period) or automatically should a switching event occur (connection to distribution is lost, chiller failure, sudden facility load increase).

k) Predictive simulation shall provide overall system health and an indication of vital power indicators in a real time environment permitting immediate management of a complex power system through modeling and simulation. Predictive simulation cannot be an off-line or snapshot function and shall be fully integrated into the overall real-time solution.

I. The Simulator functions shall include the following features and capabilities:

- Collection, upload, display and archiving of the time stamped data
- Capable of obtain snap-shots of real-time data for the purpose performing simulation at any time under various system configurations.
- Allow the system operator to perform “what if” studies by simulating any system event and running calculations to determine subsequent system parameters.
- Simultaneous Monitoring, Simulation, & Control.
- Simulate the operation of system equipment such as relays, fuses, circuit breakers, etc.
- Graphically display system responses to faults or disturbances.
- Allow for simulator playback of previously recorded events to run at original or accelerated speeds, single-stepping, fast forward, or rewind through the message log.
- Real-Time Operation of System Components
- Complete Display of Real-Time & Estimated Data
- Predict System Response to Operator Actions
- Full spectrum network analyses modules
- Get online data on demand
- Retrieve archived data for system analysis
- Graphical display of simulation results
- Unlimited study case / solution parameter editor
- Intelligent interactive graphical user interface
- Online / offline simulation alerts
- Emulate response of protective devices
- Evaluate protection & control systems
- Customizable reports via Crystal Reports
- Automatic scenario simulation using project wizards
- Multiple power analysis methodologies and techniques

1.13.30.6.19 Dispatcher Training Simulator (DTS)

A Dispatcher Training Simulator (DTS) shall be provided for SCADA/ADMS system for training of operators/ dispatchers during power system normal, emergency/ disturbance and restoration activities. The DTS shall be installed at the SCADA/ADMS control Centre where it shall be used to train employer and other utilities dispatchers. The major DTS features shall include:

- The DTS model shall simulate the distribution power system in a realistic manner, including its response to simulated events, Instructor actions, and Trainee actions. The response shall be identical to the response observed by the dispatcher in the actual computer system environment.
- The consoles shall be assignable as trainee or instructor consoles. The DTS shall support at least one instructor & two trainees
- Instructor control features shall include the ability to set up, control, participate in, and review the results of a training session
- Dispatcher control feature shall facilitate dispatchers to train dispatcher to use all SCADA, dispatcher & ADMS functions under normal & disturbed conditions.
- An ability to obtain data from the SCADA/ADMS systems automatically for DTS initialization. The initialization data shall include save cases, predefined & instructor defined scenarios.
- It shall prevent actions & keep insulated the actions performed by the Instructor and Trainee using the DTS from affecting the real-time system database or the actual power system.
- An ability to simulate actual system disturbances from historical data "snapshots" stored by the real-Time database Snapshots
- DTS function shall have ability to establish the following training conditions as a minimum:
    - Normal steady state
    - Disturbed network conditions for distribution network
    - High & Poor Voltage conditions
    - Poor VAR conditions
    - Indiscriminate tripping
    - islanding
    - System blackout

- System restoration
- Conditions/functions included for SCADA/ADMS real time system

Following features as minimum:

- All SCADA/ADMS functions as envisaged in the specification
- Cry wolf alarms
- Record/ Playback /slow/real-time/fast forward
- Record trainee actions

DTS Model features, functions & user interface shall be true replica of SCADA/ADMS system model for that project area. The DTS can be used in the following modes as minimum:

- Instructor Control
- Trainee Control

1.13.30.6.20 Relay Management System (RMS)

Relay Management provides a comprehensive solution for managing, configuring, and maintaining protective relays in electrical power systems. It streamlines relay settings management, version control, and compliance with regulatory standards, ensuring reliable protection and coordination. The system enables automated relay testing, facilitates secure storage of settings and test reports, and supports integration with existing IT infrastructure for centralized data access. With advanced analytics and reporting capabilities, Relay Management enhances operational efficiency, reduces downtime, and improves decision-making processes, making it an indispensable tool for utilities and industries aiming to optimize their power system reliability and performance.

Relay Management System consists of a real-time server and a client interface for the purpose of establishing a centralized asset management system for transmission & distribution equipment. RMS consists of a user-friendly & multi-user application that utilizes Web based thin clients for data manipulation in conjunction with desktop clients for advanced applications.

1.13.30.6.20.1 Capabilities

- One integrated solution with manufacturer independent open format database
- Integrated solution with Protection coordination like ETAP Star, Star Auto
- Support of MongoDB database or any other formats for extreme head-room of data storage
- Universal Mapping

- Import / Export of protective device settings
- Historical content / settings
- Upload / Download of device settings (Rio format, vendor specific format, open format)
- Access levels for device settings and testing
- Interface with third-party software, relay setting software, asset management
- Web-based utility and remote access
- Hierarchical categorization of protective devices per zone of protection / regions / areas / substation / feeder
- Reporting and analysis of “as found” vs “as set” vs “as tested”
- Setting lifecycle management (Planning, Pending, Issued, Implemented)
- Attachments and relevant information repository (manuals, schematics, test reports, etc.)

1.13.30.6.20.2 Integration

-
- Communicates to devices and download upload settings via com protocols such as IEC 61850, FTP, SFTP
- When direct communication is not allowed, it imports setting via vendor provided software
- Provides a web interface to make data available securely around the world

Applications

- Electrical network life-cycle management from modeling to operations
- Robust power supply design – verify & size components, overhead lines, cables, return circuits and protection
- Protection studies (short circuit analysis and coordination studies) that supports protection engineers in relay settings preparation activities
- Relay settings database lifetime management system that manages relays settings as per network hierarchy of the network from conception to implementation
- Protection asset management database that manages protection assets including but not limited to 69 kV, 34.5 kV, 33 kV substations as well as 13.8 kV feeders.
- Combine with system operating data for predictive analysis and real-time “what-if” analysis
- Combine with archived data for “root cause & effect” analysis

1.13.30.7 Consumer Portal

- The CONTRACTOR shall design a user friendly consumer portal for the consumer interface to know its own consumption, forecast, historical data, DR

schemes, alerts of various events including payment, connect/disconnect and pilferage attempts, TOU, various reports, bills etc.

- The system shall be a Web based interface. Each individual consumer shall be registered with unique User ID and password.
- The details shall be displayed in the form of a dash board and analytics and reports shall be preferably in the form of graphics.
- The system shall be robust and well secured to fail any attempts of malpractices.

1.13.30.8 Hardware Configuration

In this technical specification all hardware has been broadly classified as “Server” and “Peripheral device”. The term “server” (also referred as “processor”) is defined as any general- purpose computing facility used for hosting application functions as defined in the specification. The servers typically serve as the source of data, displays and reports. The term “Peripheral Device” is used for all equipment other than servers. Peripheral device includes Workstation consoles, WAN router, LAN, printer, Time & Frequency system, Firewalls etc.

The redundant hardware such as Servers, Firewall, and LAN etc. shall work in hot standby manner. All the servers and networking equipment (Firewalls, LAN equipment etc.) shall be mounted in rack panel.

1.13.30.8.1 Servers

The Servers shall have provision for expansion of the Processor, auxiliary memory and Main memory (RAM) by 100% of the delivered capacity. This expandability shall be possible at site with addition of plugin modules only. Initially USB ports of all work stations shall be disabled.

Application server

- SCADA
- ADMS
- ISR

Communication server

- Front –End server (Communication Front End) FEP/ CFE
- NMS
- Web server

Training & development system server

- DTS
- Developmental server

Application Servers

Redundant SCADA/ADMS servers shall house SCADA/ADMS application. The SCADA/ADMS shall include historical data storage configured to store historical data at the storage rates, for the required period of time, and for the Ultimate historical database sizes.

Communication Servers

- FEP/ CFE Server

The redundant FEP server shall be a functional unit that offloads the task of communication & preprocessing between RTUs/FRTUS/FPIs & SCADA/ADMS servers. All RTUs/FRTUs/FPIs shall be connected to CFE through IEC 60870-5-104 link. For any existing RTUs/FRTU/FPI that to be integrated, interface must be available to use existing protocols. Free slots shall be made available inside the FEP server, so as additional communication boards can be plugged-in to meet the network future expansion.

Each channel shall be assigned a different protocol and the front-end shall be able to manage several protocols in parallel.

The redundancy of front-end servers shall allow handling of RTUs/FRTUs/FPIs connected either through single channel or redundant channels. In both cases, one FEP server shall be able to take control of all RTUs/FRTUs/FPIs channels. In order to meet network's expansion behind the full capacity of a pair of FE servers, it shall be possible to connect additional FE servers' pairs to the LANs. Each communication line shall be able to support its own communication protocol. The CFE shall comply VPN based security for connecting with IEC 60870-5-104 node on public networks. Further the nodes and CFE shall be

Self-certified by manufacturers as NERC/CIP compliant to comply with future smart grid requirements.

All FEPs shall not have open ports other than needed for protocol traffic / SCADA traffic, and shall have an audit trace of all login attempts / connection attempts. This FEP shall exchange data through secured

VPN and encryption of protocol traffic whether it is a is public network or a dedicated one. The equipment should take control command from designated Master IP address only and no other IP.

The Communication Servers shall be able to process time – stamped data and can be directly connected to GPS device for time synchronization. FEP servers shall have a suitable interface for time synchronization from the GPS based time synchronizing system. This interface shall have the time synchronization accuracy of 1millisecond. The FEP server shall further synchronize the time of the RTUs on IEC 60870-5-104 protocols.

FEP server shall have feature to show the online process of raw data from the RTUs/DCUs as a protocol test analyzer.

- Network Management System (NMS) servers

Redundant NMS servers shall be used for configuration management, fault detection & performance monitoring of servers, workstations, routers & LAN equipment etc.

Proposed devices such as Servers, network equipment etc. should support functioning of NMS application.

- Web servers

Redundant Web servers shall be provided

Training & development System Server

- DTS server

A non - redundant server to host DTS applications shall be provided to impart the training.

- Development server

A non- redundant server to host project Development simulator (PDS) applications shall be provided.

1.13.30.8.2 Archive Storage

Archive storage devices shall be used for backup of the SCADA/ADMS data and software and archival storage for the Information Storage and Retrieval functions. LTO

(Linear Tape-Open) media storage shall be provided for general back-up purposes and short-term archiving. The LTO drive shall have sufficient capacity for a complete backup of the SCADA/ADMS data and software (including all source code) without requiring user action to replace filled recording media. A media changer that accepts industry-standard media handling commands is preferred. External 4mm DAT, 160/320 GB Cartridge magnetic tape drive shall be supplied for taking Backups and performing restores of the Hard disks of any computer.

The external tape drive shall have hot-pluggable port for connection to any computer. Bidder may also provide equivalent Magneto Optical (MO) – disk in place for DAT drive (Cartridge magnetic tape drive)

A SAN (Storage Area Network) based storage shall be provided which shall be sized adequately and shall be used for online storage and all online data backup. It shall be possible to take and store image backup of all servers & workstations on it.

1.13.30.8.3 Local and Wide Area Networks

The Supplier is responsible for implementing the SCADA/ADMS LAN and the connections to the Enterprise WAN and the backup Control Center WAN.

SCADA/ADMS Network

Servers, consoles and devices are connected to each other on a local area network (LAN), which allows sharing of resources without requiring any physical disconnections & reconnections of communication cable. Dual LAN shall be formed for complete SCADA/ADMS system. LAN shall have the following characteristics:

- Shall conform to the IEEE 802 series standards.
- Shall preclude LAN failure if a server, device, or their LAN interface fails.
- Shall allow reconfiguration of the LAN and the attached devices without disrupting operations
- Shall be either controlled LAN such as Token passing or uncontrolled LAN such as CSMA/CD
- Shall have minimum of forty eight (48) ports of 10/100/1000Mbps per LAN switch for SCADA/ADMS LAN & twenty four(24)ports be considered for DTS & development system & DR system each,)

1.13.30.8.4 Networking Equipment:

a. **Firewall**

Firewalls shall be provided as per BOQ. It is required that both side firewalls (Internal and External).

All firewalls shall be hardware box firewall as per the requirements mentioned in the table below

b. Routers

Routers shall be capable for data exchange between various communication media such as copper cable, PSTN /leased line, fiber optic cable, VSAT etc. Routers shall have the built-in firewall features as required.

c**. Host based Intrusion Detection System & Intrusion Prevention System (Network Based)**

The contractor shall provide host based intrusion detection system & Intrusion Prevention system as per the parameters mentioned in this technical specification.

d. **Local Area Network (LAN) and device interfaces**

Servers and peripheral devices are connected to each other on local area network (LAN). LAN switches shall be as per the features mentioned in this Technical Specification.

1.13.30.8.5 Time and Frequency Facility

A time and frequency facility to determine Universal Coordinated Time (UTC), power system time, time deviation, power system frequency, and power system frequency deviation shall be provided. UTC shall be obtained from the Global Positioning System (GPS) satellite constellation. The time receiver shall include propagation delay compensation to provide an overall accuracy of ±1.5 ms and shall also include an offset to permit correction to local time.

Upon loss of the time signal, the time and frequency facility shall revert to an internal time base. The internal time base shall have a stability of 1 ms per hour or better. The time shall return to within ±1.5 ms of UTC within five minutes of reacquisition of signal. The local frequency input shall be separate from the time and frequency facility's power input.

The time and frequency facility shall include digital displays for:

a. UTC time and date in the format DD:HH:MM:SS (the hour display shall be in 00 to 23 hour format)

b. Time deviation in the format ±xx.xx seconds
c. Power system frequency in the format xx.xxx Hz
d. Frequency deviation in the format ±x.xxx Hz.

The time and frequency facility shall include a digital display of local time suitable for mounting on the wall. The display shall be in 24-hour time, showing time in HH:MM:SS format. Each digit shall be at least

5 cm (2 inches) in height, and shall be bright enough to be read at a distance of 15 meters (50 feet) under ambient room lighting levels of 50 lumens (75 foot-candles).

1.13.30.9 RTU

The Remote Terminal Unit (RTU) shall be installed at primary substation to acquire data from Multifunction Transducers (MFTs), discrete transducers & status input devices such as CMRs etc. RTU & shall also be used for control of Substation devices from Master station(s). The supplied RTUs shall be interfaced with the substation equipment, communication equipment, power supply distribution boards; for which all the interface cables, TBs, wires, lugs, glands etc. shall be supplied, installed & terminated.

Scope also covers supply & laying of cables for:

a) Acquiring the digital data for status of field devices in the control room

b) Extending control output to field devices through heavy duty relays (Heavy duty relays to be supplied by contractor)

c) Interconnection between Contact Multiplying Relays (CMRs) and RTUs & field devices

(CMRs to be supplied by the contractor)

d) Acquiring CT, PT or other analog signals defined in specification

e) Power and signal cabling between the supplied equipment

f) Cabling between communication equipment and contractor supplied equipment

g) Any other cabling required for successful working of RTU

1.13.30.9.1 Design Standards

The RTU shall have the ability to interface to a varying number of data acquisition and control devices in the substation, through high-speed serial interfaces or a local area network (LAN), and transmit selected subsets of the data to one or more master stations in their native protocol. The RTU shall be specifically designed for electric power applications, with the ability to withstand harsh electrical and environmental conditions.

The RTUs shall be capable of performing the following functions:

- Data processing: RTU shall be capable of processing Analog values, Digital, Protection alarms, diagnostic and housekeeping alarms
- Advanced communication: Communication modules with multi-processor architecture, integrated modems and network modules
- Integrated cyber security features
- Superior redundancy concept adaptable to different availability requirements, Power supply redundancy and communication CPU redundancy
- Efficient data engineering: Easy use of MS-Excel sheets for data engineering and for data import and export
- Time synchronization
- Rugged design for substations and harsh environmental conditions
- Applicable for electrical applications from medium to extra- high voltage
- Supports a lot of modern international and third party telecontrol communication protocols.

The protocol for communication between RTU & Main control Centre shall be IEC 60870-5- 104 / DNP 3.0(TCP/IP).

1.13.30.9.2 System Design

The RTU systems shall be responsible to collect process information and control the substation equipment. They shall communicate with a Central Control System using the tele-control communication protocol described in this specification.

The RTU shall have modular design with the use of plugged-in modules and it shall easily be possible at a later stage to expand the RTU for more I/O capacity, further communication lines or other functionality.

The RTU shall have a system-wide event resolution of 1 millisecond for every input. The bidder shall certify that the RTU complies with this requirement.

The equipment shall have front access for modules, terminal blocks, alarm indications, and switches. The electronic modules shall be labeled in the front using the same name as indicated in the technical documentation. The equipment shall be designed to restart automatically after power failure. It shall not be necessary to manually restart the equipment after the recovery of the auxiliary power source.

The hardware shall be designed for a service life of at least 10 years.

The configuration data and the software of the RTU (firmware and parameters) shall be stored centrally on an exchangeable, non-volatile storage card in the Main CPU Card. The preferred media for storage is a SD Card. Battery backup is not allowed. When the RTU is restarted, and also when individual modules are restarted, all necessary data are automatically transmitted from the storage card to all CPUs and modules.

Renewed loading after module exchange shall not be necessary. The new modules shall receive all configuration information from the storage card. This means, that with the exchange of spare parts, "Plug ´n Play" must be possible and no tool or further loading is needed.

The RTU shall provide the capability to load setting for a single card in the RTU only in order to prevent restart of the complete RTU.

1.13.30.9.3 Hardware Design

The RTU shall be microprocessor-based modular unit. The boards shall be assembled in 19” standard racks.

It shall be possible to remove and replace faulty modules without the need of special tools.

CPUs:

The RTU shall provide CPU boards which are responsible for the main processing tasks and for the communication. The main tasks of the CPU boards are

- Communication to control center
- Communication to subordinated farms
- Managing and controlling of the I/O boards via the peripheral I/O bus
- Reading process events from the I/O boards
- Writing commands to the I/O boards
- Managing time base

It shall be possible to build up a multiprocessor-architecture with more than one CPU board. For those functions and communication tasks which are critical for the operation of the station it shall be possible to provide two sets of redundant CPU boards in a active/standby configuration. In case of an error condition of the active CPU board the RTU will automatically switch over to the standby CPU board and this CPU starts to take over the tasks.

Each CPU board shall have a 32-bit main processor. The RTUs shall be capable expandable of handling up to 5000 IO points. The CPU boards shall be equipped with at least 64 Mbyte RAM-Memory and 8 Mbyte Flash/EEProm Memory. The firmware and the configuration of the RTU shall be stored power-fail-save in the Flash/EEProm Memory of the RTU. Programs and configurations shall not require reloading due to power outage. It must be possible to easily change or update the firmware to implement enhancements or change protocols. The protocols should be easily selectable for the communication ports from the configuration software and the software should be able to load required firmware for protocol selection.

Each CPU board should have at minimum 4 communication ports. It shall also be possible to transfer the configuration of a RTU to a local or remote computer and also shall have the capability for remote diagnostics.

The RTU shall provide Data Archives in order to save data like system events from the RTU, process events, and measuring values. It shall be possible to store this information with the time-stamp with 1 ms resolution in the data archive which will be saved power-fail-save in the Flash/EProm memory of the RTU and not be erased in case of an outage of the power supply.

I/O Boards:

- The connection to process signals shall be made by means of input and output boards Each I/O board shall be equipped with its own microprocessor which takes over a part of the data processing, e. g. digital filter for binary inputs, threshold supervision for analog inputs, etc.
- The I/O boards shall be hot swappable, so that the modules can be replaced without the need of switching OFF the RTU.
- The I/O boards shall also have their own times which are synchronized by the CPUs periodically via the I/O bus, in order to provide time stamping of events and analog values with an accuracy of +/-1ms.
- The inputs shall be potentially isolated by the means of optical couplers.

- For commands, there should be a 1 out of n check to ensure that only one command will be activated at a time and resistance check to check the coil healthiness.

Power supply:

The RTU must have suitable power supply boards for each sub-rack that designed to supply a fully equipped sub-rack under normal conditions. The power supply boards shall have the following properties and functions:

- Potential isolation between inputs and outputs
- Cooling by natural convection
- Electronic power limitation
- Short-circuit proof
- Over voltage protection
- Controlled load balancing
- Alarm indication in case of failure
- Parallel operation with monitoring of redundant power supply configuration for the communication modules.
- 110V DC power supply shall be available at each substation, required arrangement shall be made to take the supply.

1.13.30.9.4 Functional Requirements

Tele-Commands

The RTUs shall be capable of handling the following types of output commands:

- Single command outputs
- Double command outputs
- Regulation step commands
- Set point command outputs (Analog set points and digital set points)

It shall be possible to mix different types of commands at the same binary output board (except analog set points, which are handled by analog output boards).

The commands may be executed in one or two step mode (select before operate sequence). The “Select Before Operate” mode shall decrease the residual error probability in command direction. An appropriate select acknowledge response shall be issued to the Control Center prior to executing a control. The selection of a point for

control shall be cancelled if an Execute command is not received within a time period of 20seconds.

Object Command outputs (single and double command outputs) shall be possible as pulse commands in an adjustable pulse length from 0,1 to 25,5 seconds. Single commands shall also be possible as persistent outputs.

It shall be possible to limit the pulse duration of an object command to the runtime of the switching device (e.g. isolator). The run time end is recognized by the new position indication of the respective switching device. To prevent that the command is stopped before the new position is settled, a command release delay time shall be specified.

The binary outputs shall be galvanic isolated from the internal circuits via relay contacts.

Tele-Indications

The state of power system switching devices, other indications and alarm points shall be monitored through dry contacts fed from the RTU. The RTUs shall be capable of handling single point inputs as well as double point inputs, represented by two sequential bits of the binary input board. The normal state of a double point input is a non-equivalent bit combination (10 or 01). An intermediate state (00) is given during the runtime of a device from one position to the other.

It stall be possible to mix different single and double inputs on one binary input board.

In order to reach a time resolution of time stamping of events of 1 millisecond, the binary input board shall read all its inputs periodically every millisecond.

Each binary input must have a digital filter in order to prevent ordinary contact bouncing. The digital filter is set by a parameter to specify how many milliseconds an input must be stable before it is accepted as a new signal stage.

To prevent a permanent transmission of indications which frequently change their state, a oscillation suppression must be available, which can be activated or deactivated per indication.

The binary inputs shall be isolated from the internal circuits by means of optic couplers.

Tele-Metering

The RTU shall provide differential analog inputs for the acquisition of analog signals from measuring transducers. The following measuring ranges shall be available:

- 4-20mA
- +/- 2mA
- +/- 5mA
- +/- 10mA
- +/- 20mA
- +/- 2Vdc

The resolution of the measurement shall be 11 bit + Sign. Unstable input signals shall be smoothed to prevent too many updates. The smoothing factor shall be configurable.

It shall be possible to configure an analog dead band for each analog input point. The purpose of the analog dead band is to prevent noisy input signals from continuously reporting analog fluctuations within the RTU and to the control center. The RTU shall only report new analog values that exceed the dead band.

Additionally it shall be possible to configure background cycles for the transmission of analog values.

The RTU shall also provide the possibility to acquire digital measured values, represented by 8 bits or 16 bits of a binary input board. The RTU shall handle conversions of binary data (BIN), binary coded decimals (BCD) and Gray code.

The RTU shall support following processing functions:

- scan analog inputs cyclically
- supervision of zero value and switching detection
- smoothing
- threshold supervision on integrator algorithm
- periodic update of RTU data base
- store events into FIFO with time stamp
- The measuring range and line frequency shall be easy to configure by switch registers respectively jumpers.

1.13.30.9.5 Communication Interfaces

Similarly, The RTU shall have the capability to support simultaneous communications with SGCC.

The RTUs shall have a minimum of eight communication ports for the following purposes:

- Each communication CPU board should have at minimum Two serial ports (RS485/RS232-C) and Two Ethernet Ports which can be configured separately with multi protocols.
- One port to interface with SGCC over IEC 60870-5-104
- Required number of Serial/Ethernet ports to interface with field devices over IEC60870-5-101 /IEC60870-5-104 /Modbus Serial/Modbus Ethernet protocol.
- One port for the RTU maintenance and configuration terminal.
- Provision should be made to interface with local HMI.
- The RTU shall support the use of a variety of communication data exchange rates, scanning cycles and above listed communication protocols. All the above protocols shall be built in features of RTUs. Use of protocol converters shall not be permitted.

All serial communication ports shall use RS-232C or RS-485 signal specifications to interface to above listed equipment. All ports shall be accessible to the Owner to attach the interface equipment and to provide access for the maintenance, test, and monitoring equipment.

It should be able to change protocol of the communication ports in a later stage for accommodating new functionalities.

1.13.30.9.6 Redundancy

The RTU shall have the possibility of different redundancy concepts. That means it shall at least have the possibility of:

- redundant communication lines/links
- redundant communication CPUs
- The redundant communication CPUs shall run in an active/standby switchover mode
- redundant power supply for communication modules

1.13.30.9.7 Programmable Logic Capability

The RTU shall support programmable logic capabilities, easy to use editor facilities. These facilities shall allow creation of programmable logic and computational algorithms for the RTU. The programmable logic capability shall enable the RTU to perform control functions such as closed-loop analog control, sequencing for equipment startup and shutdown, automatic failover control, and other such functions typically performed by Programmable Logic Controllers (PLCs).

The programming methods can also comply with IEC 61131-3, the emerging international standard for programmable logic controllers in following program languages:

- Function block diagram (FBD)
- Instruction List (IL)
- Structured Text (ST)
- Ladder Diagram (LD)
- Sequential Function Chart (SFC)

The PLC programs shall run parallel to the tele-control task, or on separate CPU central board used only for the PLC application.

PLC programs shall have access to all process signal value as well as the process signal qualifiers such as invalid, time, etc. PLC programs running distributed applications shall use the qualifiers for secure and safe operation.

PLC programs shall update the process signal values via the process data interface. The tele-control task shall be informed about changes and updates of the new output values either to the process output boards or via the communication line to the network control centers and sub-devices.

1.13.30.9.8 Time Management and Synchronization

The internal time management shall be controlled by the CPU communication boards. The time resolution of the RTU shall be 1 ms for events, scanned by the directly connected I/O boards. Synchronization with absolute time shall support any one of the following methods:

- Time synchronization of the RTU by the Smart Grid Control centre (SGCC) via a periodically transmitted synchronization instruction with a communication protocol supporting this function.
- Time synchronization of the RTU using SNTP on a LAN/WAN network
- RTU should be capable for configuring as SNTP server to synchronize downstream devices.
- The long term time accuracy of the main RTU (in case of multi-level RTUs) shall be +/- 5 milliseconds or better.
- The time resolution of the RTU is 1 ms for events, scanned by the directly connected I/O.

- A time synchronized RTU shall be able to synchronize subordinate RTUs and IEDs via:
- a periodically transmitted synchronization instruction with a communication protocol supporting this function
- Time synchronization using SNTP on a LAN/WAN network

1.13.30.9.9 Diagnostics

All RTU boards shall have light emitting diodes (LEDs) to indicate errors or operating modes. The application/configuration data shall be stored on Compact Flash Cards which makes it possible to exchange modules without new configuration download. The functional operation of the RTU shall be guaranteed by a comprehensive monitoring concept. The hardware and software shall be continuously monitored from the I/O boards throughout the entire RTU. The hardware and software monitoring shall be carried out by active checks at several levels. The RTU shall report its system and error states to the Control Center by means of System Events. The RTU shall provide remote diagnostics capabilities. It shall be possible to connect to the RTU from a remote computer in order to analyze the system and error status, check-up of the configuration or signal values of the RTU remotely, e.g. by means of a Web-Server via LAN/WAN.

Remote access via Intranet shall be combined with authority privileges for the user. For following activities:

- Monitoring the RTU-produced internal error messages
- Monitoring and checking the RTU configuration and the status of all connected process signals
- Checking the current version of the configuration file
- Downloading or uploading the RTU configuration file
- Checking and downloading revised software files for the RTU CPU boards
- Uploading the archive files

1.13.30.9.10 Cyber Security

The following security functions shall be included in the RTU:

- Password Complexity enforcement based on at least one upper/lower/number/non-alphanumeric character options
- Security Event Logging and viewing of the same through the web browser. It shall also be possible to upload this log into CSV files.

- The RTU shall be hardened - Closing of unused TCP/IP ports and services
- Enabling/disabling of Web server use individually per CMU
- All the above security features fulfill basic requirements of the following security standards:
- NERC/CIP - North American Electric Reliability Corporation - Critical Infrastructure Protection

The RTU time management system shall have hardware and software logic with a high control quality incorporated on the CPU communication boards to manage real time within the LDC.

1.13.30.9.11 Master Stations Communication Interface

1. The SGCC will acquire the data from the RTUs. The Contractor will provide communication channels between the RTUs and SGCC.
2. The communication channels will consists of mainly MPLS, Leased Line, optical fiber, Radio and Microwave links. Use of dedicated or party-line communication channels shall be supported.

1.13.30.9.12 Tools

Configuration tool:

The supplier shall provide a suitable software tool for the configuration and database programming of the RTUs. The tool shall be state-of-the-art, running on standard desktop or laptop computers, and shall be based on Windows. The user interface shall be an application according to Microsoft standard presentation format. The configuration tool shall contain an online documentation for easy handling. It also shall provide an Excel import data interface that enables the user to use Excel sheets to manage RTU configuration data and processing parameters.

1.13.30.9.13 PLC programming tool:

A powerful software tool for the preparation of user specific programmable logics shall be provided. That means the engineering tool of the RTU must be able to perform the task of a single, stand-alone RTU, as well as to be able to be integrated into an overall data-engineering concept for a network control system.

To get a higher flexibility for configuration extensions of modifications, the engineering tool and the RTU concept shall allow to download the files into the RTU in the stations via INTRANET using WEB browser technology or via the communication line, when the protocol supports file transfer.

The PLC programming tool shall allow programming according to the IEC 61131-3 programming standard. The following programming methods shall be supported so the users can preference:

- Function Block Diagram (FBD)
- Instruction List (IL)
- Structured Text (ST)
- Ladder Diagram (LD)
- Sequential Function Chart (SFC)
- Local Configuration & Maintenance Interface

The RTUs shall include the interface to support the portable configuration and maintenance terminal (PCMT). The interface shall provide easy access to allow employer to use the maintenance terminal at the RTUs installed in the field.

1.13.30.9.14 Local Data Monitoring System (LDMS) Interface

The RTUs shall include the interface to support IEC 60870-5-104 protocol for communication with the LDMS system.

1.13.30.9.15 Communication interface between RTU & MFTs

The RTU shall acquire data from the MFTs. The MFTs will act as slave to the RTU. The RTU shall have the ability of issuing retry scan to acquire data from the MFTs in case of communication failure between RTU and MFTs. All data from the devices connected on a single port shall be acquired within 5 seconds.

The RTU shall store data acquired from the MFTs in its database and do processing like change detection/deadband processing on the data for optimizing its transmission to the Master station. The processing shall include necessary mapping of information to the protocol requirement for communication with master station.

1.13.30.9.16 Master Station Communication Protocol

RTU shall use IEC 60870-5-104 communication protocol for communicating with master station. The RTU communication protocol shall be configured to report analog & status changes by exception to master stations. However, RTU shall support periodic reporting of analog data and periodicity shall be configurable from 10 sec to 1 hour. Digital status data shall have higher priority than the Analog data. The dead-band for reporting Analog value by exception shall be initially set to 1% (user configurable up to 10%) of the previously reported value. In addition, analog values shall also be reported to Master station by exception on violation of a defined threshold limit. All the analog

values and status data shall also be assigned to scan groups for integrity check by Master stations at every 10 minutes configurable up to 60 minutes RTU wise. All communication shall be initiated by the SCADA master stations. RTU must notify the master stations of unusual conditions at the RTU (such as a power fail/restoration or RTU malfunction), the transfer of changed data etc. All the notifications shall be accomplished within the framework of the periodic data acquisition exchanges.

The RTU shall process the various messages/commands for communication to the Master station using the following priority.

a) Control command

b) Status data by exception

c) Analog data by exception

d) Analog data periodic

e) Status data integrity scan

f) Analog integrity scan

The communication interface to the master station(s) shall allow scanning and control of points within the RTU independently for each master station. It shall be possible to pick points from the RTU database randomly and assign it for reporting to a Master station.

1.13.30.9.17 Scan Groups

Analog and digital input points (including points reported by exception) shall be assignable to scan groups. A scan group shall be a specified set of data points within the RTU central database which will be communicated to a master station when requested by a specific (addressed) scan request. A scan group size shall only be limited by the communication protocol message length. Any RTU input point shall be assignable to any scan group. The RTUs shall support at least four (4) scan groups and all scan groups per communication port (i.e. master station/ LDMS interface).

1.13.30.9.18 RTU Communication Protocol

The RTU shall act as an IEC 60870-5-104 protocol master and collect data and also perform supervisory control from/on the slave RTUs and communicate it to the Control Centre. The Master protocol implementation shall be such that the data polling requirements shall be accomplished.

1.13.30.9.19 Contact Multiplying Relay

Contact multiplying relays (CMRs) are required to multiply the existing auxiliary contacts of breaker/ relay etc. The contacts of these relays shall be used to provide status input to the RTUs. The relays shall be of self-reset type. The relay shall have a minimum of two changeover contacts each with minimum current carrying capacity of 5 A at 110V DC.

The relays shall conform to the following requirements:

a) Power frequency withstand voltage: 2 kV for 1 minute as per IEC standards.

b) Insulation resistance of 100 Mohms at 500 V DC.

c) 5 KV Impulse test as per IEC 255-5 standards

The CMRs shall be generally mounted in existing control & Relay panel.

1.13.30.9.20 Momentary Change Detection

Two-state status input points with momentary change detection shall be used by Employer for points where multiple operations (changes of state) can occur between scans from the master station (such as breakers with auto-reclosing devices that operate faster than the master station scan rate). The RTU shall capture and maintain all of the momentary changes, up to 4 per MCD digital status point. The MCD status input points shall be set to capture operations of greater than 20 ms duration.

Alternatively, the RTU can store and report the multiple state changes of a digital input as discrete events. It shall be ensured that all the changes are reported to the Master station in the sequence in which they occur in the RTU.

1.13.30.9.21 Latching (Dummy Breaker) Relay

The Contractor shall provide a latching relay in each RTU to be used to simulate and test supervisory control from the RTU. The simulation relay shall accept the control signals to open and close from the RTU, and shall provide the correct indication response through a single contact indication input point.

1.13.30.9.22 Raise/Lower Pulse Output

A pair of outputs shall be supplied for each (raise/lower) control output point that drive control relays. One output shall be supplied for raise, the other for lower. When commanded from the master station, the appropriate raise or lower output shall be operated for the selected time interval. The closure time interval for raise/lower pulse

output points shall be specified in the operate command from the master station. The raise/lower output for each point shall operate over a range of 0.1 to 4 seconds in a minimum of eight equal increments.

1.13.30.9.23 Heavy Duty Control Output (Double Contact Digital Output)

The control output contact from the RTU shall be used for initiating heavy duty relays for trip/close of switching devices and energising relays of OLTC raise lower the pulse output. The contractor shall provide heavy duty relays. Each control output relays shall consist of at least 2 NO contacts. The output contacts shall be rated for at least 5 Amps Continuous at 110Vdc and shall provide arc suppression to permit interruptions of an inductive load. Relay coils shall be shunted with diodes to suppress inductive transients associated with energizing and deenergizing of the relay coils. The relays shall conform to the IEC 60255-1-00 and IEC 60255-5 requirements.

1.13.30.9.24 Control Security and Safety Requirements

The RTU shall include the following security and safety features as a minimum:

(a) Select-check-operate sequence for control output- The verification message for check-before-operate control sequences shall be obtained by re-encoding the verification message directly from the control point selection lines. Thus, a simple reflection of the received message is not acceptable.

(b) Partitioned database for each master station- A control point shall be selectable only from one master station at a time. A control point in the RTU once selected by a master station shall not be operable from another master station.

(b) No more than one control point shall be selected at any given time. A detection and lockout method shall be provided that prevents a control operation if more than one control point has been selected.

(d) The control selection shall be automatically cancelled if after receiving the "control selection" message, the "operate" command is not the next received message and is not received within the set time period.

(e) No false output shall result during power up or power down. No false output shall result from inadvertent connections to a circuit card.

(f) All control output connections shall have protective covers.

1.13.30.9.25 Local/Remote selector switch

A manual Local/Remote selector switch shall be provided for each RTU to disable all control outputs by breaking the power supply connection to the control outputs. When in the "Local" position, the Local/Remote switch shall allow testing of all the control outputs of RTU without activating the control outputs to field devices. A status input indication shall be provided for the Local/Remote switch to allow the SCADA system to monitor the position of the switch.

1.13.30.9.26 Environmental Requirements

The RTU will be installed in control room buildings with no temperature or humidity control. The RTUs shall be capable of operating in ambient temperature from -10 degree to +55 degree C with rate of temperature change of 20 degree C/hour and relative humidity not less than 95%, non-condensing.

1.13.30.9.27 Noise level

The audible noise generated by the RTU equipment shall not exceed 50 dbA at a distance of one meter from the enclosure.

1.13.30.9.28 RTU Size and Expandability

The software and the database shall be sized to accommodate growth within the ultimate sizing parameters as defined in this specification for the RTU without requiring software or database structure regeneration. The RTU shall have additional wired available reserve capacity of twenty percent (20%) for each type of points. This reserve capacity shall be used without any additional hardware such as I/O cards and terminal blocks. Further each RTU shall be provided with one additional status Input and control output module. The RTUs delivered shall have the capability to accommodate additional I/O modules to expand the overall point count of the RTU by a minimum of fifty percent (50%) i.e. 60% more than the actual RTU count. The I/O modules here mean Status Input module, Analog input module and the Control output module. Other modules, such as processor module, racks etc. as required to meet the overall expandability requirement defined above shall also be supplied by the contractor.

1.13.30.9.29 RTU panels

The Contractor shall provide panels, which shall house RTU and accessories. The panels shall meet the following requirements:

- Shall be free-standing, C channel frame mounted on floor trenches and height shall not exceed 2200 mm.

- Shall have maintenance access to the hardware and wiring through lockable full height doors.
- Shall have the provisions for bottom cable entry
- The safety ground shall be isolated from the signal ground and shall be connected to the ground network. Safety ground shall be a copper bus bar. The contractor shall connect the panel's safety ground to the owner's grounding network. Signal ground shall be connected to the communication equipment signal ground.
- All panels shall be supplied with 230 Vac, 50 Hz, single-phase switch and 15/5A duplex socket arrangement for maintenance.
- All panels shall be provided with an internal maintenance lamp, space heaters and gaskets.
- All panels shall be indoor, dust-proof with rodent protection, and meet IP41 class of protection.
- There shall be no sharp corners or edges. All edges shall be rounded to prevent injury.
- Document Holder shall be provided inside the cabinet to keep test report, drawing, maintenance register etc.
- All materials used in the enclosures including cable insulation or sheathing, wire troughs, terminal blocks, and enclosure trim shall be made of flame retardant material and shall not produce toxic gasses under fire conditions.

1.13.30.9.30 Interconnections

All cabling between component units of the RTU, RTU to MFTs / sensors and to the Employer control and relay panels (located in the substation control room) shall be supplied and installed by the Contractor and shall be shown on Contractor supplied drawings. Plug-type connectors with captive fasteners or compression type connectors shall be used for all internal inter-connections. The connectors shall be polarized to prevent improper assembly. Each end of interconnection cables shall be identified by a marker which includes the cable number and the identifying number and location of each of the cable's terminations. This information shall match with the Contractor's drawings.

- Adequate space and hardware shall be provided for routing of the field wiring within the enclosures. Contractor wiring within enclosures shall be neatly arranged and shall not be directly fastened to the enclosure frame. All internal

interconnection wiring and cables shall be routed separately from field wiring to the RTU terminals & power wiring. All wiring shall use copper conductors and have flame retardant insulation.

- Conductors in multi-conductor cables shall be individually colour coded.
- The use of non-flammable, self-extinguishing, plastic wire troughs is permissible. Metal clamps must have insulating inserts between the clamps and the wiring. Wiring between stationary and movable components, such as wiring across door hinges or to components mounted on extension slides, shall allow for full movement of the component without binding or chafing of the wiring.

1.13.30.9.31 Wiring/Cabling requirements

Shielded (screened) cables shall be used for external Cabling from the RTU panels. These external cables (except communication cables) shall have the following characteristics:

a) All cables shall have stranded copper conductor.

b) Minimum core cross-section of 2.5 mm2 for PT cables, 4 mm2, for CT cables and 2.5mm2 for Power &

Control outputs and 1.5mm2 for Digital Status inputs, transducer mA current output

c) Rated voltage Uo/U of 0.6/1.1KV

d) External sheathing of cable shall have oxygen index not less than 29 & temperature index not less than 250. Cable sheath shall meet fire resistance test as per IS 1554 Part- I.

e) Shielding, longitudinally laid with overlap.

f) Dielectric withstand 2.5 kV at 50 Hz for 5 minutes

The Communication cable shall be of shielded, twisted pairs and of minimum 0.22sq mm size.

1.13.30.9.32 Terminal Blocks

Terminal blocks shall be having provision for disconnection (isolation), with full-depth insulating barriers made from moulded self-extinguishing material. Terminal blocks shall be appropriately sized and rated for the electrical capacity of the circuit and wire used. No more than two wires shall be connected to any terminal. Each analog input

signal, digital status input and digital output signals shall require two terminals per point plus a common shield termination for each cable All terminal blocks shall be suitably arranged for easy identification of its usages such as CT circuits, PT circuits, analog inputs, status inputs, control outputs, auxiliary power supply circuits, communication signals etc. Terminal Blocks for CT circuits shall have feature for CT shorting (on CT side) & disconnection (from load side) to facilitate testing by current injection. Similarly, TBs for PT circuit shall have feature for disconnection to facilitate voltage injection for testing.

1.13.30.9.33 Transducer & Weather Sensor Requirements

All transducers shall use the DC auxiliary power supply as available in the control panel or provided for the RTU depending upon the location of installation. All transducers shall have a maximum power consumption of 10 watts.

Transducer Protection

The input, output and auxiliary circuits shall be isolated from each other and earth grounded. The Transducer/Sensors output shall be ungrounded and shall have short circuit and open circuit protection. The transducers shall comply with the following requirements in addition to IEC 60688:

a) Electromagnetic Compatibility: IEC 61000-4-2, 3, 4, 5, 6 level 1

b) Shock Resistance: Minimum severity 50 A, IEC 60068-2-27

c) Vibration Strength: Minimum severity 55/05, IEC 60068-2-6

d) Input Circuit Consumption: Less than 0.2 VA for voltage and 0.6 VA for current circuits.

1.13.30.10 FRTU

The Feeder Remote Terminal Unit (FRTU) shall be installed in Ring Main Units (RMUs). FRTU shall be used for control of switching devices such as breaker, isolator inside RMU.

1.13.30.10.1 Design Standards

The FRTUs shall be designed in accordance with applicable International Electro-technical Commission (IEC), Institute of Electrical and Electronics Engineer (IEEE), American National Standards Institute (ANSI), and National Equipment Manufacturers association (NEMA) standards, unless otherwise specified in this Technical

specification. In all cases the provisions of the latest edition or revision of the applicable standards in effect shall apply.

1.13.30.10.2 FRTU Functions

As a minimum, the FRTU shall be capable of performing the following functions:

a) FRTU should be modular and DIN rail mountable with separate head unit and IO module. Head unit shall communicate upstream with control centre and downstream to IO modules. (IO module shall acquire hardwired digital input, digital output and analog Input).
b) Receiving and processing digital commands from the master station(s)
c) Data transmission rates 300 to 19200 bps for Serial ports for MODBUS. and 10/100 mbps for TCP/IP Ethernet ports
d) Use of IEC 60870-5-101/104 protocol to communicate with the Master station(s)
e) Use of MODBUS protocol over RS485 interface to communicate with MFTs.
f) Have required number of communication ports for simultaneous communication with Master station(s), MFTs and FRTU configuration & maintenance tool.
g) FRTU shall have the capability of automatic start-up and initialization following restoration of power after an outage without need of manual intervention. All restarts shall be reported to the connected master stations.
h) Remote database downloading of FRTU from master station from SCADA/ADMS control centre.
i) As the SCADA/ADMS system will use public domain such GPRS/CDMA etc, therefore it mandatory to guard FRTU data/ equipment from intrusion/damage/breach of security & hence FRTU shall have adequate cyber security features as per IEEE P1686, IEC62351.
j) The FRTU shall support IEC 61131-3 PLC programming for incorporation of automation logic.
k) The FRTU head unit shall have in-built webserver facility for commissioning and maintenance with local and remote access compatibility with PC, digital tablet or smartphone.
l) One sensor input shall be taken in FRTU to measure temperatures, such as (ambient air or transformer oil).
m) The FRTU head unit shall provide output lamp contact for local Indication.

1.13.30.10.3 Communication ports

The FRTUs shall have following communication ports to communicate with master station MFTs and configuration & maintenance terminal.

The FRTU shall have one RJ45 Ethernet port for upstream communication and shall be able to communicate with two SCADA simultaneously.

FRTU shall have one RJ45 Ethernet port for communication with third party field devices.

FRTU shall have one RJ45 Serial port for communication with MFT's to be connected in daisy chain using MODBUS protocol.

FRTU shall have one RJ45 Ethernet port for future LV automation.

FRTU shall have one port (USB) for connecting the portable configuration and maintenance tool for FRTU.

1.13.30.10.4 Master Station Communication Protocol

FRTU shall use IEC 60870-5-104/101, DNP3 as a communication protocol for communicating to master station. The FRTU shall support Secure Authentication according to IEC 62351-5.

1.13.30.10.5 Communication Protocol between FRTU & MFTs

The FRTU shall acquire data from the MFTs using the MODBUS protocol.

1.13.30.10.6 Cyber Security

In order to secure all controls and data acquisition, the FRTU shall be designed to be compliant with NERC and IEC62351 requirements. The FRTU shall support secure access based on RBAC, with the possibility to configure the roles.

- Local and remote access connection shall be secured for maintenance (locally and remotely) with HTTPS, SFTP, IPSEC and SSH protocols.
- Authentication shall be based on a Radius server.

1.13.30.10.7 Future proof design

Remote firmware update

- The FRTU shall support remote firmware updates

Centralised RBAC management

- The FRTU shall be evolutive in order to be compatible with a full centralised RBAC management in compliance with IEC 62351-8

1.13.30.10.8 Hardening

Device hardening

- Disabled or unused functionality shall not compromise security.
- Unnecessary services and programs shall be removed. If removal is not possible, the unnecessary services and programs shall be disabled.

Interface minimization

- Each interface shall support only the data types and protocols needed to meet the functional requirements.
- Unused interfaces and ports shall be removed. If removal is not possible, the unused interfaces and ports shall be disabled.
- A complete list of supported data types and supported communication protocols per interface shall be provided.
- All hardware interfaces that are used for programming or debugging shall be completely removed after production.

Account hardening

- The FRTU shall not contain active default, guest and anonymous accounts.
- All remote access to root accounts on the FRTU shall be disabled.
- All Vendor-owned accounts where feasible shall be removed.
- The list of all accounts on the FRTU shall be provided.

1.13.30.10.9 Communication

Compliance to security standards

The FRTU shall follow the IEC 62351 standards and at least:

- IEC 62351-5: 2013
- IEC 62351-3

Communication security

The FRTU shall support network and transport layer encryption using IPsec.

1.13.30.10.10 Configuration

- Access to the FRTU by configuration tool shall be possible only through secured connection: HTTPS for Webserver and SSH for console and configuration tool.

1.13.30.10.11 Access control

RBAC

- The FRTU shall support the implementation of Role-based Access Control in compliance with IEC 62351-8.
- It must be possible to configure the privileges of individual roles. It must be possible to carry out changes by configuration files through a secure way.
- It must be possible to define more roles for future applications.
- It shall be possible to assign each role individual security credentials.
- It shall be possible to bind roles to individual user accounts on the FRTU.

The minimum following function and data shall be controlled through RBAC:

- Configuration files
- Software update
- User management
- Executing program or shell command
- I/O on local maintenance access

A specific tool shall permit to configure the security policy, role and password.

1.13.30.10.12 Management of Security passwords

- The FRTU service application shall support individual user passwords.
- Passwords shall be stored together with a salt using an allowed cryptographic hash function.
- The FRTU service application shall enforce a high complexity of passwords.
- The FRTU shall lock the access after several password error.

1.13.30.10.13 User Authentication

- The FRTU shall authenticate the communication parties on the WAN interface using a challenge-response protocol based on message authentication codes The FRTU shall terminate the connection if the user authentication fails.
- The FRTU shall authenticate the communication parties on the Local Maintenance interface.

It shall be possible to configure the FRTU so that it blocks authentication requests, either temporarily or permanently, from an account after a number of failed login attempts. The number of failed login attempts and the time the account is blocked shall be configurable.

1.13.30.10.14 Central management of user account

The FRTU should allow to manage user authentication.

1.13.30.10.15 Security Log

The FRTU shall provide a local audit trail for all security events that occur.

Log files shall be produced in Syslog format.

Security events shall be logged locally in a dedicated security log or/and on a SYSLOG server.

1.13.30.10.16 Security testing

The FRTU shall comply with ACHILLE Level1 certification.

1.13.30.10.17 Documentation

Secured Versioning

All released versions (hardware, firmware, software) of a device or product shall be uniquely identifiable.

Exchangeable hardware modules shall be versioned separately.

Design Documentation

The Protocol Implementation Conformance Statement as in IEC 62351 and IEC 60870-5-7 shall be provided on request.

IO Acquisition module details:

1.13.30.10.18 Status input (32 DI in IO module)

FRTU shall be capable of accepting isolated dry (potential free) contact status inputs. The FRTU shall provide necessary sensing voltage, current, optical isolation and de-bounce filtering independently for each status input. The sensing voltage shall not exceed 24Vdc /48 Vdc/220VAC

1.13.30.10.19 Sequence of Events (SOE) feature

To analyse the chronology or sequence of events occurring in the power system, time tagging of data is required which shall be achieved through SOE feature of FRTU. The

FRTU shall have an internal clock with the stability of 100ppm or better. The FRTU time shall be set from time synchronization messages received from master station using IEC 60870-5-104 protocol. SOE time resolution shall be 10 ms or better.

1.13.30.10.20 Control Outputs (16 DO in IO module)

The FRTU shall provide the capability for a master station to select and change the state of digital output points. These control outputs shall be used to control power system devices such as Circuit breakers, isolator, reset, relay disable/enable and other two-state devices, which shall be supported by the FRTU. A set of control outputs shall be provided for each controllable device. On receipt of command from a master station using the select check-before-execute operate (SCBO) sequence, the appropriate control output shall be operated for a preset time period which is adjustable for each point from 0.1 to 2 seconds. Each control output shall consist of one set of potential free NO contact. The output contacts shall be rated for atleast 0.2 Amp. at 24Vdc / 48 Vdc. These output contact shall be used to drive heavy duty relays. In case Control output module of FRTU does not provide potential free control output contact of this rating, then separate control output relays shall be provided by the contractor. These relay coils shall be shunted with diodes to suppress inductive transients associated with energizing and de-energizing of the relay coils & shall conform to the relevant IEC requirements.

Heavy duty control output relays

The control output contact from the FRTU shall be used for initiating heavy duty relays for trip/close of switching devices. The contractor shall provide heavy duty relays. Each control output relays shall consist of atleast 2 NO contacts. The output contacts shall be rated for at least 5 Amps Continuous at 220Vdc and shall provide arc suppression to permit interruptions of an inductive load. Relay coils shall be shunted with diodes to suppress inductive transients associated with energizing and de-energizing of the relay coils. The relays shall conform to the IEC255-1-00 and IEC 255-5 requirements.

Control Security and Safety Requirements

The FRTU shall include the following security and safety features as a minimum for control outputs:

(a) Select- check-before-operate operate (SCBO) sequence for control output.

(b) No more than one control point shall be selected/executed at any given time.

(c) The control selection shall be automatically cancelled if after receiving the "control selection" message, the "control execute" command is not received within the set time period.

(d) No control command shall be generated during power up or power down of FRTU.

Dummy breaker latching relay

The Contractor shall provide a latching relay to be used to simulate and test supervisory control from the Master station. The latching relay shall accept the control signals from the FRTU to open and close, and shall provide the correct indication response through a single point status input.

1.13.30.10.21 Analog Inputs (4AI capability in IO module)

The real time values like, Active power, Reactive Power, Apparent power three phase Current & Voltage and frequency, power factor & accumulated values of import /export energy values will be acquired FRTU from the following in the given manner:

1. MFTs installed in RMU/DTs

2. FRTU shall also take 4-20 mA, 0-20mA, 0- -10mA, 0-+10mA, 0-5V etc as analog inputs to acquire DC power supply voltage etc.

1.13.30.10.22 Contact Multiplying Relays (CMRs)

Contact Multiplying Relays (CMRs) are required to multiply the contacts of breaker, isolators and protection relays etc. The contacts of these relays shall be used to provide status inputs to the FRTUs. The relays shall be DC operated, self reset type. The rated voltage for relay operation shall be on 24/48/110V DC depending on the station DC supply. The relay shall be able to operate for +/-20% variation from nominal voltage. The relay shall have a minimum of two change over contacts, out of which one shall be used for telemetry purposes. The contacts shall be rated to carry minimum current capacity of 5A. The relay shall conform to following requirement.

a) Power Frequency withstand voltage–2KV for 1 minute as per IEC 255-5.

b) Insulation Resistance of 100M ohms measured using 500V DC megger.

c) 5KV Impulse test as per IEC 255-5

The relays coils shall be shunted with diodes to suppress inductive transients associated with energizing and de-energizing of the relay coils. The relays shall conform to the IEC 255-1-00 and IEC 255-5 requirements. The relays must be

protected against the effects of humidity, corrosion & provide with a dust tight cover. The connecting terminals shall be screw type & legibly marked. The relays may optionally have a visual operation indicator. The relays are to be mounted in junction /termination box and therefore shall be equipped with suitable mounting arrangements. In case suitable space is not available in junction /termination box the same shall be mounted in FRTU panel.

1.13.30.10.23 Time facility

The internal FRTU time base shall have a stability of 100 ppm. The FRTU shall be synchronised through synchronisation message from master station at every 5 minutes (configurable from 5 minutes to 60 minutes) over IEC 60870-5-104/101/NTP/SNTP

1.13.30.10.24 Diagnostic Software

Diagnostic Software shall be provided to continuously monitor operation of the FRTU and report FRTU hardware errors to the connected master stations. The soft-ware shall check for memory, processor, and input/output ports errors and fail-ures of other functional areas defined in the specification of the FRTU.

1.13.30.10.25 Power Supply

- FRTU shall get DC power supply from DC power supply arrangement of the RMU.

Monitoring

The power supply shall deliver the following status to the SCADA

- End of life detection
- Battery disconnected
- Absence of power input
- Voltage output faults
- Battery fault

Any other data should be available through a serial link communication.

1.13.30.10.26 Environmental Requirements

The FRTU will be installed in inside RMU Panel or in open environment with no temperature or humidity control. The FRTUs shall be capable of operating in ambient temperature from 0 to +55 degree C with rate of temperature change of 20 degree C/hour and relative humidity less than 95%, non-condensing. FRTUs to be installed in

the hilly region with the history of snowfall, the same the lower ambient temperature limit shall be -5 degree C.

1.13.30.10.27 FRTU Size and Expandability

FRTU shall be equipped for the point counts defined in the BOQ (Basic+20% spare (wired & hardware). It shall be possible to expand the FRTU capability for additional 20 % of the basic point counts by way of addition of hardware such as modules, racks, panels, , however, FRTU software and database shall be sized to accommodate such growth without requiring software or database regeneration.

1.13.30.10.28 Archives

FRTU Events shall be archived in logs.

FRTU Events shall be stored in the archive logs with a time resolution of 1ms, and a discrimination of 10ms.

The capacity of the logs shall be up to more than 500,000 events and measurement

All the logs shall be available from a maintenance tool connected to the FRTU or sent on request to the SCADA. The content of the logs shall be configurable and the name of the logs sent to the SCADA shall be configurable. It shall be formatted as a .csv file.

1.13.30.11 Multi-Function Transducers (MFTS)

The contractor shall provide the multi-function transducers for acquiring the real time analog inputs through 3 phase 4 wire CT/PTs circuits. The multi-function transducer shall be designed for nominal 110 V (Ph-Ph voltage) and 1A/5A (per phase current). The MFT shall be suitable for 20% continuous over load and shall be able to withstanding 20 times the normal current rating for a period one second. The MFT shall be able to accept the input voltages upto 120% of the nominal voltage. The MFT shall have low VA burden. MFTs shall be mounted generally in the owner's existing control panel or in the interface cabinet as per requirement to be supplied by the contractor.

Multi-function transducers shall provide at least the following parameters as a minimum with the specified accuracies.

Sl. No.	Parameters	Accuracy
1	Voltage(each phase)	±0.5%
2	Current(each phase)	±0.5%

3	Frequency	± 0.2%
4	Active Power/Reactive power	±0.5% / ±1%
5	Power Factor	(measuring range shall be 0.6 to 1.0 lag & lead)

The parameters to be acquired from multifunction transducers shall be selectable. Multi-function transducers shall accept nominal DC available in the owner's Control panel as auxiliary power supply. Multi-function transducer shall be provided with RS 232 / RS485 interface to communicate with RTU over IEC 60870-5-104 / Modbus protocol in multi-drop mode. The MFTs shall be suitable for mounting on DIN rails. The MFT terminals shall accept upto two 2.5 mm2 / 4mm2 for PT/CT circuit terminations as applicable. The multifunction Transducer shall comply to the test requirements as per latest IEC/IS standard including IEC 60687/ IEC60688/ IEC 60801-4/ IEC 60802-3. MFT shall comply IS3231 for di-electric strength at 2.5 kV for 1 min.

1.13.30.11.1 DC Transducer

The DC Transducers are required to measure battery charger current & voltage shall be suitable for 20% continuous over load and shall be able to withstanding 20 times the normal current rating for a period one second. The DCT shall be able to accept the input upto 120% of the nominal voltage.

1.13.30.11.2 Transformer Tap Position Transducer

The Contractor shall provide suitable resistance tap position transducers which shall have the following characteristics

(a) The input measuring ranges shall be from 2 to 1000 ohms per step, which is tuneable at site with at least 25 steps.

(b) Dual output signal of 4 to 20 mA DC, 0.5% accuracy class as per IEC 688 shall be provided. One output will be used for driving a local digital indicator (to be provided by the contractor) and the other will be used for interfacing with the RTU.

(c)In case of lamp type tap position indication, additional resistance/potentiometer unit shall be provided to convert the dry type contacts to a variable resistance as defined in (a) above, suitable for the remote indication.

1.13.30.11.3 Weather Sensors

All weather sensors shall be maintenance free and of Industry standard design. The design of sensors shall permit calibration on site. The sensing mechanism shall be

rugged enough to avoid frequent recalibration. The sensor, support structure shall have built-in protection against lightning stroke/electrical surges. The output of all the sensors shall be 4 to 20 mA at 0-500 ohm impedance.

Air Temperature Sensor

Temperature Range:	-	5 o C to + 60 o C
Resolution	:	0.1o C
Accuracy	:	< 0.5o C or better

Radiation Shield: Radiation Shield made of weather resistant material and suitable to sensor used.

Relative Humidity Sensor

Range	:	0 to 99 %
Resolution	:	1 %
Accuracy	:	3 % or better

Radiation Shield: Radiation Shield made of weather resistant material and suitable to sensor used.

Operating Temperature Range: 0oC to + 60oC

Note: The Air Temperature and Relative Humidity sensors may be supplied in a single enclosure or separately.

Weather Sensor Installation Requirement

The weather sensor shall be supplied along with necessary accessories (e.g. tripod, stand, clamps etc.) for installation/ fixing of sensors, signal/power cables etc. as part of weather sensors station. All the accessories shall be made of stainless steel or other suitable material having sufficient mechanical strength and corrosion resistance to withstand atmospheric temperature, pressure, wind speed and relative humidity up to the working range (Minimum to Maximum) of sensors for these parameters as defined. The Employer will prefer to install the sensors on roof top of control centre/substation or other building. The mounting arrangement for all the sensors shall be designed suitably for installation on the roof top.

1.13.30.11.4 Design & Performance Requirements of Transducers

- Transducers for converting current transformer secondary currents of 1/5 A and voltage transformer secondary voltage of 110 V to 4-20 mA DC analog signals or to a suitable signal from acceptable to I/O modules of RTUs shall be provided.
- The Transducers shall be either multi-purpose type microprocessor based or a single purpose zener diode network based, in which they shall be of active type.
- Galvanic isolation shall be provided between the input and output.
- Transducers shall comply with IEC 60688 requirements.

1.13.30.12 User Interfaces

1.13.30.12.1 System Users

The term "user" is applied to the personnel interacting with the SCADA system. These users shall be required to login in one or more of following user modes, which include:

Supervisor Personnel responsible for SCADA system administration and management such as assigning the access area to users, creating users etc.

Dispatcher Personnel responsible for real-time Power system operations including real-time study.

Engineer Personnel having access to certain SCADA system functions and maintenance of database/ displays and responsible for support activities such as post fault analysis , report generation, regular backup of database

Programmer Personnel responsible for continuing development and maintenance of the SCADA system functions, databases, displays and report formats. Security system

Remote VDU user Personnel having only monitoring access of real-time power system from SCADA system, reports.

DTS (Instructor & Trainee modes- The Consoles dedicated for DTS shall have instructor & trainee modes.

Password security shall be provided for access to the SCADA system, its operating system, layered products, and other applications. Each password shall be validated against the corresponding user information in the database. Users shall have the ability to change their own passwords.

1.13.30.12.2 Function and Data Access Security

After a user has successfully logged on, access to the SCADA functions, displays, reports, and databases shall be restricted by pre-assigned operating jurisdictions. These operating area assignments shall be made when the function, display, report, or database element is defined.

The access security function shall compare the user's assigned operating jurisdiction against the operating jurisdictions assigned to the function, display, report, or database element each time a user attempts a console action, such as:

- Calling a display
- Entering or changing display data
- Viewing, editing, or printing a report
- Executing a supervisory control action

There shall be no restrictions on the assignment of multiple jurisdictions to a console & user or the assignment of a jurisdiction to multiple consoles & users. The access security function shall ensure that each jurisdiction is at all times assigned to a least one console. If a console failure or manual reassignment of jurisdiction results in one or more jurisdictions not being assigned to at least one console, the unassigned jurisdictions shall be automatically assigned to a reassigned default console and suitable alarms shall be generated.

SCADA users shall not require additional login (user name and password) to the other facility allowed as per operating jurisdictions such as ISR. “Single Sign-On” (SSO) technology be employed (i.e., a user logs on once to the SCADA using individually defined user name and password which permits appropriate level of access to all SCADA facilities, including IS&R. Further, the facility should be compatible with enterprise-wide SSO capabilities.

Each log-on and log-off shall be reported as an event. Unsuccessful attempts to log-on shall also be reported as events.

1.13.30.12.3 Windows Environment

The user interface for SCADA system shall be web enabled. The SCADA system displays shall operate within a windows environment and shall conform to the standards contained in the X Consortium's Inter-Client Communications Conventions Manual (ICCCM). The window system shall work with the graphical user interface provided and shall allow windows created on the workstations to communicate with

processors equipped with X Windows-compatible software on their respective local area networks (LANs) and with future remote applications over the wide area network (WAN).

Alternatively, the SCADA system can have the user Interface based on Microsoft Windows. The functionality in technical specification related to the GUI features of X-windows, shall be met by available features of Microsoft Windows.

The user interface software shall be based on state-of-the-art web-based technology to present interactive, full-graphics views of system data via LAN, corporate intranet or the internet. The same displays shall be used.

It is essential that the same web-based user interface (same navigator, same tools) be available to the operator either for local use in the dispatching center or remotely.

The web technology shall be natively supported by the DMS product, which means that having the displays shown in the web browser shall not bring additional work to the maintenance engineer at display building time. Nor shall it require additional third-party software products like specific plug-ins.

The web user interface shall support and enforce all security features described in the subsequent sections.

1.13.30.12.4 Display interactions

Rapid, convenient, and reliable display requests shall be provided using the following methods and industry standards around the following -

- Display Requests
- Display Navigation
- Permanent Indicators
- Default Screen Layout
- Display Note pad
- Quality Code and Tag Indication

1.13.30.12.5 User Interaction Techniques

The user's interaction with the SCADA system for power system operations shall primarily be accomplished using a menu item selection technique. The first step in the interaction will be selection of the item to be operated upon. The user shall then be provided a menu of operations applicable to the selected item. The required operation alternatives include:

- Supervisory control
- Data entry
- Device status entry
- Scan inhibit/enable
- Tag placement/removal
- Trend

A set of parameters shall be presented appropriate to the item type and operation to be performed. For example, selecting a device for control shall cause a menu of control actions to be presented. Selecting an analog value for trending shall cause a menu of parameters, such as range and trend rate etc., to be presented.

As appropriate for the data and function requested, a menu containing output destinations such as screen, printer, or file shall be presented. When the destination is selected by the user, the requested action shall begin. It shall not be necessary to select an execute command to complete the interaction except for supervisory control actions.

The user shall be able to end the interaction sequence at any time by selecting a cancel command. The progress of all user operations shall be monitored. If the user does not complete to a step within a multi-step operation within a pre-defined time, the process shall reset, and the user shall be informed of the reset. A partially completed action shall be reset if the user begins another non-related sequence. A programmer-adjustable time-out cancel shall also be provided

User Guidance

The SCADA system shall respond to all user input actions indicating whether the action was accepted, was not accepted, or is pending. For multi-step procedures, the systems shall provide feedback at each step. User guidance messages shall be English text and shall not require the use of a reference document for interpretation. User shall be guided for multiple options. The use of mnemonics is prohibited, unless the mnemonics are industry-accepted or approved by employer. Provisions are required for administrators to edit the toolbars and menus, user guidance messages and to construct new ones through an interactive procedure and without programming.

User Help

In addition to the user guidance, general and specific context-sensitive on-line help shall be available to the SCADA user. Context sensitive means that the help

information provided shall be applicable to the next step or steps in the sequence being performed. The Help menu shall present a list of topics available for reference. The topics shall refer to the SCADA user documents. The ability to scroll through the topic's explanatory text shall be supported.

The Help button in a dialog box and help key shall present the text of the user documents where use of the dialog box is explained. The user shall be able to scroll through this text. Exit from the help facility shall return the user to the same point in the sequence for which help was requested.

Context sensitive help facilities shall be provided for each application software package and operator display. The capability to easily edit or add additional help facilities in the future shall be provided.

The provided help facility shall also support:

- search mechanism
- navigation links between related topics within the help documents select/copy mechanism
- print facilities

Overlapping user access

The ability to queue multiple commands from different consoles shall be provided. In this regard, however, interlocks shall be provided to avoid overlapping user access to certain functions such as data entry and supervisory control

Both graphical trend and tabular trends shall be supported. Trend shall be a display of series of values of parameters on a time axis based on industry standards.

Alarms

Alarms are conditions that require user attention. All alarms shall be presented to the user in a consistent manner. Alarm conditions shall include, but not be limited to, the following:

- Telemetered or calculated value limit violations
- Values returning to normal from a limit violation state
- Uncommanded changes of a power system device state
- SCADA application program results
- Data source communication errors resulting in loss of data

- SCADA system hardware or software failures.

Each alarm shall be subjected to a series of alarm processing functions. A device or value's alarm able conditions shall be assigned to an alarm category and alarm priority levels. Alarms shall also be subjected to advanced alarm processing. The results of the alarm processing shall determine the console(s) that will receive and be authorized to respond to the alarm and the associated actions with the alarm.

All alarm messages shall be recorded on auxiliary memory of SCADA system and archived in chronological order & reverse chronological order. It shall be possible to sort, display and print user selected alarm messages from any console by the user.

Alarm Categories

An alarm category provides the logical interface that connects an alarm condition to a specific Area of Responsibility (AOR) or operational jurisdiction as defined and accordingly alarm shall be reported to user. Every alarm shall be assignable to a category. Each category shall, in turn, be assignable to one or more users. A means shall be provided for changing operating shifts without reassignment of alarm categories at a console. Each log-on and log-off shall be reported as an event.

Alarm Priority levels

Each alarm shall be assigned to an alarm priority level. Up to 8 alarms priority levels shall be supported. Each alarm priority level shall be presented in separate display. For each alarm, it shall be possible for the programmer to independently configure the following actions:

- Audible alarm tone type selection and its enabling/disabling
- Alarm messages to be displayed on an alarm summary
- Alarm message deleted from alarm summary when acknowledged
- Alarm message deleted from alarm summary when return-to-normal alarm occurs
- Alarm message deleted from alarm summary when return-tonormal alarm is acknowledged
- Alarm message deleted by user action.
- This assignment shall determine how the alarm will be presented, acknowledged, deleted, and recorded.

User Interaction for Alarms

The User shall be able to perform the alarm interactions described below alarm

Inhibit/Enable

- Inhibiting alarms for a value or device, including a complete RTU /FRTU/FPI or other data source, shall cause all alarm processing of that value or device to be suspended. The action shall be recorded in the event log. However, Scanning of the value or device shall continue and the database shall be updated.

Alarm Acknowledgment

An alarm shall be acknowledged by selecting an alarm acknowledge command when the item in alarm is selected on:

- Any display showing the item in alarm
- Any display showing the alarm message.

User shall be able to acknowledge alarm individually, by page, user selected manner. It shall be possible for the user to distinguish persistent & reset alarms under acknowledged & unacknowledged conditions. All alarms shall be stored by the system

Audible alarm silencing

User shall be able to silence alarm without acknowledgement and shall remain until the user enable the audible alarm. The silencing & enabling shall be recorded as event. The tones shall be definable on the console basis. For each console, multiple tones shall be available. Tones shall be of continuous & short duration type both. The former shall be of high priority condition & require operator intervention to stop. In case of short duration tone, it shall go off at it's own.

Change Alarm Limits

The user shall be able to change the alarm limits.. When the user selects an item to change its alarm limits, a menu showing the alarm limits currently in use and a data entry field for the revised limits shall appear. All changes to alarm limits shall be subjected to data entry error checking and recorded as events. The alarms shall be annunciated according to the changed alarm limits. The user shall be able to reset alarm limits to the limits set in the SCADA database. However, these shall be treated as temporary changes & if the system is re-initialised, the original limits defined in the SCADA database shall be operationlised.

Alarm Presentation

Alarm presentation shall be determined by the alarm's category and priority. Displays shall highlight every alarm condition using a combination of colour, intensity, inverse video, blinking and audible sound. The alarm condition highlighting shall show whether the alarm has been acknowledged. The highlighted alarm condition shall appear on all displays containing that device or value at all consoles regardless of the alarm's category.

Alarm messages shall be a single line of text describing the alarm that has occurred and the time of occurrence. The alarm message shall be English text and shall not require the use of a reference document for interpretation.

Events

Events are conditions or actions that shall be recorded by the SCADA system but do not require user action. Events shall be generated under the following conditions

- User initiated actions
- Conditions detected by application functions that do not require immediate user notification, but should be recorded

Events shall be recorded in the form of an event message. The event message format shall be similar to the alarm message format. The same message format shall be used for displaying and printing events. Event messages shall be displayed on an events summary.

Event messages shall be stored on auxiliary memory of SCADA system and archived in chronological order and reverse chronological order.. It shall be possible to sort, display, and print event messages from any console.

Hardcopy Printout

The SCADA system shall have features to produce a print out of a display, reports, Alarms, Events etc. from a menu. Any of the available printers shall be selectable by the SCADA users from menus for taking printout.

It shall be possible to print a complete display or a selected portion of a display. The options for printing shall include at least choice for orientation, background colour, page size, colour/ black & white and print preview. Also any of the available printers shall be selectable from the print Menu.

Summaries

The system shall provide for composing the summaries of points with similar status. On the control engineer's command, a summary could be displayed/printed. The following type of summaries shall be included:

- Summary of existing alarms,
- 'Bad point' summary,
- Points out of scan summary,
- Summary of alarm limit changes for the day,
- Summary of substituted values,
- Summary of SCADA System faults, power supply system, auxiliary systems and telecommunication systems faults.
- Events shall be printed in chronological order. Storage shall be provided for 1000 events.

Logs/ Report Generation

The contractor shall be required to generate the Daily, Weekly, Monthly reports formats for SCADA system. The report formats shall be finalised during detailed engineering stage. The user shall be able to schedule periodic generation of reports, direct report to display, print report, and archive report using report-scheduling display. The report scheduling display shall enable entry of the following parameters, with default values provided where appropriate:

- Report name
- Report destination (printer or archiving device)
- Time of the system should produce the report.

The user shall be able to examine and modify the contents of reports for the current period and for previous report periods using displays. Any calculation associated with the revision of data in a report shall be performed automatically after data entry has been completed.

The report review displays shall accommodate formatted report pages up to 132 characters in width and 66 lines in length and shall contain headings that correspond to the printed report headings. For reports containing more columns or rows than the display, the system shall include a means to view the entire report in a graphic format. The report view and editing displays shall function with the initially supplied reports and all future reports added by employer.

All alarms and abnormal system conditions in the process shall be recorded on the hard copy device. Software shall generate the following reports in the required formats and shall be approved by PURCHESER/CONSULTANT.

a) Periodic Logs

The system shall store values of specified parameters at hourly or half-hourly intervals in different groups (exact group will be identified later). Logs shall be printed out periodically.

b) Shift Report

The system shall generate and print the following shift reports at the end of each shifts:

- Summary of active alarm including 'bad input' summary.
- Status changes (breaker/isolator)
- Alarm limit changes by the operator.

c) Daily Report

The system shall generate and print-out following daily reports at the end of each day:

- Daily maximum and minimum values with time for frequency, voltage, input (generation) flow and transfer flow.
- Summary of predefined important alarms. A printout of persisting alarms related to SCADA and distribution system separately shall be printed in reverse chronological order, which will be used for necessary action.
- The SCADA system shall provide storage of shift report and daily report for one month and monthly report for one year.

d) Monthly Report

Monthly reports shall include -

- Daily maximum and minimum values with date and time.
- Monthly maximum and minimum values with date and time.
- The SCADA system shall provide storage of monthly report for one year.

The above reports shall be prepared for the following parameters:

- System demand
- Line flows
- System generation
- Energy consumption

- Calculated losses.

e) SCADA, Auxiliary System, Telecommunication System Fault Log

- The system shall printout any fault detected in the system e. g. card failures, any processor failure peripheral failures, etc. immediately on occurrence of the same on printer.

f) Power System Equipment Service Log

The following logs shall be provided :

- Number of manual operations and fault clearances per circuit breaker.
- Hours logged in service and out of service per circuit breaker.

Also customized reports as per the formats approved by the EMPLOYER shall be possible to prepare (using suitable software and it's connectivity with the offered SCADA, which Contractor shall provide as a part of offered system) with the offered SCADA system. The customization of reports in addition to the standard SCADA system reports shall be done by the Contractor. Final report formats shall be approved by the EMPLOYER.

System Configuration Monitoring and Control

The user shall be provided with the capability to review SCADA computer system configuration and to control the state of the configuration equipment using displays. The following operations shall be possible:

- Failover of each server
- Monitoring of servers, device, including workstations, RTUs, FRTUs, FPIs, status & loading of WAN LANs etc.
- Monitoring of the processor resource, hard disk & LAN/WAN utilization
- Control & monitor of SCADA functions

Dynamic Data Presentation

It shall be possible to present any item in the database on any display. All supervisory control and data control capabilities shall be supported from any window of a world display. Device status or data values shall be displayable anywhere on the screen, excluding dedicated screen areas such as the display heading.

Only standard X Window system or Microsoft windows standard fonts shall be provided with the SCADA. All fonts supplied shall be supported on the user interface devices and all printers supplied with the system. The types of fonts to be used in a particular

display shall be selected at display definition time Status and data values shall be presented in the following formats as appropriate:

- Numerical text that presents analogue values shall have the provision for the format definition of the text shall include the number of characters, number of decimal places, and the use of positive /negative sign or flow direction arrows, etc.
- Normally the telemetered MW/Mvar values alongwith the sign/direction shall be displayed on the Single line diagram and Network diagram. However the user shall also be able to display all other telemetered and calculated/ estimated analog values (I, V, pf etc. for each phase) on the Single line diagram (SLD) and Network diagram. All the displays shall be suitably designed to view 12 telemetered and 12 estimated/calculated values simultaneously for each feeder.
- Symbols, including alphanumeric text strings for an item, based upon state changes e.g., circuit breaker (OPEN/CLOSE/ INVALID).
- Symbols, including alphanumeric text strings for indicating the data quality flags.
- Colours, textures, and blink conditions based upon state or value changes or a change of data quality, e.g., alarm limits.

Element Highlighting

Element highlighting techniques shall be provided to draw the attention of Dispatcher to critical state of the system. The highlighting technique shall include change of colour, colour intensity, blinking, Character inversion, Line texture, appended symbols etc. This feature shall be used to highlight alarms, power system device and measurement status, data quality, data entry locations on a display and error conditions.

Display Types

The following list describes the types of displays that are to be included in the SCADA system. The user interface shall support the capabilities of all displays as specified. The User mode, Current Time and date shall be displayed on a screen-basis, not on a display basis, and shall be always visible.

SCADA System Display

A display shall be provided that lists all SCADA system directory displays. The displays shall be listed in alphabetical order with suitable separation in the list to enhance readability. Each entry in the list shall have a cursor target for display selection.

Distribution System Network Display

A graphic overview network display of the distribution system with substations feeders. Distribution network colour coded by voltage shall be provided. This display shall present the distribution system in a graphic format provided by employer. Telemetered and calculated data like Real and reactive power flows shall be displayed as a value with a direction arrow/positive- negative signs. Lines that have exceeded their loading limits shall be highlighted. Substations and power stations shall be depicted by symbols that reflect the presence of alarms at that substation or power station. Cursor selection of a substation/ power station symbol shall result in the associated Single line diagram display for that substation/ power station.

Interchange Display

The interchange display shall be provided as a schematic diagram showing power transfers among various utilities. This diagram shall show each power system as a block with actual and scheduled net interchange values outside the block. Symbolic arrows shall indicate power flow directions. The diagram shall also show schedule deviations. This display shall show the frequency values collected from all substations having tie-lines.

Substation Single Line Display (SLD) displays Menu

A display shall be provided that lists all substations that can be viewed via a SLD display. The name of the SLD displays shall be listed in alphabetical order, according to substation name, with suitable separation in the list to enhance readability. Each entry in the list shall have a cursor target for graphic display selection.

Mimic Diagrams

It shall be possible to display mimic diagrams which represent various systems/sub-systems equipment of power system network in colour graphic from with associated dynamic plant information. The following features shall be provided :

- Dynamic information (database) shall be updated at least every 1 second.

- It shall be possible to construct pictures containing bar charts and trends as part of mimic diagrams or construct pictures containing only bar charts and trends.
- Values of variables in alarm shall be displayed in different colours depending upon alarm severity.
- It shall be possible to change the colour and flash the variable and equipment symbols to indicate alarm/trip and certain pre-defined operating conditions.
- The limitation, if any, for maximum no. of mimic diagram that can be configured and displayed shall be as indicated by CONTRACTOR in Data Sheet.
- It shall be possible to perform control actions through mimic diagrams.

Control panel displays

As utilities are presently using conventional panels at S/S for supervision & monitoring, The control panel displays giving look -alike feeling shall be provided for operator supervise & operate

Substation Tabular Displays

Tabular displays shall be provided for each substation. These displays shall list the real-time values of telemetered, manually entered, and calculated data associated with the substation as well as related information such as alarm limits. The user shall be able to perform any user interaction defined by the Specification on these displays.

Alarm Summary Displays

Displays that list or summarize all unacknowledged and acknowledged alarms shall be provided. The summary shall separate acknowledged and unacknowledged alarms. Capacity shall be provided for at least 200 alarm messages for each alarm summary type. If an alarm summary display becomes full, the oldest messages shall be automatically deleted and the newest messages shall be added. It shall be possible to perform any alarm interaction from this display. The user shall be able to select between viewing events in chronological or reverse chronological order.

Event Summary Displays

Event summary displays shall list the most recent events and shall be organized by category for those categories assigned to a given console, as one summary display for all categories assigned to a console, or by all conditions system-wide without reference to the categories assigned to a console, as selected by the user. The user shall be able to select between viewing events in chronological or reverse chronological order.

Operating Information Summaries

The operating information summaries defined below shall be provided. Summary items shall be listed in reverse chronological order with the most recent item shown on the first page. All summary displays, except for Tag Summary shall be information-only displays; no user interaction, other than display call up, shall be associated with them. The Tag Summary shall be interactive, i.e., the user shall be able to place or remove tags on this summary.

Manual Override Summary

The manual override summary shall list all telemetered and calculated device status and data values for which a user has substituted a value

Off-Normal Summary

The off-normal summary display shall list devices and values that are found to be abnormal, i.e., are not in their normal state. Telemetered, calculated, and manually entered status and data values shall be included.

Out-of-Scan Summary

The out-of-scan summary display shall list device status and data values that are not currently being processed by the system. If an entire telemetry source such as an RTU /FRTU /FPI is out-of-scan, the out-of-scan summary shall display the source without any of the individual device status or data values associated with the source

Alarm Inhibit Summary

This display shall list devices and data values for which the user has suspended alarm processing.

Tag Summary

This display shall list and describe all active device tags.

Graphical Trending Summary Displays

The summary display shall list all items being trended. The list shall include the item name, trace number or Colour, trend orientation, and trend range.

Tabular Trending Summary Displays

The summary display shall list all items being recorded for tabular trends. The list shall include the item name and the file name.

Notes Display

This display shall include a minimum of 5 pages on which a user at any console may enter and edit messages. The contents of these pages shall be accessible by any console. The user shall have the ability to clear any page of this display and to type over previous messages.

Computer system Configuration and Monitoring Displays

Graphic and tabular displays shall be provided that allow the user to:

- Monitor and revise the configuration of the computer system
- Monitor the system's resource utilization statistics

RTU/ FRTU/FPI Communication Channel Monitoring and Control Display

This display shall show information on the status of the system's communication interface devices (including communication channels), the accessibility of each RTU/FRTU/FPI in a graphical form. The user shall be able to Enable/Disable any communication channel from this display.

SCADA Application Program Displays

Application program displays shall be provided to satisfy the user interface requirements of the system functions stated throughout this Specification. Application program displays shall be based on a standard user interface design across all applications to provide a common look and feel. The application's information shall be presented in such a way as to facilitate user operations.

GIS integration

The SCADA dynamic distribution network with GIS land base at the back ground shall be available for navigation. Operator shall be able to perform all functions & have features as envisaged in the specification. Suitable GIS adaptor shall be provided to import the distribution network model & GIS information from GIS system.

1.13.30.12.6 Printers

The printers shall function as output devices. Basically, there are three types of printers for performing different printing function as given below:

- Page printer - This printer shall facilitate printing of logs, reports, operator requested output.
- Alarms/Events printer - This printer shall facilitate on demand or automatic printing of alarms, sequence of events printing, etc.
- Colour Graphic Printer - This printer shall function as hard copy device to copy diagrams from the colour VDUs for documentation and graphic diagram development functions.

The printer shall have following general features:

- Design for continuous trouble free operation, with a minimum of maintenance.
- Quiet operation suitable for location in control room.
- Character from and spacing to present a pleasing and easily readable output.
- Easy maintainability, with provision for ease of execution of routine tasks such as ribbon changing, paper insertion, etc.
- Control unit with all error detection, error reporting and fail-safe facilities.
- Off-line mode selector switch to enable safe maintenance.

The minimum configuration for the printers shall be as indicated in the Data Sheet.

1.13.30.12.7 Magneto-optical Drive/Magnetic Tape Drive/DAT Drive:

CONTRACTOR shall provide a magneto-optical drive (MOD) and/or a magnetic tape drive/DAT Drive as specified in Data Sheet. Where the data sheet calls for only a tape drive, MOD can also be offered as an alternative.

1.13.30.13 Software Requirements

This section describes the characteristics of system software such as Operating system, RDBMS and support software (programming language compilers, database development and maintenance, display development, network services, report generation, diagnostics and backup utilities) to be provided by Contractor and the original software manufacturer as necessary to support the SCADA applications. This section also describes the standards to be followed for all supplied software. The contractor shall make use of common applications such as security, networking etc created under R-APDRP- IT infrastructure. However, it is necessary that functional, availability & performance aspects are met. Bidder shall assess the adequacy of software specified & if any additional software is required to meet all the requirements of the technical specifications, the same shall also be included in the offer.

1.13.30.13.1 Software Standards

All SCADA/ Smart grid software provided by the Contractor, including the Operating system, RDBMS and support software, shall comply with the industry-accepted software standards produced by national and international organizations, such as ANSI, ISO, IEC, IEEE, ECMA in order to facilitate maintenance and enhancement of the SCADA systems being supplied. In areas where these organizations have not yet set standards, the software shall comply with those widely accepted de- facto standards put forth by industry consortiums, such as OSF and X/Open. The Contractor shall commit to meet the "open systems" objective promoted by industry standards groups by using software products that are based on open standards.

1.13.30.13.2 Design and Coding Standards for smart grid integrated applications

All smart grid integrated applications shall be maintainable by employer using the supplied software utilities and documentation. The smart grid integrated software design and coding standards shall also address the following:

Expansion/scalability: software shall be dimensioned to accommodate the ultimate size of smart grid control centre envisaged.

Modularity: software shall be modular to minimize the time and complexity involved in making a change to a program.

User-Directed Termination: Functions taking long execution times shall recognize and process user requests to abort the processing.

Programming languages: The software shall be written using ISO or ANSI or ECMA standard programming languages and for Unix based systems the APIs shall be POSIX- conforming.

SOA architecture: Software shall conform to SOA.

Enterprise service bus (ESB): ESB based architecture is essential to enable interaction of applications from different product manufacturer, platforms etc.

Portability & Interoperability: The software shall be designed for hardware independence and operation in a network environment that includes dissimilar hardware platforms to the extent possible. The use of system services software shall be built on Open standards.

1.13.30.13.3 Operating System

The contractor shall use UNIX /Linux /Microsoft Windows operating system servers. The servers based on Unix O/s, shall generally comply with the evolving set of POSIX standards defined by IEEE.

1.13.30.13.4 Time and Calendar Maintenance

The smart grid control centre shall maintain Time and date for use by various software applications. The GPS based time receiver shall be used for synchronizing the smart grid control centre time. All Servers and Operator workstation clocks shall be synchronized within the accuracy of +/-100 milliseconds. The smart grid control centre shall not be dependent on a particular server for time /calendar maintenance. The smart grid control centre shall include two redundant time and frequency standards. Failure of the online unit shall result in automatic switching to the redundant unit. The smart grid integrated shall periodically check if the backup unit is operational and failure of either unit shall be alarmed. The frequency reading shall be accessible by smart grid control centre applications with three post-decimal digits resolution. The system shall support communication protocols such as NTP and SNTP. The time and frequency standard unit shall support a common time code output format such as IRIG-B. A surge protection system shall be included to prevent the time and frequency standard equipment from lightning.

1.13.30.13.5 Network Software

The network software for smart grid control centre shall include software for network communication, security and services.

Network Communication

Users and various applications shall be able to communicate within the smart grid integrated local area network and operate as described in this Specification. The network communications software shall use a standard network protocol such as TCP/IP. The software shall link dissimilar hardware nodes, including local and remote workstations, application servers, communication servers, and various peripherals (such as printers) into a common data communication network allowing communications among these devices.

Network Security

A user authentication scheme consisting at least of a user identification and password shall be required for the user to request a connection to any network node.

Network services

The following network services shall be provided for the users of smart grid control centre:

i. Network file management and transfer, for files containing text, data, and/or graphics information.
ii. Network printing management.
iii. Network time synchronization.
iv. Network backup over LAN.
v. Task-to-task communications to external computers.
vi. LAN global naming facilities.
vii. Remote procedure call
viii. Remote terminal session

Security Services

The security solution shall comprise of comprehensive solution for secured zone Firewalls i.e. LAN

Firewall & Gateway Firewall, intrusion Prevention system IPS (Network based & Host based) & Strong Authentication (multi layered), LDAP, Encryption mechanism. The contractor shall provide a tightly integrated intrusion detection system to detect and prevent intrusion.

Followings are the functional requirement for the security system:

i. System shall have Multilayer (at least network, application layer) firewall which shall protect the complete system network from unwanted users. Further these separate firewall of different OEMs shall be provided to take care the security of all the servers & shall have high availability architecture with No Single Point of Failure (NSPOF).
ii. Gateway Firewall should be capable of load balancing multiple links from different service providers.
iii. LAN Firewall shall provide isolation/security services between the subsystems
iv. Firewalls deployed should not become a bottleneck. It shall be Robust, Secure, Scalable and future-proof with Centralized Management.
v. Two type of IPS Host based & Network based shall be deployed with minimum hardware & they should not go blind in peak traffics.

vi. IPS should have hybrid technology to detect attacks. It should detect through a combination of Protocol Anomaly and Signature matching.

vii. Shall have Gateway antivirus which will protect from inflow of virus from the

viii. Internet and other WAN locations at the gateway itself with content filtering without any lag in data transmission.

ix. Shall have strong authentication containing user name and passwords which shall be very difficult to compromise.

x. SSL over VPN to provide secured link over public network if required.

Features

Followings are the features specific to each component of security system

Firewall:

The Firewall shall be hardware box Firewall system with following features:

- Firewall speed >250 Mbps.
- Data encryption supported DES (56 bits) 3 DES (168 bits) and hashing algorithm like MD5 and SHA-1.
- Encryption to offload the main CPU.
- It shall have minimum 8 Ethernet 10/100 /1000 ports (4ports for connectivity to webservers & 4 Ports for connectivity to LAN.
- Support NAT and PAT
- Capability of working in Load sharing and hot standby mode
- Denial of service prevention
- DNS guard features
- JAVA and ActiveX blocking
- Radius integration
- Web based management interface
- Stateful inspection for web, mail, SQL application etc.
- Detailed system logging and accounting feature
- No. of concurrent TCP Sessions supported shall be more than 5000.

Intrusion Prevention System (IPS)

The contractor shall provide a tightly integrated intrusion detection &prevention system Capable for detecting the intrusion attempt that may take place and intrusion in progress and any that has taken place. Both Network based and Host based IPS should have centralized Management Console system which will be either the

application server with NMS or any of the workstation. The Centralized management console shall have integrated event database & reporting system & it must be able to create and deploy new policies, collect and archive audit log for post event analysis. The system shall have Integrated Event Database & Reporting System. Automated Update of the signature for two years shall be provided and there should be provision for creating customized signature.

Intrusion Prevention System (Network Based)

After detecting any intrusion attempt there should be provision to configure to perform the following functions:

i. Capability for Detecting the intrusion attempt that may take place, intrusion in progress and the intrusion that has taken place.
ii. Reconfigure the firewall provided in this package.
iii. Beep or play a WAV file.
iv. Send an SNMP Trap datagram to the management console. The NMS server envisaged under the specification shall be used as management console also.
v. Send an event to the event log.
vi. Send E-mail to an administrator to notify of the attack.
vii. Save the attack information (Timestamp, intruder IP address, victim IP address/port, protocol information).
viii. Save a trace file of the raw packets for later analysis
ix. Launch a separate program to handle the event
x. Forge a TCP FIN packet to force a connection to terminate.
xi. Detect multiple forms of illicit network activity: -Attempted.
xii. Vulnerability Exploits -Worms -Trojans -Network Scans -Malformed Traffic – Login Activity.
xiii. The System shall support monitoring of multiple networks. The system shall also support the monitoring of additions or changes to addresses of devices on the network.

The system shall have detection rules for monitoring faults, dangerous and malicious activity related to IP based protocols. The Contractor shall also apply its power control and security experience to enhance these detection rules for specific issues within the system.

Intrusion Prevention System (Host Based)

Host based IPS shall run on the servers. After detecting any intrusion attempt there shall be provision to configure the IPS to perform following actions-

Send an SNMP Trap datagram to the management console. The NMS server envisaged under the specification shall be used as management console also.

Send an event to the event log. Send e-mail to an administrator to notify of the attack.

It should be capable of creating audit trail for user and file access activity, including file accesses, changes to file permissions, attempts to install new executables and/or attempts to access privileged services,

In an event where user accounts are added, deleted, or modified changes to key system files and executables is done in by unauthorized account or there is unauthorized attempt to overwrite vital system files, to install Trojan horses or backdoors, suitable action shall be taken such as :

a. Terminate user Login (intruder)

b. Disable user Account (intruder)

c. Administrator can define the action to be taken

d. Forge a TCP FIN Packet to force an intruder connection to terminate.

Should provide events check for suspicious file transfers, denied login attempts, physical messages (like an Ethernet interface set to promiscuous mode) and system reboots.

Gateway Antivirus:

This shall be used for Gateway scanning of viruses. Gateway antivirus shall have

Centralized-user Administration which will communicate directly with centralized userdirectories such as LDAP. It shall have the all the essential/standard features of Latest version of Gateway antivirus, some of the features are as following:

It shall have Policy-based URL filtering and Dynamic Document Review.

It shall protect web traffic with high-performance, integrated virus scanning and web content filtering at the gateway

It shall ensure protection by combining list-based prevention with heuristic content analysis for both virus protection and web content filtering

It shall eliminate unwanted content and malicious code & Scan all incoming and outgoing HTTP and FTP traffic etc.

The Security System shall use the best practices to prevent the System itself being a source of security compromise. The System shall be hardened, patched, tested, and designed with security as a primary objective. Communication with (GUI and notifications) and within (Agent reporting and updates) the System shall use encryption and authentication.

Other aspects of security:

- Application Security Monitoring-

The standard operating system shall support the monitoring of security on host installed applications. The system shall support or allow the creation of monitoring for:

a. Application Software Error Conditions

b. Application Software Performance Issues

c. Application Configuration Changes

d. Application Logins, etc.

- Security Alarms-

The system shall be capable of annunciation, to include audible and visual alarms and remote paging whenever a security event takes place and shall support the following:

a. Instant notification through email or pager

b. Grouping of security events by time, location, and device, etc

c. Interactive dashboard window for viewing and acknowledgement

- Analysis and Reports

a) The system with the stored information, shall be able to produce analyses and reports to meet security compliance requirements. The system shall be equipped with best practices ad-hoc reports widely used in the industry.
b) The employer's personnel shall be trained to be capable of creating new custom analysis and reports, and revising existing, without requiring external consultation.

- Log Archiving-

The security system shall archive, record, and store all security related events in raw form for at least one year. As a minimum, the event logger shall record all security related events from the perimeter security devices and the host IPS. Graphical trend displays of each event shall be available along with specific information on the type of intrusion, the area affected and the source via IP address.

- Data Access through intranet-

The Web server at Control Center is to function as source of information on the distribution network. It will be accessed by utility intranet user. Any additional client software, if required, at external clients/users ends, the same shall be made dynamically available from Web server for its downloading by these external clients. There shall not be any restriction to the number of clients downloading this software (i.e. Unlimited number of client downloads shall be provided).

The external users shall be licensed users of the employer. The following features are Required:

a. The Web servers shall be sized to support at least 500 concurrent external intranet clients/users for providing access to real-time data.
b. External intranet clients/users shall be connected to the web servers through secure authentication such as VPN access. These users shall be denied direct access to the smart grid integrated protected LAN.
c. Internal smart grid integrated users shall not have any dependency on the availability of the Web servers.
d. For the purpose of transfer of data/displays/ from the smart grid control centre to the Web server system, the smart grid control centre shall initiate a session with the Web server and any attempt to initiate a session by the Webserver shall be terminated by the Firewall in smart grid control centre LAN.

Interface between Web server and smart grid integrated zone shall preclude the possibility of external clients defining new data/Report/Displays.

e. For any sessions initiating from the DMZ LAN into the protected LAN, the servers shall be located in a separate DMZ LAN that will be isolated from common applications connected directly to ISP such as email.

The Access to these servers from the external web will be through authorization of Virtual Private Network.

f. The web server shall provide access to allowable real time data and displays, at defined periodicity, for viewing by external clients/users. The access to each display shall be definable on per user type basis. It shall be possible to define up to 100 users. Further the smart grid control centre administrator shall exercise control over the real-time displays which can be accessed through the Web server.

g. The Web server at Control Center shall also facilitate exchange of email messages from ISP (Internet Service Provider) and other mail servers supporting SMTP.

h. Suitable load balancing shall be provided among the web servers where each shall serve proportionate number of clients. However in case of failure of one of the servers, all the clients shall automatically switch to the other webserver(s).

Typical displays/pages for Intranet access shall be same as that on the smart grid integrated. Real time smart grid data on web server shall be refreshed every minute.

The access to Web server/site shall be controlled through User ID and password o be maintained /granted by a system administrator. Further, different pages/data access shall be limited by user type (i.e. CMD, Mgmt user, incharge etc). The access mechanism shall identify and allow configuration of priority access to selected users.

Further, tools shall be provided for maintaining the website, web server configuration, E- mail configuration, FTP configuration, Mailing lists setup and customer support. Latest protections against viruses shall be provided.

- Signature Updating Requirements-

The system shall be able to accept timely updates. The updates shall keep the threat signatures current, providing the latest detection and protection. The updates shall also incorporate the latest security enhancements into the Security Management System. These enhancements shall increase security and functionality, without requiring redesign or reengineering efforts.

- Report Generation Software

The smart grid control centre shall include report generation software to generate new report formats for smart grid integrated and edit existing report formats. The user shall

be guided in defining the basic parameters of the report, such as the report database linkages as symbolic point names, the report format, the report activation criteria, the report destination(workstation, printer, or text file), and the retention period for the report data.

The user shall be able to construct periodic reports and ad-hoc queries via interactive procedures. The capability to format reports for workstations and printers shall be provided. The user shall be able to specify the presentation format for periodic reports and ad-hoc query reports as alphanumeric display format, graphical display format, or alphanumeric printer format. The user shall be able to specify that processing functions, such as summations and other arithmetic functions, be applied to portions of the report data when the report is processed for display, printing, or file storage. The software shall provide for generation of reports that are the full character width of the printers and that use all of the printer's capabilities, such as font sizes and styles and print orientation.

For report data editing, the user shall be able to obtain the data from a retained report, modify the data, repeat the inherent data calculations, reprint the report, and save it in a report retention file on auxiliary memory without destroying the original report. The user shall also be able to access a retained report, modify its point linkages to the database, modify its format, and save it in a report retention file on auxiliary memory as a new report without destroying the original report.

Executing the report generating functions shall not interfere in any server of the system with the on-line smart grid integrated functions.

1.13.30.13.6 System Generation and Build

System generation includes the activity of generating an executable object code of all databases, displays, and reports as required for smart grid control centre. System build is the process under which all the above executables and the executables provided for smart grid integrated application software are ported to the smart grid control centre hardware and configuring to make it operational.

The contractor shall do the complete system generation and build as required for successful operation of the smart grid control centre. The contractor shall also provide the complete backup of the smart grid control centre in electronic media such as tapes, CDs, MO disks etc. RSCC’s personnel shall be able to restore the smart grid control centre at site by using above backup tapes/CDs etc. The contractor shall provide the

procedures necessary to restore the system from the backup tapes/CDs etc. The DR system shall always have updated set of system build. It shall be synchronized with the smart grid integrated control centre.

1.13.30.13.7 Software Utilities

All software utilities used to maintain smart grid integrated software, whether or not specifically required by this Specification, shall be delivered with the system. The software utilities shall operate on-line (in background mode) without jeopardizing other smart grid integrated application functions that are running concurrently. This utility software shall be accessible from workstations, programming terminals, and command files on auxiliary memory. Multiple users shall have concurrent access to a utility program task, provided there are no conflicts in the use of peripheral devices.

File Management Utility-

File management utilities shall be provided that allocate, create, modify, copy, search, list, compress, expand, sort, merge, and delete program files, display files, and data files on auxiliary memory and archive storage.

Auxiliary Memory Backup Utility-

A utility to backup auxiliary memory of server and workstation files onto a user-selected auxiliary memory or archive device shall be supplied. The backup utility shall allow for user selection of the files to be saved based on:

i. Server and workstation

ii. File names (including directory and wildcard designations)

iii. File creation or modification date and time

iv. Whether or not the file was modified since the last backup.

A backup utility that can backup all server and workstation auxiliary memories on to a single target auxiliary memory or archive device shall be provided. The backup utility must ensure that the source auxiliary memory files are captured properly regardless of caching activity.

Failure Analysis Utility-

Failure analysis Utility shall be provided to produce operating system and application program status data for analyzing the cause of a fatal program failure. The failure

information shall be presented in a condensed, user-oriented format to help the user find the source of the failure.

The information shall be presented on displays and recorded for historical records and user requested printed reports.

Diagnostic Utility-

The system shall have suitable auto diagnostic feature, on line & offline diagnostic Utility for on-line and off-line monitoring for equipments of smart grid control centre shall be provided.

System utilization Monitoring Utility-

Software utility shall be provided in each server and workstation to monitor hardware and software resource utilization continuously and gather statistics. The monitoring shall occur in real-time with a minimum of interference to the normal smart grid integrated functions. The period over which the statistics are gathered shall be adjustable by the user, and the accumulated statistics shall be reset at the start of each period. The statistics shall be available for printout and display after each period and on demand during the period.

Other Utility Services-

- On line access to user and system manuals for all software/Hardware products (e.g., Operating System and Relational Database Software/hardware) and smart grid integrated application shall be provided with computer system.

1.13.30.13.8 Design and Performance Requirements of Software

- The software shall consist of various utilities as described in Data sheet.
- The online Real Time Operating System (RTOS) supplied shall be proven for similar application and shall be able to support all the equipment / peripherals.
- The background executive shall enable software development in background time sharing mode by two or more programs simultaneously. It shall be possible to run / test any program without making it into an online program.
- The file handling utility shall allow copying of one file in part on a whole into another, copying from one medium to another medium and typing the file contents on VDU without entering edit mode i.e. copying from console into a file.
- The utility for copying of files from magnetic tape to disk and vice versa shall have capability to read / write in both ASCII/EBCDIC mode. It shall also have

capability to read from one medium in any one mode and write on another medium in different mode. It shall also have the capability to do a backup of disk on tape/magneto-optical disk.

- The debugging utility shall allow for online debugging of programs.
- The display generation utility shall be of interactive type. There shall be no need to write programs for generation and maintenance of displays.
- It shall be possible to make the system backup copy and program changes while the system is online. There shall be no need to take the system in standalone mode for making the backup copy and program changes.
- Test programs shall be provided for hardware testing of CPU and other equipment. It shall be possible to test the equipment, except CPU and disks, without taking the system in stand alone mode. Online error checking and diagnostic message facility for CPUs various equipment shall be provided.
- It shall be possible to do the system generation at site after any addition or deletion in memory and peripherals.
- Utility shall be provided for generation and maintenance of plant input data base. The plant input data base implemented in SCADA system shall be the master data base.
- The data acquisition, processing and alarm monitoring / reporting software resident in each RTU shall enable processing of raw process data including engineering unit conversion and process alarm limit checking.
- The control programs resident in the RTUs shall enable the execution of sequential control without interrupts to ensure security of control.
- The communication package shall enable data transfer between the distributed modules though the data bus system.
- The operator interface software shall enable the operator to call up displays and to control the process through VDU/keyboard.
- The control language shall be a user oriented language to formulate control system.
- Report /display generator shall facilitate creation of reports and graphic displays in user definable formats.
- The report processor shall assess the plant database for necessary data and initiate printing of logs and reports.
- The diagnostic package shall enable online or off-line testing of all distributed modules as well as the data base communication system. The online

diagnostics shall run during the normal functioning of the distributed modules without interfering with the real time performance of the system. If any malfunction is detected in a module, it shall be disabled automatically and an alarm message shall be reported to the maintenance engineer.

- The debugging utility shall allow for online debugging of programs. The down loading utility shall enable down loading of all programs developed at programmer's works station to the respective distributed modules.

Suitable communication software protocol for the communication link for communication between SCADA System and other computer system shall be provided.

1.13.30.14 Configuration And System Availability

1.13.30.14.1 General

This chapter describes the requirement of monitoring and managing the smart grid control centre with regard to its configuration and availability under normal conditions and under hardware and software failure conditions.

1.13.30.14.2 System Redundancy

The redundancy requirement for hardware of smart grid control centre shall be as follows:

- Servers: The servers for SMART GRID application, servers for DMZ/ security system Shall be configured as redundant system except (development server).
- LAN and device interface: LAN shall be configured as redundant. All equipment, except (Development system shall have single LAN).
- Printers: All Printers shall be non-redundant devices.
- Operator workstations: These shall be configured as non-redundant devices.
- Time and frequency system: The GPS receiver of time and frequency system shall be configured as a redundant device at smart grid control centre.
- WAN Router: The WAN router connected to dual LAN shall have channel redundancy.
- DAT Magnetic tape autoloader shall be non-redundant drive

Every critical function must be supported by sufficient hardware redundancy to ensure that no single hardware failure will interrupt the availability of the functions for a period exceeding the automatic transfer time. Non-critical functions are those that support

maintenance and development of database, application software and training of users. No hardware redundancy is envisaged for these functions.

1.13.30.14.3 Functional Redundancy

Every critical function must be supported by sufficient hardware redundancy to ensure that no single hardware failure will interrupt the availability of the functions for a period exceeding the automatic transfer time. Non-critical functions are those that support maintenance and development of database, application software and training of users. No hardware redundancy is envisaged for these functions.

1.13.30.14.4 Backup Databases

Copies of all databases shall be maintained on the Backup server so that system operations may continue in the event of Primary server, peripheral device or software failure. The backup database shall be updated with the current contents of the primary databases such that all changes to a primary database are reflected in the backup database within 60 seconds of the change. The backup databases shall be maintained in such a manner as to be protected from corruption due to server and device failure. Backup databases shall be preserved for system input power disruptions of any duration. The information maintained in the backup databases shall include:

Telemetered, calculated, and manually-entered values and their attributes, including quality codes, control inhibit state, and tag data.

Data and associated attributes maintained by the Information Storage and Retrieval function.

Alarm, event, and summary displays (such as off-normal, control inhibit, and alarm inhibit displays) or sufficient information to rebuild the displays in their entirety (including the time and date of the original data entries, not the time and date the display is newly created)

Application function execution, control, and adaptive parameters and input and output data.

Changes resulting from the addition or deletion of items and restructuring of databases in an existing database shall be automatically accommodated in the backup database.

1.13.30.14.5 Error Detection and Failure Determination

All servers, peripheral devices, on-line software functions, and maintenance functions in smart grid control centre shall be monitored for fatal error and recoverable errors. All

errors shall be recorded for review by maintenance personnel. Each type of error (e.g., server failure, memory access violation, device reply time-out, or message checksum error) shall be recorded separately with a date and time tag.

1.13.30.14.6 Server and peripheral device Errors

The Server/Device shall be declared as failed in case of fatal error. Server and peripheral device failure shall be detected and enunciated to the user within 10 seconds of the failure. For each type of recoverable error the programmer shall assign a threshold. When the count of consecutive recoverable errors exceeds this threshold, a warning message shall be issued to the operator.

1.13.30.14.7 Software Errors

Execution errors in on-line and maintenance functions that are not resolved by program logic internal to the function shall be considered fatal software errors. Examples of errors that may be resolved by internal program logic include failure of a study function to achieve a solution due to violation of an iteration limit or arithmetic errors (such as division by zero) which are caused by inconsistent input parameters or data. These errors shall produce an alarm informing the user of the error but shall not be considered fatal software errors. Fatal software errors shall result either in termination of the function or shall be handled as a fatal Server error. The action to be performed shall be defined by the programmer for each on-line function and each maintenance function. If the function is to be terminated, future executions of the function shall also be inhibited until the function is again initiated by the programmer.

On the occurrence of each fatal software error, Server and operating system error codes and messages shall be recorded in the smart grid control centre.

1.13.30.14.8 Server Redundancy and Configuration Management

Each server or server group supporting the critical functions described in the specifications, shall include at least one redundant server. The redundant server shall normally be assigned to the backup state and shall take the role of a primary server in the event of failure or upon user command.

When a failure of a primary server in a redundant group is detected, the smart grid integrated computer system shall invoke the appropriate failover and restart actions so that online function assigned to the failed server are preserved. The on-line functions of the failed primary server shall be assigned to the backup server by execution of a function restart within 30 seconds after detection of server failure. In case of failure of

smart grid sever, the data shall be stored in the smart grid control centre till the failover of Primary server is completed to avoid data loss. This stored data shall be transferred to the smart grid server automatically after restoration of Smart grid server. If on-line functions are restarted in a backup server, the server's state shall be changed to primary. If backup servers are not available to perform the required functions, the smart grid integrated computer system shall attempt to restart the failed primary server. A complete restart of the System, including full update from the field, shall not more than the stipulated time as specified above. No data shall be lost during the transfer of operation.

A failover (transfer of critical functions) to an alternate Server shall occur, as a minimum, under any one of the following situations:

- Non-recoverable failure of a server performing a critical function
- User request for a transfer of servers
- Failure of a periodic / scheduled function to execute on schedule.
- Violation of a configurable hardware device error counter threshold.

Failure of non-critical function shall not cause server failover. Functions assigned to a failed server in a non-redundant group may be lost until the failed server is restored to service. Failure of server operating in the backup state shall not initiate failover action. Failed server shall be switched from down to any other state by user command only. All server reinstatement action shall result in operator message. The messages shall identify the server(s) affected, all server state changes, and the success or failure of any restart operations.

1.13.30.15 Maintenance & Testing Requirements Of Various Modules Of Smart Grid System

1.13.30.15.1 Maintenance Requirements

All equipment shall be designed for ease of maintenance to help achieve a high mean time between failures. All equipment shall be of modular design to assure a short mean time to repair. The following provisions shall be made:

- The Contractor shall furnish the details of the maintenance requirements for each equipment, indicating list of parts which require regular maintenance and frequency of maintenance for these parts. Based on CONTRACTOR's experience, documentation giving a recommended maintenance program to achieve a high MTBF for the system shall be furnished.

- The CONTRACTOR shall furnish sufficient documentation to ensure efficient maintenance and trouble shooting of equipment and modules. This shall include point-to-point wiring diagrams and schematic diagrams of all electronic assemblies supplemented with concise description of theory of operation of individual sub-systems. Expected faults, trouble shooting hints, check-out lists and a list of sub-components prone to failure shall also be provided.
- All equipment shall have extensive self-diagnostic features, test points and clearly labelled error indication lamps which will help in speedy identification of faulty modules.
- Provision shall be made for isolating sub-systems/modules which are identified to be faulty, thus enabling on-line replacement without taking equipment off-line.
- Adequate number of test equipment like test sockets, test cables, digital voltmeters, signal generators, card extenders, etc. shall be provided to facilitate ease in maintenance.
- Necessary maintenance equipment tools and special erection tools which are not specifically mentioned in the specification but are normally required for ease of maintenance and to have minimum down time, shall be supplied.
- Components of same function shall be as far as possible interchangeable.
- Standardisation concept shall be used in selecting the components for the system.
- All the documentation shall be in English language.
- All the documentation shall be provided on floppy disk (s) and also on compact disk (s) [CDs] in addition to the printed documents.

1.13.30.15.2 Testing Requirements

I/O Modules of RTU

The analog input module shall be tested as follows:

- Checks using simulated inputs to represent each type of input
- Tests to determine analog input module operability, addressing capability, scan rate, linearity, repeatability and stability over a 24 hour period.
- Tests to determine the reproducibility of a known analog input (mid-range value).
- The analog output module shall be tested as follows :
- Checks using simulated output to represent each type of output.

- Tests to determine analog output module operability, addressing capability, scan rate, linearity, repeatability and stability over a 24 hour period.
- Tests to determine the reproducibility of a known analog output (mid-range value).
- The digital input module shall be tested for addressing, signal level, input delay, noise rejection and interrupt recognition time.
- The pulse input module shall be tested for counting accuracy and capacity of the accumulator.
- The digital output module shall be tested to check addressing, power failure status, signal level and output delay.

All these I/O modules shall be checked for one to one input-output channel allocation as per the input-output list furnished by Contractor and with reference to specifications/project requirements.

Specified environmental conditions shall be simulated and operation of the system shall be checked.

Central Processing Unit

CONTRACTOR shall submit in writing for EMPLOYER's review and approval a detailed description of the test procedures and programs at least two months prior to start of the system test. The tests indicated in the following paragraphs shall be included:

- Main memory test of twelve (12) hours duration to demonstrate the capability of memory read - write function under worst pattern at various voltage levels.
- Main memory parity detection test of 12 hours duration to demonstrate that parity detection feature performs properly to the EMPLOYER's satisfaction.
- Logic tests of 12 hours duration to demonstrate the hardware commands, interrupt structures and hardware failure detection.
- Count-down registers and pulse counter test of eight (8) hours duration to demonstrate the accuracy of all time count-down registers.
- Bulk memory data transfer test of thirty-six (36) hours duration to demonstrate possible combinations of transfer from/to bulk memory including checks for illegal writing, reading and wrong transfer indications. Voltage and speed variation checks shall also be performed.

- Bulk memory parity detection test of 12 hours duration to demonstrate the proper functioning of the parity detection feature.

CCMS & CEIE

CCMS & CCIE shall be tested for all performance characteristics at CONTRACTOR's works. The following tests shall be included:

- Individual digits and digit selection logic of the digital display.
- All capabilities of the VDU, including the error detection features.
- All keyboards shall be tested for satisfactory operation of the keyboard, controls, push buttons and all associated functions.
- All interlocks, performance and error detection features of the printers.
- Accuracy, addressing and output capability of the analog trend recorders.

Transducers

The following tests shall be carried out for transducers:

- Routine test
- Type test

Routine test

The following routine test shall be carried out on every transducer:

- Calibration and Accuracy of the Transducers at 0 - 100% rated output burden.
- Power frequency H V test for the voltage level and duration specified in Data Sheet
- No- load voltage test.
- Ripple content of the output voltage.
- I R test
- Tests shall be carried out as per IEC-60688.

Type Test

One sample of each type of transducers will be tested in live conditions monitoring input and output continuously. Type tested transducers shall not form the part of the supply as these tests are considered destructive in nature. The following tests shall be performed

Cold test - At 5 ° C for 96 hours as per IS-9000-Part -II

Dry heat test	-	At 55 ° C for 72 hours as per IS-9000-Part-III
Dry heat Cyclic test	-	Two cycles at 40°C as per IS-9000-Part-V for 12+12 hours

1.13.30.15.3 Integrated SCADA System Tests

The integrated testing of SCADA system along with the field instruments (simulated as well as actual process/system signals), power supply and communication system and auxiliary system (s) etc. shall be carried out.

The equipment/materials will be inspected and tested by the EMPLOYER's representative. The supplier shall give at least one month's notice for readiness of equipment for testing at the manufacturer's works.

All tests as required, both at the factory i.e. Factory Acceptance Test (FAT) before dispatch, and at site after installation i.e. Site Acceptance Tests (SAT), shall be carried out. Detailed Test reports and certificates shall be submitted. Test reports and test certificates for bought out components shall be submitted for approval. These components shall also be included in the integrated FAT.

Contractor shall furnish the list of tests, to be carried for both FAT and SAT along with test instruments to be used, with the Bid for review. Contractor shall indicate the place of FAT and the test facilities available.

The testing of all the equipment and accessories shall be carried out as per latest applicable Indian/International standards recommendations.

Prior to testing, all relevant documentation and sufficient briefing about the tests shall be given to EMPLOYER's Engineers who would witness the testing.

Factory Acceptance Test (FAT)

The FAT to be performed in the factory shall include but not be limited to the following:

- Tests for guaranteed technical parameters
- Integrated functional tests and burn-in tests

In addition, testing done during manufacturing and assembly in the factory such as heat run, component testing, circuit testing etc. for similar equipment shall be demonstrated to the EMPLOYER.

Site Acceptance Tests (SAT)

After installation and commissioning, the Contractor shall demonstrate, by tests in the field, compliance of the values, functionalities, quality and reliability of the complete system and its components, both hardware and software, as specified and as per guarantees.

Contractor shall fully participate in interfacing to the equipment of Others. It shall be Contractor's responsibility to ensure satisfactory functioning of the system in conjunction with related equipment like exchanges, data equipment and other communication equipment of the EMPLOYER. Problems relating to such interconnections shall be mutually resolved.

After tests as above, the complete system shall be on continuous uninterrupted service with all functionalities and interconnections to Employer’s equipment for 4 weeks without any failures or manual interventions for correction, modification, rectification or replacements in the Contractor's system.

Additional specific tests, if required, would be decided mutually.

1.13.30.16 Documentation

The following specific document for items covered under this section shall be submitted which shall be in addition to the applicable general document required.

- Data Requirement Sheets (DRS)
- Battery sizing calculations
- Cable sizing calculations
- Inventory of the hardware
- Panel General arrangement drawing
- Panel Internal General Arrangement drawing indicating modules, major devices/components location etc.
- Installation drawings
- Schematic drawings
- Type Test reports
- FAT plan & procedure
- SAT plan & procedure
- External cable laying & termination schedule details
- Availability test plan & procedure

PLOT WISE POWER DEMAND CALCULATION & TRANSFORMER SIZING FOR ATAL PURAM TWONSHIP

Plot No.	Product Mix	Phase	Area (Sqm)	BUA (Sqm)	Power Demand in KW	Power Demand in KVA @ 0.95 PF	RMU	Selected Distribution Voltage Level (kV)	Substation Code	Incoming Power supply Source
UT-4	Utility	Phase-2	5299.94	5299.94	256.91	270.43	RMU-01	11kV	ESS-1-11kV-Ring-1	ESS-1(3X10/12.5 MVA)
C-36	Commercial	Phase-2	9327.3315	18654.663	964.51	1015.27	RMU-02	11kV	ESS-1-11kV-Ring-1	ESS-1(3X10/12.5 MVA)
C-35	Commercial	Phase-2	8281.70	16563.40	856.38	901.46	RMU-02	11kV	ESS-1-11kV-Ring-1	ESS-1(3X10/12.5 MVA)
G-56	Green	Phase-2	3783.27	3783.27	5.16	5.43	RMU-02	11kV	ESS-1-11kV-Ring-1	ESS-1(3X10/12.5 MVA)
C-34	Commercial	Phase-2	8232.15	16464.29	851.26	896.06	RMU-03	11kV	ESS-1-11kV-Ring-1	ESS-1(3X10/12.5 MVA)
PSP-57	PSP	Phase-2	7270.84	14541.67	704.90	742.00	RMU-03	11kV	ESS-1-11kV-Ring-1	ESS-1(3X10/12.5 MVA)
Total Load In 11kV Ring-1			**36895.28**	**70007.29**	**3639.12**	**3830.65**				
G-53	Green	Phase-2	8330.57	8330.57	11.36	11.96	RMU-04	11kV	ESS-1-11kV-Ring-2	ESS-1(3X10/12.5 MVA)
PSP-46	PSP	Phase-2	2219.61	4439.21	215.19	226.51	RMU-04	11kV	ESS-1-11kV-Ring-2	ESS-1(3X10/12.5 MVA)
PSP-47	PSP	Phase-2	7537.01	15074.02	730.70	769.16	RMU-04	11kV	ESS-1-11kV-Ring-2	ESS-1(3X10/12.5 MVA)
PSP-48	PSP	Phase-2	10389.57	20779.14	1007.25	1060.27	RMU-05	11kV	ESS-1-11kV-Ring-2	ESS-1(3X10/12.5 MVA)
G-55	Green	Phase-2	1050.61	1050.61	1.43	1.51	RMU-05	11kV	ESS-1-11kV-Ring-2	ESS-1(3X10/12.5 MVA)
G-54	Green	Phase-2	3970.45	3970.45	5.41	5.70	RMU-05	11kV	ESS-1-11kV-Ring-2	ESS-1(3X10/12.5 MVA)
PSP-56	PSP	Phase-2	18072.11	36144.21	1752.06	1844.28	RMU-07	11kV	ESS-1-11kV-Ring-3	ESS-1(3X10/12.5 MVA)
Total Load In 11kV Ring-2			**46382.75**	**78434.20**	**3723.41**	**3919.38**				
PSP-51	PSP	Phase-2	26278.26	52556.53	2547.64	2681.72	RMU-08	11kV	ESS-1-11kV-Ring-3	ESS-1(3X10/12.5 MVA)
PSP-50	PSP	Phase-2	6921.90	13843.81	671.07	706.39	RMU-08	11kV	ESS-1-11kV-Ring-3	ESS-1(3X10/12.5 MVA)
G-58	Green	Phase-2	979.67	979.67	1.34	1.41	RMU-09	11kV	ESS-1-11kV-Ring-3	ESS-1(3X10/12.5 MVA)
PSP-49	PSP	Phase-2	4983.36	9966.71	483.13	508.56	RMU-09	11kV	ESS-1-11kV-Ring-3	ESS-1(3X10/12.5 MVA)
Total Load In 11kV Ring-3			**90733.12**	**167134.93**	**3703.17**	**3898.07**				
PSP-53	PSP	Phase-2	31430.51	62861.02	3047.14	3207.52	RMU-06	11kV	ESS-1-11kV-Ring-4	ESS-1(3X10/12.5 MVA)
PSP-52	PSP	Phase-2	11755.83	23511.67	1139.71	1199.70	RMU-06	11kV	ESS-1-11kV-Ring-4	ESS-1(3X10/12.5 MVA)
Total Load In 11kV Ring-4			**43186.34**	**86372.69**	**4186.85**	**4407.21**				
C-28	Commercial	Phase-2	3986.99	7973.98	412.28	433.98	RMU-12	11kV	ESS-1-11kV-Ring-5	ESS-1(3X10/12.5 MVA)
C-29	Commercial	Phase-2	2930.87	5861.73	303.07	319.02	RMU-12	11kV	ESS-1-11kV-Ring-5	ESS-1(3X10/12.5 MVA)
C-30	Commercial	Phase-2	3503.51	7007.03	362.29	381.35	RMU-12	11kV	ESS-1-11kV-Ring-5	ESS-1(3X10/12.5 MVA)
C-31 a	Commercial	Phase-2	1028.81	2057.61	106.39	111.98	RMU-11	11kV	ESS-1-11kV-Ring-5	ESS-1(3X10/12.5 MVA)
C-31 b	Commercial	Phase-2	816.60	1633.20	84.44	88.89	RMU-11	11kV	ESS-1-11kV-Ring-5	ESS-1(3X10/12.5 MVA)
C-31 c	Commercial	Phase-2	455.02	910.05	47.05	49.53	RMU-11	11kV	ESS-1-11kV-Ring-5	ESS-1(3X10/12.5 MVA)
PSP-55	PSP	Phase-2	6518.96	10186.76	493.80	519.78	RMU-07	11kV	ESS-1-11kV-Ring-5	ESS-1(3X10/12.5 MVA)
PSP-54	PSP	Phase-2	6518.96	9778.43	474.00	498.95	RMU-07	11kV	ESS-1-11kV-Ring-5	ESS-1(3X10/12.5 MVA)

PLOT WISE POWER DEMAND CALCULATION & TRANSFORMER SIZING FOR ATAL PURAM TWONSHIP

Plot No.	Product Mix	Phase	Area (Sqm)	BUA (Sqm)	Power Demand in KW	Power Demand in KVA @ 0.95 PF	RMU	Selected Distribution Voltage Level (kV)	Substation Code	Incoming Power supply Source
G-57	Green	Phase-2	3374.51	3374.51	4.60	4.84	RMU-10	11kV	ESS-1-11kV-Ring-5	ESS-1(3X10/12.5 MVA)
C-32	Commercial	Phase-2	8937.38	17874.76	924.19	972.83	RMU-10	11kV	ESS-1-11kV-Ring-5	ESS-1(3X10/12.5 MVA)
C-33	Commercial	Phase-2	5341.84	10683.68	552.38	581.46	RMU-10	11kV	ESS-1-11kV-Ring-5	ESS-1(3X10/12.5 MVA)
Total Load In 11kV Ring-5			**43413.44**	**77341.74**	**3764.49**	**3962.62**				
PSP-5	Utility	Phase-1	4128.49	4128.49	200.13	210.66	RMU-01	11kV	ESS-2-11kV-Ring-6	ESS-2(2X10/12.5 MVA)
GH-8	GH	Phase-1	5029.69	12574.22	172.75	181.85	RMU-20	11kV	ESS-2-11kV-Ring-6	ESS-2(2X10/12.5 MVA)
PSP-6	PSP	Phase-1	4007.52	6011.28	291.39	306.73	RMU-20	11kV	ESS-2-11kV-Ring-6	ESS-2(2X10/12.5 MVA)
GH-9	GH	Phase-1	4024.25	10060.63	138.22	145.50	RMU-20	11kV	ESS-2-11kV-Ring-6	ESS-2(2X10/12.5 MVA)
C-4	Commercial	Phase-1	1386.26	2425.96	125.43	132.03	RMU-21	11kV	ESS-2-11kV-Ring-6	ESS-2(2X10/12.5 MVA)
C-5	Commercial	Phase-1	1206.22	2110.89	109.14	114.88	RMU-22	11kV	ESS-2-11kV-Ring-6	ESS-2(2X10/12.5 MVA)
MIG	Residential	Phase-1	4100.17	7175.30	98.58	103.77	RMU-22	11kV	ESS-2-11kV-Ring-6	ESS-2(2X10/12.5 MVA)
895-924	MIG	Phase-1	1850.00	11883.03	163.26	171.85	RMU-22	11kV	ESS-2-11kV-Ring-6	ESS-2(2X10/12.5 MVA)
925-946	MIG &HIG	Phase-1	1430.00	6516.35	89.53	94.24	RMU-23	11kV	ESS-2-11kV-Ring-6	ESS-2(2X10/12.5 MVA)
PSP-7	PSP	Phase-1	4241.62	5089.94	246.73	259.72	RMU-23	11kV	ESS-2-11kV-Ring-6	ESS-2(2X10/12.5 MVA)
G-32	Green	Phase-1	11845.01	11845.01	16.15	17.00	RMU-23	11KV	ESS-2-11kV-Ring-6	ESS-2(2X10/12.5 MVA)
G-31	Green	Phase-1	3329.61	3329.61	4.54	4.78	RMU-24	11KV	ESS-2-11kV-Ring-6	ESS-2(2X10/12.5 MVA)
867-894,823-866	MIG & HIG	Phase-1	4620.00	26303.12	361.37	380.39	RMU-24	11KV	ESS-2-11kV-Ring-6	ESS-2(2X10/12.5 MVA)
G-24	Green	Phase-1	6570.12	6570.12	8.96	9.43	RMU-25	11KV	ESS-2-11kV-Ring-6	ESS-2(2X10/12.5 MVA)
418-441,807-822,752-776	MIG &HIG	Phase-1	4055.00	23509.29	322.99	339.99	RMU-25	11KV	ESS-2-11kV-Ring-6	ESS-2(2X10/12.5 MVA)
442-480,730-751	MIG &HIG	Phase-1	3365.00	41532.34	570.60	600.63	RMU-26	11kV	ESS-2-11kV-Ring-6	ESS-2(2X10/12.5 MVA)
777-806,405-417	MIG &HIG	Phase-1	2795.00	12496.71	171.69	180.73	RMU-28	11kV	ESS-2-11kV-Ring-6	ESS-2(2X10/12.5 MVA)
PSP-5	PSP	Phase-1	4128.49	4128.49	200.13	210.66	RMU-41	11kV	ESS-2-11kV-Ring-6	ESS-2(2X10/12.5 MVA)
G-22	Green	Phase-1	11907.94	11907.94	16.24	17.09	RMU-41	11KV	ESS-2-11kV-Ring-6	ESS-2(2X10/12.5 MVA)
Total Load In 11kV Ring-6			**79891.90**	**205470.22**	**3307.83**	**3481.92**				
MIG-947-990,664-729	MIG	Phase-1	7020.00	43983.13	604.27	636.08	RMU-29	11kV	ESS-2-11kV-Ring-7	ESS-2(2X10/12.5 MVA)
G-33	Green	Phase-1	3246.05	3246.05	4.43	4.66	RMU-30	11KV	ESS-2-11kV-Ring-7	ESS-2(2X10/12.5 MVA)
PSP-8	PSP	Phase-1	1737.85	2085.42	101.09	106.41	RMU-60	11kV	ESS-2-11kV-Ring-7	ESS-2(2X10/12.5 MVA)
PSP-9	PSP	Phase-1	2835.56	4253.33	206.18	217.03	RMU-60	11kV	ESS-2-11kV-Ring-7	ESS-2(2X10/12.5 MVA)
PSP-10	PSP	Phase-1	2380.70	5951.75	288.51	303.69	RMU-60	11kV	ESS-2-11kV-Ring-7	ESS-2(2X10/12.5 MVA)

PLOT WISE POWER DEMAND CALCULATION & TRANSFORMER SIZING FOR ATAL PURAM TWONSHIP

Plot No.	Product Mix	Phase	Area (Sqm)	BUA (Sqm)	Power Demand in KW	Power Demand in KVA @ 0.95 PF	RMU	Selected Distribution Voltage Level (kV)	Substation Code	Incoming Power supply Source
MIG-583,663	MIG	Phase-1	4465.00	42466.04	583.43	614.14	RMU-31	11kV	ESS-2-11kV-Ring-7	ESS-2(2X10/12.5 MVA)
G-27	Green	Phase-1	897.64	897.64	1.22	1.29	RMU-32	11KV	ESS-2-11kV-Ring-7	ESS-2(2X10/12.5 MVA)
C-3	Commercial	Phase-1	1024.00	1792.00	92.65	97.53	RMU-27	11kV	ESS-2-11kV-Ring-7	ESS-2(2X10/12.5 MVA)
PSP-11	PSP	Phase-1	4096.06	6144.09	297.83	313.51	RMU-66	11kV	ESS-2-11kV-Ring-7	ESS-2(2X10/12.5 MVA)
G-35	Green	Phase-1	992.77	992.77	1.35	1.43	RMU-66	0.415kV	ESS-2-11kV-Ring-7	ESS-2(2X10/12.5 MVA)
C-6	Commercial	Phase-1	2301.13	4026.97	208.21	219.17	RMU-66	11kV	ESS-2-11kV-Ring-7	ESS-2(2X10/12.5 MVA)
Total Load In 11kV Ring-7			**30996.76**	**115839.20**	**2389.17**	**2514.92**				
MIG-481-500,513,518,367,378	MIG	Phase-1	2350.00	12988.76	178.45	187.84	RMU-33	11kV	ESS-2-11kV-Ring-8	ESS-2(2X10/12.5 MVA)
G-25	Green	Phase-1	5416.38	5416.38	7.39	7.77	RMU-33	11KV	ESS-2-11kV-Ring-8	ESS-2(2X10/12.5 MVA)
MIG-519-524	MIG	Phase-1	330.00	4465.70	61.35	64.58	RMU-34	11kV	ESS-2-11kV-Ring-8	ESS-2(2X10/12.5 MVA)
G-26	Green	Phase-1	18741.77	18741.77	25.56	26.90	RMU-34	11KV	ESS-2-11kV-Ring-8	ESS-2(2X10/12.5 MVA)
G-28	Green	Phase-1	4122.37	4122.37	5.62	5.92	RMU-34	11KV	ESS-2-11kV-Ring-8	ESS-2(2X10/12.5 MVA)
MIG-525-545	MIG	Phase-1	760.00	12126.52	166.60	175.37	RMU-35	11kV	ESS-2-11kV-Ring-8	ESS-2(2X10/12.5 MVA)
MIG-550-582,546-551	MIG	Phase-1	2325.00	10386.94	142.70	150.21	RMU-36	11kV	ESS-2-11kV-Ring-8	ESS-2(2X10/12.5 MVA)
UT-1	STP	Phase-1	5499.00	5499.00	266.56	280.59	RMU-37	11kV	ESS-2-11kV-Ring-8	ESS-2(2X10/12.5 MVA)
UT-2	Utility	Phase-1	4653.12	4653.12	225.56	237.43	RMU-39	11kV	ESS-2-11kV-Ring-8	ESS-2(2X10/12.5 MVA)
PSP-4	PSP	Phase-1	2602.73	3904.09	189.25	199.21	RMU-38	11kV	ESS-2-11kV-Ring-8	ESS-2(2X10/12.5 MVA)
C-2	Commercial	Phase-1	608.56	1064.99	55.06	57.96	RMU-38	11kV	ESS-2-11kV-Ring-8	ESS-2(2X10/12.5 MVA)
G-11,G13,G14,G15	Green	Phase-1	7694.74	7694.74	10.49	11.05	RMU-38&RMU39&RMU37	11kV	ESS-2-11kV-Ring-8	ESS-2(2X10/12.5 MVA)
G-73	Green	Phase-1	273.83	273.83	0.37	0.39	RMU-62-t/F	0.415kV	ESS-2-11kV-Ring-8	ESS-2(2X10/12.5 MVA)
G-74	Green	Phase-1	145.59	145.59	0.20	0.21	RMU-62-t/F	0.415kV	ESS-2-11kV-Ring-8	ESS-2(2X10/12.5 MVA)
G-75	Green	Phase-1	3777.78	3777.78	5.15	5.42	RMU-62-t/F	0.415kV	ESS-2-11kV-Ring-8	ESS-2(2X10/12.5 MVA)
GH-4	GH	Phase-1	7649.54	19123.85	262.74	276.57	RMU-63	11kV	ESS-2-11kV-Ring-8	ESS-2(2X10/12.5 MVA)
GH-5	GH	Phase-1	8781.30	21953.25	301.61	317.48	RMU-61	11kV	ESS-2-11kV-Ring-8	ESS-2(2X10/12.5 MVA)
GH-6	GH	Phase-1	8793.49	21983.73	302.03	317.93	RMU-61	11kV	ESS-2-11kV-Ring-8	ESS-2(2X10/12.5 MVA)
Total Load In 11kV Ring-8			**84525.19**	**158322.39**	**2206.70**	**2322.84**				
MIG-322-353,501-512	MIG	Phase-1	2800.00	32528.23	446.90	470.42	RMU-38	11kV	ESS-2-11kV-Ring-9	ESS-2(2X10/12.5 MVA)
PSP-2	PSP	Phase-1	3414.20	4097.04	198.60	209.05	RMU-43	11kV	ESS-2-11kV-Ring-9	ESS-2(2X10/12.5 MVA)
PSP-3	PSP	Phase-1	2624.67	3937.00	190.84	200.89	RMU-43	11kV	ESS-2-11kV-Ring-9	ESS-2(2X10/12.5 MVA)

PLOT WISE POWER DEMAND CALCULATION & TRANSFORMER SIZING FOR ATAL PURAM TWONSHIP

Plot No.	Product Mix	Phase	Area (Sqm)	BUA (Sqm)	Power Demand in KW	Power Demand in KVA @ 0.95 PF	RMU	Selected Distribution Voltage Level (kV)	Substation Code	Incoming Power supply Source
GH-13	GH-LIG	Phase-1	6714	16783.78	95.78	100.82	RMU-43	11kV	ESS-2-11kV-Ring-9	ESS-2(2X10/12.5 MVA)
224-279	MIG	Phase-1	3640.00	10870.06	149.34	157.20	RMU-44	11kV	ESS-2-11kV-Ring-9	ESS-2(2X10/12.5 MVA)
PSP-1	PSP	Phase-1	1997.80	2697.03	130.74	137.62	RMU-45	11kV	ESS-2-11kV-Ring-9	ESS-2(2X10/12.5 MVA)
GH-18	GH-EWS	Phase-1	6153	15382.27	87.78	92.40	RMU-45	11kV	ESS-2-11kV-Ring-9	ESS-2(2X10/12.5 MVA)
EWS 01-64	EWS	Phase-1	4800.00	4467.13	25.49	26.83	RMU-46	11kV	ESS-2-11kV-Ring-9	ESS-2(2X10/12.5 MVA)
GH-17,65-82,83-192	GH-EWS	Phase-1	13508	22254.88	127.00	133.68	RMU-47	11kV	ESS-2-11kV-Ring-9	ESS-2(2X10/12.5 MVA)
G3,G4,G5	Green	Phase-1	627.00	627.00	0.86	0.90	RMU-47	11kV	ESS-2-11kV-Ring-9	ESS-2(2X10/12.5 MVA)
C-1	Commercial	Phase-1	889.40	1556.45	80.47	84.71	RMU-48	11kV	ESS-2-11kV-Ring-9	ESS-2(2X10/12.5 MVA)
GH-16,GH-14	GH-LIG	Phase-1	7604.54	19011.35	108.49	114.20	RMU-48	11kV	ESS-2-11kV-Ring-9	ESS-2(2X10/12.5 MVA)
GH-15	GH-LIG	Phase-1	3348.34	8370.86	47.77	50.28	RMU-49	11kV	ESS-2-11kV-Ring-9	ESS-2(2X10/12.5 MVA)
EWS-193-223	EWS	Phase-1	2025	3919.55	22.37	23.54	RMU-49	11kV	ESS-2-11kV-Ring-9	ESS-2(2X10/12.5 MVA)
G-8	Green	Phase-1	6195.24	6195.24	8.45	8.89	RMU-50	11kV	ESS-2-11kV-Ring-9	ESS-2(2X10/12.5 MVA)
GH-12	GH-EWS	Phase-1	2262	5654.38	32.27	33.96	RMU-50	11kV	ESS-2-11kV-Ring-9	ESS-2(2X10/12.5 MVA)
MIG-301-314,392-406,379-391,354-366	MIG	Phase-1	3265	21510.85	295.53	311.09	RMU-51	11kV	ESS-2-11kV-Ring-9	ESS-2(2X10/12.5 MVA)
G-18,G20,G21	Green	Phase-1	2453	2452.65	3.34	3.52	RMU-40	11kV	ESS-2-11kV-Ring-9	ESS-2(2X10/12.5 MVA)
Total Load In 11kV Ring-9			**71867.14**	**179863.12**	**2052.00**	**2160.00**				
PSP-17	Utility	Phase-1	4180.36	4180.36	202.64	213.31	RMU-52	11kV	ESS-3-11kV-Ring-10	ESS-3(3X10/12.5 MVA)
PSP-18	PSP	Phase-1	798.73	798.73	38.72	40.76	RMU-52-Res	0.415kV	ESS-3-11kV-Ring-10	ESS-3(3X10/12.5 MVA)
G-71	Green	Phase-1	742.64	742.64	1.01	1.07	RMU-52-Res	0.415kV	ESS-3-11kV-Ring-10	ESS-3(3X10/12.5 MVA)
G-72	Green	Phase-1	840.79	840.79	1.15	1.21	RMU-52-Res	0.415kV	ESS-3-11kV-Ring-10	ESS-3(3X10/12.5 MVA)
GH-3	Group Housing	Phase-1	3369.69	8424.23	115.74	121.83	RMU-52	11kV	ESS-3-11kV-Ring-10	ESS-3(3X10/12.5 MVA)
Residential(1411-1424)	MIG	Phase-1	910.00	5361.93	73.67	77.54	RMU-52-Res	0.415kV	ESS-3-11kV-Ring-10	ESS-3(3X10/12.5 MVA)
UT-3	Utility	Phase-1	9093.29	9093.29	440.79	463.99	RMU-55	11kV	ESS-3-11kV-Ring-10	ESS-3(3X10/12.5 MVA)
GH-2	Group Housing	Phase-1	13999.74	34999.35	480.85	506.16	RMU-53	11kV	ESS-3-11kV-Ring-10	ESS-3(3X10/12.5 MVA)
C-20 a	Commercial	Phase-1	3075.31	5381.79	278.26	292.90	RMU-53	11kV	ESS-3-11kV-Ring-10	ESS-3(3X10/12.5 MVA)
C-20 b	Commercial	Phase-1	4414.10	7724.68	399.39	420.41	RMU-53	11kV	ESS-3-11kV-Ring-10	ESS-3(3X10/12.5 MVA)
GH-1	Group Housing	Phase-1	8571.36	21428.39	294.40	309.89	RMU-54	11kV	ESS-3-11kV-Ring-10	ESS-3(3X10/12.5 MVA)
C-19 a	Commercial	Phase-1	4100.17	7175.30	370.99	390.51	RMU-54	11kV	ESS-3-11kV-Ring-10	ESS-3(3X10/12.5 MVA)

PLOT WISE POWER DEMAND CALCULATION & TRANSFORMER SIZING FOR ATAL PURAM TWONSHIP

Plot No.	Product Mix	Phase	Area (Sqm)	BUA (Sqm)	Power Demand in KW	Power Demand in KVA @ 0.95 PF	RMU	Selected Distribution Voltage Level (kV)	Substation Code	Incoming Power supply Source
C-19 b	Commercial	Phase-1	6179.39	10813.93	559.12	588.54	RMU-54	11kV	ESS-3-11kV-Ring-10	ESS-3(3X10/12.5 MVA)
GH-7	Gh	Phase-1	8356.02	20890.05	287.00	302.11	RMU-57	11kV	ESS-3-11kV-Ring-10	ESS-3(3X10/12.5 MVA)
Total Load In 11kV Ring-10			**68631.59**	**137855.46**	**3543.72**	**3730.23**				
PSP-15	PSP	Phase-1	4029.36	6044.04	292.98	308.40	RMU-59	11kV	ESS-3-11kV-Ring-11	ESS-3(3X10/12.5 MVA)
PSP-16	PSP	Phase-1	4280.94	6421.41	311.27	327.66	RMU-59	11kV	ESS-3-11kV-Ring-11	ESS-3(3X10/12.5 MVA)
G-70	Green	Phase-1	3771.12	3771.12	5.14	5.41	RMU-59-t/F	0.415kV	ESS-3-11kV-Ring-11	ESS-3(3X10/12.5 MVA)
PSP-13	PSP	Phase-1	1042.83	1042.83	50.55	53.21	RMU-59 t/f	0.415kV	ESS-3-11kV-Ring-11	ESS-3(3X10/12.5 MVA)
PSP-12	PSP	Phase-1	3356.50	4027.80	195.24	205.52	RMU-60	11kV	ESS-3-11kV-Ring-11	ESS-3(3X10/12.5 MVA)
PSP-14	PSP	Phase-1	2343.44	3515.16	170.39	179.36	RMU-60	11kV	ESS-3-11kV-Ring-11	ESS-3(3X10/12.5 MVA)
G-68	Green	Phase-1	16058.04	16058.04	21.90	23.05	RMU-65	0.415kV	ESS-3-11kV-Ring-11	ESS-3(3X10/12.5 MVA)
C-8	Commercial	Phase-2	1342.73	2349.77	121.49	127.89	RMU-65	11kV	ESS-3-11kV-Ring-11	ESS-3(3X10/12.5 MVA)
C-9	Commercial	Phase-2	1128.53	1974.93	102.11	107.48	RMU-65	11kV	ESS-3-11kV-Ring-11	ESS-3(3X10/12.5 MVA)
C-10	Commercial	Phase-2	1822.63	3189.60	164.91	173.59	RMU-64	11kV	ESS-3-11kV-Ring-11	ESS-3(3X10/12.5 MVA)
C-11	Commercial	Phase-2	727.37	1272.89	65.81	69.28	RMU-64	11kV	ESS-3-11kV-Ring-11	ESS-3(3X10/12.5 MVA)
C-12	Commercial	Phase-2	1416.22	2478.39	128.14	134.89	RMU-64	11kV	ESS-3-11kV-Ring-11	ESS-3(3X10/12.5 MVA)
C-13	Commercial	Phase-2	1518.97	2658.19	137.44	144.67	RMU-70	11kV	ESS-3-11kV-Ring-11	ESS-3(3X10/12.5 MVA)
C-14	Commercial	Phase-2	1411.06	2469.36	127.67	134.39	RMU-70	11kV	ESS-3-11kV-Ring-11	ESS-3(3X10/12.5 MVA)
C-15	Commercial	Phase-2	1195.13	2091.48	108.14	113.83	RMU-70	11kV	ESS-3-11kV-Ring-11	ESS-3(3X10/12.5 MVA)
C-16	Commercial	Phase-2	1500.71	2626.24	135.79	142.93	RMU-69	11kV	ESS-3-11kV-Ring-11	ESS-3(3X10/12.5 MVA)
C-17	Commercial	Phase-2	1500.71	2626.24	135.79	142.93	RMU-69	11kV	ESS-3-11kV-Ring-11	ESS-3(3X10/12.5 MVA)
C-18	Commercial	Phase-2	1480.99	2591.73	134.00	141.05	RMU-69	11kV	ESS-3-11kV-Ring-11	ESS-3(3X10/12.5 MVA)
Residential(1308-1352)	Residential	Phase-2	2925.00	14941.86	205.28	216.09	RMU-68	0.415kV	ESS-3-11kV-Ring-11	ESS-3(3X10/12.5 MVA)
G-59	Green	Phase-2	1721.93	1721.93	2.35	2.47	RMU-13	0.415kV	ESS-3-11kV-Ring-11	ESS-3(3X10/12.5 MVA)
PSP-42	PSP	Phase-2	2959.61	5179.32	251.06	264.28	RMU-13	11kV	ESS-3-11kV-Ring-11	ESS-3(3X10/12.5 MVA)
PSP-43	PSP	Phase-2	3090.37	5408.15	262.16	275.95	RMU-13	11kV	ESS-3-11kV-Ring-11	ESS-3(3X10/12.5 MVA)
PSP-45	PSP	Phase-2	7861.54	15723.07	762.16	802.28	RMU-13	11kV	ESS-3-11kV-Ring-11	ESS-3(3X10/12.5 MVA)
Total Load In 11kV Ring-11			**60624.19**	**94460.50**	**3891.79**	**4096.62**				

PLOT WISE POWER DEMAND CALCULATION & TRANSFORMER SIZING FOR ATAL PURAM TWONSHIP

Plot No.	Product Mix	Phase	Area (Sqm)	BUA (Sqm)	Power Demand in KW	Power Demand in KVA @ 0.95 PF	RMU	Selected Distribution Voltage Level (kV)	Substation Code	Incoming Power supply Source
Residential(1252-1307,1243-1251)	Residential	Phase-2	4225.00	16918.41	232.44	244.67	RMU-71	0.415kV	ESS-3-11kV-Ring-12	ESS-3(3X10/12.5 MVA)
Residential(1225-1242,1368-1410)	Residential	Phase-2	3965.00	12269.16	168.56	177.43	RMU-72	0.415kV	ESS-3-11kV-Ring-12	ESS-3(3X10/12.5 MVA)
Residential(1353-1367,1206-1224)	Residential	Phase-2	2020.00	12802.68	175.89	185.15	RMU-67	0.415kV	ESS-3-11kV-Ring-12	ESS-3(3X10/12.5 MVA)
PSP-29	PSP	Phase-2	1829.41	3658.82	177.36	186.69	RMU-73	11kV	ESS-3-11kV-Ring-12	ESS-3(3X10/12.5 MVA)
G-62	Green	Phase-2	12992.38	12992.38	17.72	18.65	RMU-73	0.415kV	ESS-3-11kV-Ring-12	ESS-3(3X10/12.5 MVA)
PSP-26	PSP	Phase-2	4064.68	6097.02	295.55	311.10	RMU-75A	11kV	ESS-3-11kV-Ring-12	ESS-3(3X10/12.5 MVA)
PSP-28	PSP	Phase-2	5869.08	10270.89	497.87	524.08	RMU-67A	11kV	ESS-3-11kV-Ring-12	ESS-3(3X10/12.5 MVA)
PSP-32	PSP	Phase-2	1152.89	2305.79	111.77	117.65	RMU-67A	11kV	ESS-3-11kV-Ring-12	ESS-3(3X10/12.5 MVA)
G-61,G-60	Green	Phase-2	3845.77	3845.77	5.24	5.52	RMU-67A	0.415kV	ESS-3-11kV-Ring-12	ESS-3(3X10/12.5 MVA)
PSP-33	PSP	Phase-2	1317.60	2635.20	127.74	134.46	RMU-67B	11kV	ESS-3-11kV-Ring-12	ESS-3(3X10/12.5 MVA)
PSP-34	PSP	Phase-2	4548.17	9096.34	440.94	464.15	RMU-67B	11kV	ESS-3-11kV-Ring-12	ESS-3(3X10/12.5 MVA)
PSP-27	PSP	Phase-2	4798.66	8397.65	407.07	428.49	RMU-67B	11kV	ESS-3-11kV-Ring-12	ESS-3(3X10/12.5 MVA)
C-7	Commercial	Phase-2	4427.14	7747.49	400.57	421.65	RMU-75	11kV	ESS-3-11kV-Ring-12	ESS-3(3X10/12.5 MVA)
C-7 A	Commercial	Phase-2	590.47	1033.32	53.43	56.24	RMU-75	11kV	ESS-3-11kV-Ring-12	ESS-3(3X10/12.5 MVA)
PSP-44	PSP	Phase-2	5785.62	11571.24	560.91	590.43	RMU-76	11kV	ESS-3-11kV-Ring-12	ESS-3(3X10/12.5 MVA)
Total Load In 11kV Ring-12			**61431.86**	**121642.15**	**3673.06**	**3866.38**				
C-22	Commercial	Phase-2	5303.79	10607.59	548.45	577.31	RMU-74	11kV	ESS-3-11kV-Ring-13	ESS-3(3X10/12.5 MVA)
C-23	Commercial	Phase-2	4990.37	9980.74	516.04	543.20	RMU-74	11kV	ESS-3-11kV-Ring-13	ESS-3(3X10/12.5 MVA)
C-24	Commercial	Phase-2	5328.40	10656.81	550.99	579.99	RMU-74	11kV	ESS-3-11kV-Ring-13	ESS-3(3X10/12.5 MVA)
PSP-19	PSP	Phase-2	1862.66	2235.19	108.35	114.05	RMU-58	11kV	ESS-3-11kV-Ring-13	ESS-3(3X10/12.5 MVA)
PSP-30	PSP	Phase-2	3647.90	6383.83	309.45	325.74	RMU-78	11kV	ESS-3-11kV-Ring-13	ESS-3(3X10/12.5 MVA)
PSP-31	PSP	Phase-2	6127.81	12255.62	594.08	625.35	RMU-78	11kV	ESS-3-11kV-Ring-13	ESS-3(3X10/12.5 MVA)
G-63	Green	Phase-2	4788.97	4788.97	6.53	6.87	RMU-78	0.415kV	ESS-3-11kV-Ring-13	ESS-3(3X10/12.5 MVA)
C-25	Commercial	Phase-2	3391.16	6782.31	350.67	369.13	RMU-77	11kV	ESS-3-11kV-Ring-13	ESS-3(3X10/12.5 MVA)
C-26	Commercial	Phase-2	2430.59	4861.17	251.34	264.57	RMU-77	11kV	ESS-3-11kV-Ring-13	ESS-3(3X10/12.5 MVA)
C-27	Commercial	Phase-2	3290.05	6580.09	340.21	358.12	RMU-77	11kV	ESS-3-11kV-Ring-13	ESS-3(3X10/12.5 MVA)
Total Load In 11kV Ring-13			**41161.70**	**75132.32**	**3576.11**	**3764.33**				
Residential (1103-1205),G-47,48,49	MIG	Phase-2	6695.00	18828.96	258.69	272.30	RMU-19-Res	0.415kV	ESS-3-11kV-Ring-14	ESS-3(3X10/12.5 MVA)
G-46	Green	Phase-2	1161.05	1161.05	1.58	1.67	RMU-19-Res	0.415kV	ESS-3-11kV-Ring-14	ESS-3(3X10/12.5 MVA)

PLOT WISE POWER DEMAND CALCULATION & TRANSFORMER SIZING FOR ATAL PURAM TWONSHIP

Plot No.	Product Mix	Phase	Area (Sqm)	BUA (Sqm)	Power Demand in KW	Power Demand in KVA @ 0.95 PF	RMU	Selected Distribution Voltage Level (kV)	Substation Code	Incoming Power supply Source
PSP-25	PSP	Phase-2	993.91	993.91	48.18	50.72	RMU-19-Res	0.415kV	ESS-3-11kV-Ring-14	ESS-3(3X10/12.5 MVA)
G-44	Green	Phase-2	572.03	572.03	0.78	0.82	RMU-19-Res	0.415kV	ESS-3-11kV-Ring-14	ESS-3(3X10/12.5 MVA)
G-52	Green	Phase-2	5508.45	5508.45	7.51	7.91	RMU-19-Res	0.415kV	ESS-3-11kV-Ring-14	ESS-3(3X10/12.5 MVA)
G-50	Green	Phase-2	5097.69	5097.69	6.95	7.32	RMU-19-Res	0.415kV	ESS-3-11kV-Ring-14	ESS-3(3X10/12.5 MVA)
PSP-36	PSP	Phase-2	2241.23	4482.46	217.28	228.72	RMU-18	11kV	ESS-3-11kV-Ring-14	ESS-3(3X10/12.5 MVA)
PSP-37	PSP	Phase-2	1766.22	3532.43	171.23	180.24	RMU-18	11kV	ESS-3-11kV-Ring-14	ESS-3(3X10/12.5 MVA)
PSP-38	PSP	Phase-2	1984.50	3969.00	192.39	202.52	RMU-18	11kV	ESS-3-11kV-Ring-14	ESS-3(3X10/12.5 MVA)
PSP-21	PSP	Phase-2	1541.13	2311.70	112.06	117.96	RMU-16	11kV	ESS-3-11kV-Ring-14	ESS-3(3X10/12.5 MVA)
PSP-22	PSP	Phase-2	2081.50	2497.81	121.08	127.45	RMU-16	11kV	ESS-3-11kV-Ring-14	ESS-3(3X10/12.5 MVA)
PSP-23	PSP	Phase-2	2398.87	2878.65	139.54	146.88	RMU-16	11kV	ESS-3-11kV-Ring-14	ESS-3(3X10/12.5 MVA)
G-36	Green	Phase-2	849.64	849.64	1.16	1.22	RMU-17-Res	0.415kV	ESS-3-11kV-Ring-14	ESS-3(3X10/12.5 MVA)
G-37,38,43,45,39	Green	Phase-2	3996.16	3996.16	5.45	5.74	RMU-17-Res	0.415kV	ESS-3-11kV-Ring-14	ESS-3(3X10/12.5 MVA)
PSP-20	PSP	Phase-2	2012.71	301.91	14.63	15.40	RMU-17-Res	0.415kV	ESS-3-11kV-Ring-14	ESS-3(3X10/12.5 MVA)
Residential MIG,HIG(991-998,1047-1080)	HIG,MIG	Phase-2	2620.00	19863.92	272.91	287.27	RMU-17-Res	0.415kV	ESS-3-11kV-Ring-14	ESS-3(3X10/12.5 MVA)
PSP-24	PSP	Phase-2	3813.89	4576.67	221.85	233.53	RMU-17	11kV	ESS-3-11kV-Ring-14	ESS-3(3X10/12.5 MVA)
Residential MIG,HIG(999-1046)	HIG,MIG	Phase-2	2650.00	21285.80	292.44	307.83	RMU-15-Res	0.415kV	ESS-3-11kV-Ring-14	ESS-3(3X10/12.5 MVA)
C-21	Commercial	Phase-2	557.07	974.87	50.40	53.06	RMU-15-Comm	0.415kV	ESS-3-11kV-Ring-14	ESS-3(3X10/12.5 MVA)
G-40,42,41	Green	Phase-2	590.78	590.78	0.81	0.85	RMU-15-Res	0.415kV	ESS-3-11kV-Ring-14	ESS-3(3X10/12.5 MVA)
GH-10	GH	Phase-2	3584.44	8961.11	123.11	129.59	RMU-14-GH	11kV	ESS-3-11kV-Ring-14	ESS-3(3X10/12.5 MVA)
GH-11	GH	Phase-2	4491.74	11229.36	154.28	162.40	RMU-14-GH	11kV	ESS-3-11kV-Ring-14	ESS-3(3X10/12.5 MVA)
PSP-35	PSP	Phase-2	6760.30	13520.60	655.40	689.90	RMU-14	11kV	ESS-3-11kV-Ring-14	ESS-3(3X10/12.5 MVA)
G-51	Green	Phase-2	1199.13	1199.13	1.64	1.72	RMU-14-GH	0.415kV	ESS-3-11kV-Ring-14	ESS-3(3X10/12.5 MVA)
PSP-39	PSP	Phase-2	1473.81	2947.61	142.88	150.40	RMU-19/1	11kV	ESS-3-11kV-Ring-14	ESS-3(3X10/12.5 MVA)
PSP-40	PSP	Phase-2	1475.77	2951.55	143.07	150.60	RMU-19/1	11kV	ESS-3-11kV-Ring-14	ESS-3(3X10/12.5 MVA)
PSP-41	PSP	Phase-2	3039.99	5319.99	257.88	271.46	RMU-19/1	11kV	ESS-3-11kV-Ring-14	ESS-3(3X10/12.5 MVA)
Total Load In 11kV Ring-14			**71157.02**	**150403.21**	**3615.20**	**3805.47**				
TOTAL LOAD				**1710422.25**	**47272.61**	**49760.64**				

The following exclusions and provisions apply to the substation locations under the EPC package:

1. **Transformer Configuration:**
    - ESS-2 will proceed with **2 nos. of power transformers** as planned.
    - ESS-1 and ESS-3 will each have **1x10 MVA transformer** instead of the originally planned 2x10 MVA transformers.
2. **Exclusions from EPC Scope:**
    - One Power transformer (10 MVA) at ESS-1 and ESS-3.
    - One 33kV incoming line each for ESS-1 and ESS-3.
    - 33kV and 11kV interconnections between ESS-1 and ESS-3.
3. **Future Infrastructure Provision:**
    - Adequate space for future infrastructure, such as trenches and substation expansions, must be incorporated into the design.

Bidders must account for these exclusions and provisions in their proposals.

2 SMART STREET LIGHTING

2.1 General

Urban areas in the entire world are dealing with increasing energy consumption and carbon emissions, a known contributor to climate change. Due to inadequate dimming control and low efficiency, current street lighting is wasteful in terms of energy spending, accounting for a major part of governmental electricity costs. Therefore, it has become desirable and of great importance to design a new smart lighting system that is more efficient and environmentally friendly.

The main aim of a new smart street lighting system is to control energy efficient LED street lights to turn on only when needed and to remain in a dim state otherwise. The system integrates technologies such as: wireless network and dimmable LEDs.

It should control the luminaires to adjust according to the requirement of the client and should perform the function of asset management for the civic authorities.

With such a system in place, it shall become a convenient platform for the civic authorities, for the facility management team as well as for the citizens of the city.

2.2 Scope Of Work

This specification is intended to cover the *design, detailed Engineering, construction/ manufacture, procurement of electrical equipments, assembly, testing at manufacturer's works, supply in properly packed condition for transport to site, transportation, Erection, site testing and commissioning,* including preliminary acceptance test, performance guarantee and post commissioning services and insurance during transit, storage, erection and commissioning with all accessories for efficient and trouble-free operation of **Atal Puram Township, Agra.**

The smart street lighting system shall include minimum components but not limited to the following;

a) LED Street Luminaire with accessories including Dimmable Drivers
b) Hot-Dip Galvanized conical 9m Lighting pole with inbuilt Junction Box, RCC foundation, Mounting Brackets, hard wares, and other accessories
c) Connecting power Cabling laid in DWC/ HDPE pipes

d) Earthing system for pole and feeder pillars with accessories and termination
e) Smart Outdoor Main Feeder Pillars (OFP) and outdoor type external lighting feeder pillar with Smart Controller for individual light fixture Control and Monitoring System
f) Excavation of trench for laying DWC pipes and Horizontal Drilling for Existing Road crossing.
g) GPRS/Ethernet and Zigbee GPS technology connectivity for communication from Feeder Pillar
h) Cloud registration; hosting; uploading and managing all data after Mapping of Feeder Pillars and Light poles as applicable installed by BIDDER
i) All mounting and foundation supports and hardware accessories for equipment/system installations
j) All civil works associated with installations of the equipment/systems within BIDDER"s scope including excavation, concreting, back filling of soil for preparation of equipment foundation, laying of DWC pipes either by excavating of through open excavation; embedment, chipping, punching, making holes, pipe sleeves, fire/ water proof sealing etc
k) Any other electrical equipment/ component which are not specifically listed above but are necessary to make the system complete and functional in all respect as per specification and statute.
l) Safety to personnel and equipment during both operation and maintenance.

The approximate load of Street Lighting for Atal Puram Township is estimated as 197 kW. To meet the load demand four 11/0.433kV Compact Substations are proposed, 9 nos. of Main Feeder Pillars, 43 nos. of Feeder Pillars & 1484 LED fixtures (284 Including fixtures at Junctions) are proposed to ensure redundancy in distribution. Various Smart components like – Warm White LED Luminaires, Multi-Step Dimming, Individual Street Light Control etc. are proposed for the Atal Puram Township.

All sundry fittings, assemblies, accessories, hardware items, foundation bolts, termination lugs for electrical connections as required, and all other sundry items which are useful and necessary for proper assembly and efficient working of the various components of the work shall be deemed to have been included in the tender, whether such items are specifically mentioned in the tender documents or not.

CIVIL WORK for foundation of equipment's is included in this contract unless specifically excluded in the Bill of quantities. The Scope includes but not limited to Supply, Installation, testing & commissioning (SITC) of

Item	Description	Quantity	Remarks
LV CABLES:	Supply, Laying and testing of aluminium conductor cable XLPE insulated armoured, served, sheathed 1100 volts grade upto 3m below ground level in dwc pipe/ duct bank/ground with protection. The armouring of the cable shall be properly connected with the earth conductor including fixing of palm or pin type AL cable socket (lug) / end terminations to the cable leads, insulating with tape and making connections with brass / nickle plated double compression gland, providing cable tags complete in all respect including supply of lugs and compression glands etc complete upto the satisfaction of Engineer-in-charge. 16 sq.mm 3.5 core—30.50 KM 25 sq.mm 3.5 core—7.6 KM 150 sq.mm 3.5 core—9.5 KM 300 sq.mm 3.5 core—7.5 KM	1 Lot	RCC and HDPE Conduit laying infrastructure of 150 sq.mm and 300 Sq.mm considered in Power Infrastructure
Earthing system:	Supply & burrying of **90** nos of 600mm x 600mm x 6.0mm G.I. plate, vertically for earthing with its top at least 3 meters below ground level complete with 20 mm G.I. pipe for watering funnel, 300 mm square C.I. frame with hinged cover, masonry housing, alternate layers of coke and salt at least 150 mm thick alround including excavation and back filling etc. complete in all respects. (for Feeder Pillar) Providing & fixing **450 m** of 25mm x 5mm G.I. strip on surface, in recess or in ground including connections etc. as required Providing and laying **38.1 KM** of 6 SWG dia G.I. wire on surface, in recess or in ground including conections for earthing as required along with cables.	1 Lot	
DWC/HDPE Conduit:	Supplying and laying of 63 mm dia (OD-63 mm & ID-51 mm nominal) DWC HDPE pipe ISI marked along with all accessories like socket, bend, couplers etc. conforming to IS 14930, Part II complete with fitting and cutting, jointing etc. in the existing trench, complete as required for cable laying including transportation and accessories required complete in all respect.	35.9 KM	

Item	Description	Quantity	Remarks
outdoor type Main Feeder Panel (415V Switchgear, Feeder Pillar & DB)	Design, manufacture, supply, inspection, handling, assembling, affecting proper connections, testing and commissioning of 14 SWG CRCA sheet steel fabricated cubical outdoor type Main Feeder Panel , floor mounting, dust & vermin proof, front operated construction, double door enclosure class - IP 65, powder coated after proper treatment with 9 tank process with top/bottom removable gland plates, as required, double compression type cable glands, earth bus, hinged and lockable doors to achieve dust and vermin proof complete with all inter connections small wiring by min. 2.5 sq. mm. FRLS copper wires, ckt labels etc. The Aluminium Bus Bar shall be of suitable length, 600 volts, 3 phase 50 Hz TPN, electrolytic aluminium as per IS 8623 . The panel feeders shall be suitable for terminating suitable nos. 3.5 / 4 core armoured aluminium cable as required. INCOMER : 02 nos. 125 AMP FP MCCB (25 KA) BUS BAR : 250 AMP, 500 Volts, 3 phase 50 HZ TPN high conductivity electrolytic Aluminium bus bar of suitable length, insulated by heat shrinkable sleeves. The current density of bus bar shall be minimum 1.00 sq mm / amp. OUT GOINGS : 07 nos. 63 AMP FP MCCB (25 KA)	8 nos.	
outdoor type external lighting feeder pillar (Switching Point Controller)	Supply , installation testing and commissioning of outdoor type external lighting feeder pillar of suitable size made out of M.S. sheet 2mm thick (14 SWG) duly compartmentalized, double door with locking arrangement (IP-65), duly fixed on MS angle iron frame work of size 50mm x 50mm x 6mm, 90 cm long legs out of which 45 cm duly grouted in cement concrete 1:2:4 (1 cement : 2 sand :4 stone aggrete 20mm) and having following accessories mounted inside the cubical panel i/c connection, inter connection with aluminium thimbles, earthing with two nos. earth struds duly painted with power coating and 9 tank process of approved shade complete etc. as required. Smart feeder Panel-10kVA-10kVA rated Switching point controller system (SPCS) with GPRS, Timer, Energy measurement systems and switching controllers with outgoing as required to feed 32 luminaires for individual control of luminaire.	37 nos.	
Street Lighting Poles:	SITC of Hot-Dip Galvanized conical 9m height Poles for Street Lighting with decorative brackets, arrangements, including suitable boards, bakelite sheet , MCBs and 20mm dia 1.5m long MS rod earthing as per IS specifications suitable to withstand the wind speed of 47 m/sec. including civil foundation , sleeves, excavation and back filling complete in all respect with all required accessories.	915 nos.	

Item	Description	Quantity	Remarks
	Supply Installation, testing and commissioning of Hot-Dip Galvanized conical 6m height Poles for Street Lighting with decorative brackets, IS 2062 for base plate with door opening arrangements, including suitable boards, bakelite sheet and MCBs as per IS specifications suitable to withstand the wind speed of 47 m/sec.	237 nos	
	Supply & fixing of 16 mtr High mast shaft of approved make with rising system hot dip glavanized inside & outside dip, heaving pole sheet thickness 3 mm. Top dia minium 150 mm, Bottom dia 360 mm base plate 32 mm thick suitable for wind velocity as per IS 875 part 3 & having no circumferential weld, with accessories for high mast such as head frame suitable for 6 to 12 luminaries & its control gear boxes 1.5 HP power tool meter, 3 point suspension system with steel wire rope 6 mm dia, double drum winch, including making suitable foundation as per manufature drawing/ site requirement along with foundation bolts nuts, washers, anchor plates etc complete in all respect	3 nos	
Lighting Fixture:	Supply Installation, testing and commissioning of LED Luminaire for streetlight application with Dimmable driver and integrated SLC including connection with 3x1.5 sqmm flexible fire retardant copper connecting wire of required length complete as required for outdoor application. 150W-242 Nos 120W-344 Nos 90W-441 Nos 45W-96 Nos 35W-141 Nos 464W-24 Nos 440W-18 Nos	1 lot	
Web Application & Server:	1069 Nos of Web application charges per luminaire & on cloud hosting (annual subscription) 1 Nos SMS Alerts Charges (Yearly – for 50,000 SMS),	1 lot	

Detailed Technical specification of each equipment's needs to be referred in respective equipment technical specification.

2.3 Terminal Points And Interfaces

2.3.1 ..... At Main Feeder Pillar (415V Switch Gear) Incomer

Terminal point for Main feeder pillar (415V switch gear) incomer shall be outgoings of the compact Substation placed in each 33/11kV GIS indoor substation. The 415V LV cable originating from outgoing of the compact substation. 11/0.415 kV compact Substation which includes- , HT Panel with 2 incomers LBS and 1 outgoing self-powered VCBs with 250kVA, dry type, two winding, 3 phase, Dyn11, 50Hz, AN, Transformer, LT panel, APFC, FPI & FRTU. Any facility required for compact substation shall not be in this scope (covered in Power infrastructure). Any work required for arrangement of above Main Feeder Pillar (415V Switch Gear) incomer from compact substation is in bidders scope.

2.3.2 ..... At Smart Street Pole

Terminal point for LV distribution shall be up-to MCB placed at the outgoing of the (switching point controller) placed at each Smart Street Pole. All 415V, control cables & its terminations & joints, in-built DC system & all arrangement required SCADA communication as per specifications shall be in bidder's scope.

2.3.3 ..... Exclusion List

a) 3 nos Compact substation at each Substation for streetlighting covers in power infrastructure.
b) Cable laying infrastructure for 150 sq.mm and 300 Sq.mm LV cable is considered in Power Infrastructure.

2.4 Street Lighting At Intersections

The intersections street lightings are not included in the Smart Street Light Detailed Project Report. The design is to give an average value of 50 lux at the centre of the intersection. However, due to the limitation of the available luminescence, lower values are achieved, which is an average of 38 lux.

The roads are being lit to 20 lux, hence, the intersection will have better luminescence.

The light poles for the intersection are expected to be placed at the centre of the median where median are available, otherwise, at the edge of the kerb, at the curve.

2.5 Codes And Standards

i.) All equipment, system and services covered under this specification shall comply with all currently applicable statutes, regulations and safety codes. Nothing in this specification shall be construed to relieve the Bidder of this responsibility.

ii.) The standards not indicated in the specification are also acceptable, if they are established to be equal or superior to the standards indicated in the specification.

iii.) The metric units/SI units shall be used in all data/drawings submitted against this package.

iv.) The Bidder shall furnish the English translations of all standards to which the equipment and systems offered are conforming to, as and when required by the Owner.

v.) The work shall be performed in conformity with these specifications standards and Codes of Practice specified or referred in the tender. In case of any conflict the stipulations under these specifications shall govern.

vi.) In addition, work shall also conform to the requirements of latest editions/ amendments of the following:

The Indian Electricity Act and Rules framed there under

a) Fire Insurance Regulations
b) Regulations laid down by the Chief Electrical Inspectorate
c) Regulations laid down by the Factory Inspectorate
d) Regulations laid down by the Chief Electrical Inspectorate of Government etc.
e) Applicable Codes of Practice of the Bureau of Indian Standards
f) Any other regulations laid down by the Central, State or Local Authorities from time to time and during the execution of this contract.

2.6 Planning And Design Criteria

2.6.1 ..... General Design Criteria

The design concept of electrical system is based on providing safe, reliable & stable power and efficient performance of electrical system.

i.) The design standard described herein is generally in compliance with the latest Indian Standards, IEC and Code of Practices of India.

ii.) All electrical installations shall confirm to the latest CEA (Central Electricity Authority) guidelines 2010.

iii.) Latest National and International Standards shall be used for each electrical equipment design in Atal Puram township.

iv.) The design ambient temperature for all electrical equipment shall be considered as 45 0C.

Smart Street lighting design system will be adopted in the Atal Puram twonship from following criteria:

a) The illuminance level for road lighting in India is governed by IS 1944 (Part 1& 2): 1970 Code of Practice as well as MOUD guidelines for lighting of Atal Puram Township

b) Requirement of Mandatory lux level to be maintained as per MOUD guidelines:
   - For all kind of roads E.avg should be minimum 30lux is maintained.
   - For cycling track E.avg should be minimum 20lux is maintained.
   - For Pedestrain crossing E.avg should be minimum 50lux is maintained.

2.6.2 ..... Design Ambient

The electrical equipment shall be designed with due consideration to the following ambient conditions:

a)	Design ambient temperature	:	50 °C.
b)	Minimum ambient temperature	:	9.8°C.
c)	Maximum ambient temperature	:	43.1°C.
d)	Equipment design temperature range	:	5°C to 45°C.
e)	Max. Ambient relative humidity	:	95% RH
f)	Seismic Zone	:	Between Zone II & III

2.6.3 ..... Voltage Levels

Following voltage levels shall be used:

a) 415 V/230V- LV supply for LV auxiliary loads at substations & CSS to feeder pillar, UPS & street lighting.

b) 24 V DC –DC voltage for RMUs & control and instrumentation.

VOLTAGE LEVELS

Item	Voltage	Neutral Earthing
LV Power Distribution System	415V ±10%, 50 Hz ±3%, 3Ph, 4W system 230 V ±10%, 50 Hz ±3%, 1Ph, 2W system	Solidly earthed
DC System	a)110 V (+)10% to (-)15% DC b) 24 V (+)10% to (-)15% DC	Ungrounded

2.6.4 ..... Basic Insulation Level

Unless stated otherwise in the individual equipment/system specification, the insulation levels shall be as given below:

BASIC INSULATION LEVEL

Nominal System Voltage	Highest System Voltage	Rated 1 min power freq. Withstand voltage (KVRMS)	Rated Lightning Impulse Withstand Voltage (KVPEAK)
415 V	1.1 kV	3 kV_{rms}	-

2.6.5 ..... Fault Levels

Different equipment shall be designed for the following through fault withstand capabilities fault levels as mentioned below: -

FAULT LEVEL

System	Fault Level	Duration
415V	50kA	1 second
110V DC	15 kA	1 second

2.7 Appendix (Smart Street Lighting)

2.7.1 ..... LV Cables

2.7.1.1 General

This specification is intended to cover the design, Engineering, manufacture, assembly, testing at manufacturer's works, supply in properly packed condition for transport to site, Erection, site testing and commissioning of LV armour cables for power & control applications complete with all accessories for efficient and trouble-free operation.

2.7.1.2 Codes and Standards

All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) / IEC as given below except where modified or supplemented by this specification.

Table: 1.0

IS:1554(Part I)	:	PVC insulated (heavy duty) electric cables for working voltage up to and including 1100V
IS: 2982	:	Copper conductor in insulated cables and cords.
IS: 3961	:	Recommended current ratings for cables.
IS: 3975	:	Mild steel wires, strips and tapes for armouring cables
IS: 5609	:	Specification for low frequency wires and cables with PVC insulation and PVC sheath
IS:5831	:	PVC insulation and sheath of electric cables
IS: 6380	:	Specification of elastomeric insulation of sheath of electric cables.
IS:7098(Part I)	:	XLPE insulated PVC sheathed cables for working voltage up to 1.1kV
IS: 8130	:	Conductors for insulated electric cables and flexible cords
IEC: 60	:	High voltage test techniques

IEC: 230	:	Impulse tests on cables and their accessories
IEC: 287	:	Calculation of the continuous current rating of the cables (100% load factor).
IEC: 288	:	Nominal cross sectional area and composition of conductor of insulated cables.
IEC-331	:	Fire resisting characteristics of electric cables
IEC: 332-1	:	Test on electric cables under fire conditions.
IEEE: 383	:	Standard for type test for class IE electric cables, filled splices and connection for nuclear power generation station.
IEC: 540	:	The methods for insulations and sheath of electric cables and cords(elastomeric and thermoplastic compounds)
IEC-754-I	:	Test method for acid gas generation
NEMA-WC-5	:	Thermoplastic insulated wires and cables for transmission and distribution of electrical energy.
ASTM-D-2843	:	Standard test method for density of smoke from burning/decomposition of plastics.
ASTM-D-2863	:	Test for determination of oxygen index.
CEA	:	CEA Regulations
CEA	:	Standard Technical Specifications For Main Plant Package

Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted subject to approval of the Owner. In such case, copies of the English version of the standards adopted shall have to be submitted along with the bid.

The electrical installation shall meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Codes of Practice. In addition, other rules and regulations applicable to the work shall be followed.

2.7.1.3 Design Criteria

The cables shall be installed in hot, humid tropical atmosphere with ambient temperature of 45oC.

All LV cables shall be suitable for operation under the following voltage & frequency variations:

Voltage Variation	:	(±) 10%
Frequency Variation	:	(+) 3% to (-)5%
Combined Variation of Voltage & Frequency	:	10% (absolute sum)

The LV power cables shall be 1100V grade, single/multi core stranded Aluminum conductor, extruded XLPE/PVC insulated with extruded PVC inner sheath, armoured and overall sheath with extruded Flame Retardant Low Smoke (FRLS) PVC compound (Type ST-1). These cables shall conform to IS 7098 (Part I) for XLPE and 1554(part 1) for PVC insulation.

The control cables shall be 1100 V grade, multi core, stranded annealed high conductivity copper with extruded PVC insulated inner sheath, armoured and overall sheath with extruded Flame Retardant Low Smoke (FRLS) PVC compound (Type ST-1).

The continuous and short time current carrying capacity of XLPE insulated cables shall be based on maximum operating temperature of 90oC and 250oC respectively.

The continuous and short time current carrying capacity of PVC insulated cables shall be based on maximum operating temperature of 70oC and 160oC respectively.

LV power cables shall be sized taking into account the following derating factors:

- Max Ambient air temperature
- Max Ambient ground temperature
- Grouping of cables/Method of laying
- Depth of laying for cable buried in ground.
- Soil thermal resistivity for cable buried in ground.

Power cables shall be chosen taking into account the following factors:

2.7.1.4 System Fault level.

- Maximum time for fault clearance (i.e, operating time of the backup protection relays plus the time of operation of the circuit breakers).
- Full load current of the circuit.
- Short circuit current and duration (for breaker protected cables)

- Installation conditions.
- Voltage drop under normal running and starting condition
- Voltage drop at motor terminals shall be within permissible limit during starting & normal running. i.e 5% during steady state and 15% during transient or starting at motor terminal.
- The cable should withstand the maximum fault current corresponding to the particular voltage level for the minimum time before the fault is cleared.
- Consideration shall also be given to limit the cable to the nearest standard sizes instead of using too many types.

The minimum size of cables to be used shall be as follow :

Aluminium conductor	:	6 Sq. mm.
Copper conductor	:	2.5 Sq. mm

Specific Requirements

2.7.1.5 Type of Cable

LV power cables shall be 1100V grade, heavy duty, stranded aluminium conductor, XLPE/ PVC insulated, extruded black FRLS PVC inner sheathed, armoured and overall FRLS extruded black PVC outer sheathed (Type ST-1) cables conforming to IS: 1554(Part 1) for PVC insulation and IS 7098(Part 1) for XLPE insulation.

Control Cables shall be 1100 V grade, heavy duty with annealed high conductivity stranded copper conductor, PVC insulated, FRLS PVC inner sheathed, armoured and FRLS extruded black PVC outer sheathed (Type ST-1) cables conforming to IS : 1554.

2.7.1.6 Conductor

The cable conductor shall be made from standard Aluminum for LV Power cables and Copper for control cables to form compact conductor having a resistance within the limits specified. All the cables of size 25mm2 and above shall have sector shaped conductors.

2.7.1.7 Insulation

The insulation of the LV power and control cables shall be XLPE/PVC type. It shall be designed and manufactured for the specified system voltage. The manufacturing process shall ensure that insulation shall be free from voids. The insulation shall withstand mechanical and thermal stresses under steady state and transient operating

conditions. The extrusion method should give a very smooth interface between semi conducting screen and insulation. The insulation of the cables shall be of high standard quality.

2.7.1.8 Inner Sheath

The sheath shall be suitable to withstand the site conditions and the desired temperature. It shall be of adequate thickness and applied by a continuous process to produce a sheath of consistent quality free from all defects. PVC sheath shall be extruded with FRLS properties.

2.7.1.9 Armour

LV power and control cables shall be provided with galvanized steel wire/strip armouring. The hard drawn aluminium wire for armour shall be of H4 grade, as per IS-8130 (having tensile strength above 150 N/mm2). The diameter of the aluminium wire shall be as per the table for the dimensions of the galvanized steel wire armour given in the relevant standard.

2.7.1.10 Outer sheath

Outer sheath shall be extruded layer of FRLS PVC compound (ST-1).Sheath shall be resistant to water, Ultra Violet radiations, fungus, termites and rodent attacks. The color of the sheath shall be black.

2.7.1.11 Packing

Cables shall be supplied in non-returnable drums. Drum lengths shall be such so that cable joints are totally avoided. The drums shall be of heavy construction. All wooden parts shall be manufactured from seasoned wood. All ferrous parts used shall be treated with suitable rust preventive finish or coating to avoid rusting during transit or storage. Wooden cable drum shall be treated by immersing in copper-nitrate solution.

The ends of each cable length shall be sealed before shipment. Heat shrinkable cable cap shall be used for this purpose.

A label shall be securely attached to each end of the reel indicating the Purchaser's order number, Owner's identification mark, length, type, voltage grade, conductor size and number of cores of the cable. A tag containing the same information shall be attached to the leadings end of the cable inside. An arrow and necessary instructions shall be marked on the drum indicating the direction in which it should be rolled. Drum

numbers are to be indicated on the cable drums. Drum length shall not be less than the following:

Power cables	:	*500m*
Control cables	:	*1000m*

2.7.1.12 Identification of cores and spares:

LV power cables shall be identified by color code. However LV control cables shall be identified by the number of its cores.

Multi-core control cables shall have 20% spare core, minimum one spare.

2.7.1.13 Constructional Requirements

Cable shall have suitable filters laid up with the conductors to provide a substantially circular cross section before the sheath is applied. Fillers shall be suitable for the operating temperature of the cable and compatible with the insulating material. All materials shall be new, unused and of finest quality.

Workmanship shall be neat, clean and of the highest grade.

2.7.1.14 Special Properties:

- All the above cables shall be conforming to the relevant Indian/IEC standard in general, with the following special properties:
- Oxygen Index of the outer sheath shall not be less than 29, when tested as per ASTM-D-2863.
- Temperature Index of the outer sheath shall not be less than 250□C, when tested as per ASTM-D-2863.
- Halogen acid contents in outer sheath shall not be more than 20%, when tested as per IEC-60754.
- The maximum smoke density in percent light absorption should not exceed 60% in case of PVC compound and 20% in case of fire survival cables, when tested as per ASTM-D-2843.
- Swedish chimney test as per SS-4241475 class F3 and ladder test for flammability as per IEEE-383.
- The cables shall be tested for resistance to Ultraviolet radiation. The retention values of tensile strength and ultimate elongation after test shall be minimum 60% of tensile strength.

- Outer sheath of cable shall be subject to tests for water absorption. The methodology shall be as per IS 10810 part 33.

2.7.1.15 Joints and Terminations

Materials of construction for a joint/termination shall perfectly match with the dielectric chemical and physical characteristics of the associated cables. The material and design concepts shall incorporate a high degree of operating compatibility between the cable and joints. The protective outer covering (jacket) used on the joints/terminations shall have the same qualities as that of the cable outer sheath in terms of ambient/operating temperature withstand capability and resistance to hazardous environments and corrosive elements. No joints shall be allowed unless the cable drawn length is exceeded.

2.7.1.16 Cable Identification

Cable identification shall be provided by embossing the following on the outer sheath:

- *Manufacturer's name or trade mark*
- *Voltage grade*
- *Year of manufacture*
- *Type of insulation.*
- *Type of outer sheath e.g. "FRLS" etc.*
- *ISI marks*
- *Nominal cross sectional area of the conductor & no of cores*
- *Sequential marking*
- *Owner’s identification mark*

2.7.1.17 Tests

2.7.1.17.1 Type Test

For each type & rating of LV power and control cables, the Bidder shall submit for Owner’s approval the reports of all the type tests as per relevant standards and carried out within [last five] years from the date of bid opening. These reports should be for the tests conducted on the equipment similar to those proposed to be supplied under this contract and the test(s) should have been conducted at an independent laboratory.

In case the Bidder is not able to submit report of the type test(s) conducted within last five years from the date of bid opening, or in case the type test report(s) are not found

to be meeting the specification requirements, the Bidder shall conduct all such tests under this contract free of cost to the Owner and submit the reports for approval.

The list of type tests are as follows:

a) Tests on conductor:
   - o Annealing test (for copper)
   - o Tensile test (for aluminum)
   - o Wrapping test (for aluminum)
   - o Conductor resistance test.

b) Test for armouring wires/strips
c) Test for thickness of insulation and sheath
d) Physical tests for insulation and outer sheath:
   - o Tensile strength and elongation at break
   - o Ageing in air oven
   - o Shrinkage test
   - o Hot deformation
   - o Loss of mass in air oven
   - o Heat shock test
   - o Thermal Stability

e) Insulation resistance test
f) High voltage test (water immersion test)
g) High voltage test at room temperature
h) Flammability test

2.7.1.17.2 Routine Test

Cables shall be subject to acceptance and routine tests as per IS codes. Acceptance tests and FRLS test as specified earlier shall be conducted on cables and the same shall be witnessed by purchaser.

The FRLS test shall be carried out on one cable of each batch of compound used. Other acceptance tests shall be carried out on drums selected as per sampling plan as indicated in IS. Test certificates for routine acceptance and special tests shall be furnished by the Bidder for review and approval of purchaser.

2.7.1.18 Drawings, Data and Manuals

The following drawings/documents and calculation as listed below but not limited to shall be furnished along with the bid for review

Cable datasheets and cross sectional drawings

- Cable sizing calculation
- QAPs & Test Reports
- Relevant catalogues
- Estimated weight of cable and cable drum

2.7.1.19 Ratings and Requirements

- L.V. Power and control cables, 1100 V grade

S.No.	Technical Particulars	Unit	Parameters	Remarks
1.	System voltage		415 V	
2.	Voltage Grade		1.1 kV	
3.	Ambient Temperature		45oC	
4.	Maximum conductor temperature for continuous operation for XLPE/PVC cables		For XLPE: 90oC For PVC: 70oC	
5.	Maximum conductor temperature for short time operation for XLPE/PVC cables		For XLPE: 250oC For PVC: 160oC	

S.No.	Technical Particulars	Unit	Parameters	Remarks
6.	Conductor		For power cable: Aluminum	
			For Control Cable: Copper	
7.	Insulation		For power cable: XLPE/PVC	
			For Control Cable: PVC	
8.	Inner Sheath		Extruded PVC (ST-1)	
9.	Outer sheath		Extruded PVC (ST-1) with FRLS characteristic	
10.	Armored/ Un-armored		For power cable: Armoured	
			For Control Cable: Armoured	
11.	System Grounding		415 V system is solidly grounded.	
12.	Whether cores identifications numbers provided		To be provided	

S.No.	Technical Particulars	Unit	Parameters	Remarks
13.	Whether incremental running lengths are marked on cable.		By Bidder	
14.	Short circuit capability for 1 sec		50 kA	
15.	Maximum overall diameter of cables		By Bidder	
16.	Min. Bending Radius		By Bidder	
17.	Drum Details:		By Bidder	
18.	Length of cables in Drums and Volume + Tolerance		By Bidder	
19.	Weight of cable drum with cables		By Bidder	
20.	Weight of cable drum without cables		By Bidder	
21.	Type of end sealing		By Bidder	

S.No.	Technical Particulars	Unit	Parameters	Remarks
22.	Marking on cable drums as per IS required		By Bidder	

2.7.2 ..... Earthing System

2.7.2.1 General

This specification is intended to cover the design, Engineering, manufacture, assembly, testing at manufacturer's works, supply in properly packed condition for transport to site, Erection, site testing and commissioning of Earthing System complete with all accessories for efficient and trouble-free operation.

2.7.2.2 Codes and Standards

All equipment and materials shall be designed, manufactured and tested in accordance with the latest applicable Indian Standards (IS) / IEC as given below except where modified or supplemented by this specification.

IS:2629	Recommended practice for hot dip galvanizing of iron & steel
IS:2633	Method for testing uniformity of coating on zinc coated articles.
IS:3043	Code of practice for Earthing
IS:9537	Conduits for electrical installation.
IEEE:142	Grounding of Industrial & commercial power systems
CEA	CEA Regulations and standard technical specification for main plant package.

Equipment and material conforming to any other standard, which ensures equal or better quality, may be accepted subject to approval of the Owner. In such case, copies

of the English version of the standards adopted shall have to be submitted along with the bid.

The electrical installation shall meet the requirements of Indian Electricity Rules as amended upto date and relevant IS Codes of Practice. In addition, other rules and regulations applicable to the work shall be followed.

2.7.2.3 Installation

Electrodes

Plate electrode shall be buried in ground with its faces vertical, and its top not less than 3 m below the ground level. The installation shall be carried out as per standard drawing.

When more than one electrode is to be installed, a separation of not less than 3 m shall be maintained between two adjacent electrodes.

The strip or conductor electrode shall be buried in trench not less than 0.6 m deep.

If condition necessitate the use of more than one strip or conductor electrode, they shall be laid as widely distributed as possible, in a single straight trench where feasible, or preferably in a number of trenches radiating from one point.

Normally an earth electrode shall not be located closer than 2 m from any building. Care shall be taken to see that the excavation for earth electrode does not affect the foundation of the building; in such cases, electrodes may be located further away from the building, with the prior approval of the Engineer-in-Charge.

2.7.2.4 Watering Arrangement

In the case of plate earth electrodes, a watering pipe 20mm dia. medium class pipe shall be provided and attached to the electrodes. A funnel with mesh shall be provided on the top of this pipe for watering the earth.

The watering funnel attachment shall be housed in a masonry enclosure of size not less than 30cm*30cm*30cm.

A cast iron/MS frame with MS cover, 6 mm thick, and having locking arrangement shall be suitably embedded in the masonry enclosure.

2.7.2.5 Main Earthing Conductor

The earthing conductor shall be securely terminated on to the plate with two bolts, nuts, check nuts and washers.

A double C-clamp arrangement shall be provided for terminating tape type earthing conductor with GI watering pipe coupled to the pipe earth electrode. Galvanized "C" shaped strips, bolts, washers, nuts and check nuts of adequate size shall be used for the purpose.

The earthing conductor from the electrode up to the building shall be protected from mechanical injury by a medium class GI pipe. The protection pipe in ground shall be buried at least 45 cm deep (to be increased 65 cm in case of road crossing and pavements). The portion within the building shall be recessed in walls and floors to adequate depth in due co-ordination with the building work.

The earthing conductor shall be securely connected at the other end to the earth stud/earth bar provided on the switchboard by:

- Soldered or preferably crimped lug, bolt, nut and washer in the case of wire, and,
- Bolt, nut and washer in case of strip conductor.
- Earthing Terminal / neutral point / earth bus in case of equipments / sub stations.

2.7.2.6 Protective Earth Conductor

Earth terminal of every switchboard in the distribution system shall be bonded to the earth bar/terminal of the upstream switchboard by protective conductor(s).

Two protective conductors shall be provided for a switchboard carrying a 3 phase switch gear thereon.

All the mountings of industrial type switchboards shall be bonded to the earth stud/earth bar using a protective conductor looping from one to another. Loop earthing of individual units will not be however necessary in the case of cubical type switchboards.

The earth connector in every distribution board (DB) shall be securely connected to the earth stud/earth bar of the corresponding switchboard by a protective conductor.

All metallic switch boxes and regulator boxes in a circuit shall be connected to the earth connector in the DB by protective conductor.

The earth pin of socket outlets as well as metallic body of fan regulators shall be connected to the earth stud in switch boxes by protective conductor. Where the switch boxes are non-metallic type, these shall be looped at the socket earth terminals, switch or at an independent screwed connector inside the switch box. Twisted earth connections shall not be accepted in any case.

Double earthing strips in Main Feeder Pillar, Feeder Pillar etc. shall be securely connected to the earth bar/earth stud at the sending end switchboard. In the case of overhead bus bar systems, protective conductors shall be provided in addition to feeder cable armouring connection.

2.7.2.7 Connection of Earthing Conductors

Main earthing conductors shall be taken from the earth connections at the main L T panel to an earth electrode with which the connection is to be made. All joints in tapes shall be with four rivets and shall be brazed in case of copper and by welding bolting in case of GI, wires shall be connected with crimping lugs, all bolts shall have spring washers. Sub- mains earthing conductors shall run from the main distribution panel to the sub distribution panel. Final distribution panel earthing conductors shall run from sub-distribution panel.

Circuit earthing conductor shall run from the exposed metal of equipment and shall be connected to any point on the main earthing conductor, or its distribution panel. Metal conduits, cable sheathing and armouring shall be earthed at the ends adjacent to distribution panel at which they originate, or otherwise at the commencement of the run by an earthing conductor in effective electrical contact with cable sheathing. Where equipment is connected by flexible cord, all exposed metal parts of the equipment shall be earthed by means of an earthing conductor enclosed with the current carrying conductors within the flexible cord. Switches, accessories, lighting fitting etc. which are rigidly secured in effective electrical contact with a run of metallic conduit shall not be considered as a part of the earthing conductor for earthing purposes, even though the run of metallic conduit is earthed. The installation shall be complete in all respects for efficient and trouble free service. All work shall be carried out in a first class quality and neat workmanship. Grounding conductors shall be handled carefully to avoid kinking and cutting of the conductors during their installation. All exposed ground conductors run shall be taken in a neat manner horizontal, vertical

and parallel to the building walls or columns and shall not be laid haphazardly. All connections to the grounding grid shall be made with earthing strip welded to grid and bolted at equipment ends.

2.7.2.8 Prohibited Connections

Neutral conductor, sprinkler pipes, or pipes conveying gas, water or inflammable liquid, structural steel work, metallic enclosures, metallic conduits and lightning protection system conductors shall not be used as a means of earthing an installation or even as a link in an earthing system. The electrical resistance measured between earth connection at the main LT panel and any other point on the completed installation shall be low enough to permit the passage of current necessary to operate or circuit breakers, and shall not exceed 1 ohm. All switches carrying medium voltage shall be connected with earth by two separate and distinct connections. The earthing conductors inside the building wherever exposed shall be properly protected from mechanical injury by running the same in G I pipe of adequate size. The overlapping in strips at joints where required shall be minimum 75 mm. The joints shall be riveted and brazed in case of copper and by welding / bolting in case of GI in an approved manner. Sweated lugs of adequate capacity and size shall be used for termination of all conductor wires above 6 sq.mm size. Lugs shall be bolted to the equipment body to be earthed after the metal body is cleaned of paint and other oily substances and properly tinned. Equipotential bonding of all metallic structures shall be done.

2.7.2.9 Earth Resistance

The earth resistance at each electrode shall be measured. No earth electrode shall have a greater ohmic resistance than 2 ohms as measured by an approved earth testing apparatus. In rocky soil the resistance may be up to 5 ohms.

Where the above stated earth resistance is not achieved, necessary improvement shall be made by additional provisions, such as additional electrode(s), different type of electrode, or artificial chemical treatment of soil etc., as may be directed by the Engineer-in-charge.

2.7.2.10 Marking

Earth bars/terminals at all switchboards shall be marked permanently either as "E" with green colour.

Main earthing terminal shall be marked "SAFETY EARTH - DO NOT DISCONNECT".

2.7.3 ..... 415V SWITCHGEAR, FEEDER PILLAR and DB

*Please refer the Technical Specification of Power Infrastructure Appendix at section **1.13.26** for the same subject.*

2.7.4 ..... Street Poles

2.7.4.1 Scope

The scope of this specification covers the manufacture, transport, installation, testing and commissioning of the complete Street lighting system, including the Civil Foundation Works and other allied works as per BOQ.

2.7.4.2 Design Criteria

Design: The Conical Poles shall be designed to withstand the maximum wind speed as per IS 875. The top loading i.e. area and the weight of fixtures are to be considered to calculate maximum deflection of the pole and the same shall meet the requirement of BSEN 40-2- 1 & 3.

Pole Shaft: The pole shaft shall be made from sheet steel confirming to BSEN 10025 having yield strength of 355 N/sqm. The pole shaft shall have circular cross section and shall be continuously tapered with single longitudinal welding. There shall not be any circumferential welding. The welding of pole shaft shall be done by Submerged Arc Welding (SAW) process.

All Conical pole shafts shall be provided with the rigid flange plate manufacture from MS FE410 confirming to IS: 2062 of suitable thickness with provision for fixing 4 foundation bolts. This base plate shall be fillet welded to the pole shaft at two locations i.e. from inside and outside. The welding shall be done as per qualified MMAW process approved by Third Party Inspection agency.

Door opening: The Conical Poles shall have door of approximate 500 mm length at the elevation of 500 mm from the Base plate. The door shall be vandal resistance and shall be weather proof to ensure safety of inside connections. The door shall be flush with the exterior surface and shall have suitable locking arrangement. There shall also be suitable arrangement for the purpose of earthing.

The pole shall be adequately strengthened at the location of the door to compensate for the loss in section.

Welding: The welding shall be carried out confirming to approve procedures duly qualified by third party inspection agency. The welders shall also be qualified for welding the Conical shafts.

Pole sections: The Conical Poles shall be in single section (up to 9 mtr). There shall not be any circumferential weld joint.

Galvanization: The poles shall be hot dip galvanized as per BSEN ISO 1461 standard with average coating thickness of 70 micron. The galvanizing shall be done in single dipping.

Fixing Type: The Conical Poles shall be bolted on a pre-cast foundation with a set of four foundation bolts for greater rigidity.

Top Mountings: The galvanized mounting bracket shall be supplied along with the Conical Poles for installation of the luminaries.

Pole Testing Facility: The Manufacturing unit shall have in house pole testing facility for validation for structure design data. The Pole testing facility shall be as per BSEN 40 – 2 1 & 3.

The bidder should be ISO 9001 certified having their own marketing division and project cell with adequate qualified and experienced Engineers to carry out the job and must have experience of handling similar turnkey jobs in past and the proof of the same is to be furnished for issue of tender documents.

The bidder has to specify the name of manufacturer of Conical Poles and has to submit an authorization letter for technical assistance from manufacturer of Conical Poles with bid documents. This may not be applicable if manufacturer themselves is a bidder.

The Conical Poles manufacturer should have in-house civil, structural and product design facilities and the shaft is to be manufactured from ISO 9001, ISO 14001 and OSHAS 18001 certified factory taking care of all aspects of design, quality, environment and safety. The manufacturer of Conical Poles must have minimum 10 years of manufacturing experience.

The poles have to be manufactured by CNC Controlled plasma sheet cutting and bending machine and fully Automated Submerged arc welding machine for longitudinal welding of shaft and welding to be carried out by experienced and certified welders.

Manufacturer should have in house test facility to test Pole as per BSEN 40-2-1 & 3 and submit steel test certificate showing silicon content less than 0.04%. Structural calculation of Poles should be vetted from reputed institute like IIT or structural consultant.

Poles, bracket, foundation bolts, and fixture should be of one make. Test certificate of steel manufacturer and Pole manufacturer specifying grade of steel used for Poles.

2.7.5 ..... Lighting Fixture

2.7.5.1 Scope

The scope of this specification covers the manufacture, transport, installation, testing and commissioning of the complete Street lighting system, including the Civil Foundation Works and other allied works as per BOQ.

2.7.5.2 Control Gear

The luminaries shall be of integral design with the electronic control gear mounted inside the body of the luminaries. The luminaire should have a potted driver. The control gear specification shall be confirming to the specifications mentioned below:

Electrical Specifications of LED Driver

LEDs – LEDs used in the luminaire should be one of Approved makes.

S.No.	Criteria	Specification for LED street light fitting
	Universal Input Voltage	240 V AC ± 5% (140V to 270V Operating Range)
	Input Frequency	50 Hz ± 3%
	Surge & Spike Protection	5 KV
	THD (I)	< 10%
	Driver Efficiency	> 85%
	Operating Temperature	0 to 50 DEG C
	IEC Compliance	Confirming to IEC- 61347-1 & IEC 61347-2-13, IEC 61547, 610-3-2, CISPR-15

LED Streetlight Specification in Tabular Format:

S.No.	Criteria	Specification for LED street light fitting
	Luminaire configuration / technical requirement	Side entry type. Shall consist of separate optical and control gear compartment. Driver should be easily replaceable in the field condition
	Housing / Body of fitting	High pressure die cast Aluminum LM6 housing with corrosion resistant polyester powder coating with name engraved / logo embossed into the housing to allow traceability till the end of life (stickering / printing is not acceptable)
	Finish	Aesthetically designed housing with Black / Silver Grey color corrosion resistant polyester powder coating
	Fixture Cover	Heat resistant toughened glass
	Glare control details	Luminaire light distribution should have zero candela intensity at an angle of 90 degree and more.
	Protection – IP	IP- 66
	Impact resistance	Impact resistance greater than or equal to IK 07
	Input Voltage	240 V AC ± 5% (140 to 277 V Range)
	Frequency	50 Hz ± 3%
	Power factor	>= 0.95
	Fixture designed ambient Temperature	+ 45 degree C
	Operating temperature	Range 0 to + 50 degree C
	Working Humidity	10% to 90% RH
	Storage Temperature	0 to 45 degree C

S.No.	Criteria	Specification for LED street light fitting
	Total Current Harmonic distortion	Total Current Harmonic Distortion should be lesser than 10 %
	LED efficacy (lumen/watt)	Efficacy of LED should be greater than 130 lumens / watt.
	LED Luminaire efficacy	>100 lumen/watt +/- 5%
	Power efficiency / LED driver efficiency	The efficiency of the electronic driver shall be more than 85 % in all cases at all times during project period.
	Lumen maintenance	Life span of LEDs used in the Luminaire shall be more than 50,000 hours at 70% light output.
	Correlated Color temperature	Correlated Color Temperature shall be nominal 3000K (with variation limits of ±355K) per ANSI C78.377A CCT standard.
	CRI	The value of CRI shall be more than 70.
	Make of LED	Nichia /CREE /Lumileds / OSRAM /Seol approved by client. The LED shall be of Surface Mounted Design. (>1W<3W)
	LED Drive Current	Not more than 90% of the rated current carrying capacity of LED
	Driver Specification	AC universal electronic potted drivers with internal surge protection of 5 kV, having multi-level step dimming facility and should be compatible with automated outdoor street lighting control system through compatible interfacing units. External surge protection of 10KV (DM/CM) within an enclosure inside the luminaire, the driver should be isolated type for protecting the LED Boards from abnormalities

S.No.	Criteria	Specification for LED street light fitting
	Electrical safety as per IEC.	As per IEC safety standards IEC61000 / IS 16104 :2012 / IS 15885 (Part 1) 2011 / Part 2/ Sec 13 - 2012
	Conformation standards of luminaire	The luminaire conform to IEC 60598 / IS 10322 Part 5 Sec 3. Type test certificate should be provided with the technical bid as per IS 10322 Part 5 Sec 3.
	Reports / certifications	NABL accredited lab only for luminaire & driver
	Test reports of luminaire	The luminaire should be tested as per IEC 60598 standards and following test reports should be submitted: Heat Resistance Test, Thermal Test, Ingress Protection Test, Electrical / Insulation Resistance Test, Endurance Test, Humidity Test. The luminaire should be tested for 'Drop test' as per IEC 60068-2-31/IS9000 Part 7 / Sec 3 standards. The luminaire should be tested for 'Vibration test' as per ANSI/IEC 68-2-6 standards. Should comply with IESNA LM-79 (Approved method for the Electrical and Photometric Measurements of Solid-State Lighting Products). The Photometric distribution & electrical parameters should be tested at all dimming wattages The LED used should comply to LM-80 standards (IESNA: Approved Method for Measuring Lumen Maintenance of LED Light Sources and LED lumen depreciation time to L70 based on LM-80 data) Copy of above test certificates should be submitted with tender. Random samples from supplied lot should be tested at NABL accredited laboratory and report submitted for acceptance.as requested by the department.

S.No.	Criteria	Specification for LED street light fitting
	Serial number	LED street light fitting should be supplied with serial number which should be attached to the fitting. The label should mention: Name of Manufacturer, model name and number, system lumen pack, nominal CCT, Wattage of fitting, Date of Manufacture, and other labeling details as per IS.
	The photometric distribution of the shall be based on the required lighting parameters mentioned in the tender elsewhere (as per table 1)	Valid LM 79 tested at all dimming wattages for each luminaire from NABL approved UL/ERDA/ERTL laboratory only. Soft copy of the IES file to be submitted along with the tender.
	Design Parameters	The luminaire should be able to match road lighting parameters (lux levels >= 30 lux & uniformities with a maintenance factor = 0.8. The luminaire should be able to match Footpath, Cycle track of road lighting parameters (lux levels >= 20 lux. for a typical road with a maintenance factor = 0.8,

2.7.5.3 Smart System Functional Compliance

S.No.	Specification	Compliance (Yes/No)	Remarks
	Ability to control individual lights based on commands and policies		
	The smart light should be using technologies like 0-10V or DALI or any variant of these for providing controlling of LEDs		

S.No.	Specification	Compliance (Yes/No)	Remarks
	The smart light control nodes must use industry standard RF technologies like Wi-Fi, 802.15.4, Zigbee, LoRA or GPRS as connectivity options		
	The system should support reading, monitoring of various electrical parameters like Voltage, Current, Power Consumption etc. at each light.		
	The system should have the ability to detect faults in individual lights and sent alerts and notifications to the management system		
	The system should have ability to control the ON/OFF/Dimming operation of the Luminaire centrally.		
	The smart street lighting system should be able to operate at any weather conditions		
	The smart street lighting system should preferably be communicating using RF. Other allowed technologies can be ZigBee, LoRA and IEEE 802.15.4		
	The smart street lighting system should be able to communicate to the Lighting Operations Management software hosted on the cloud (Preferably)		
	The smart street lighting system should have the capability to receive the instruction from the Lighting Operations Management software and act accordingly		
	The smart street lighting system should be able to operate the lights switch on/off, increase/decrease luminosity (Dimming) as per the command received from the Lighting Operations Management software		

S.No.	Specification	Compliance (Yes/No)	Remarks
	The Lighting Operations Management software should have the capability to apply policies to the smart lighting system.		
	Example: set up policies like light up alternate lights during low traffic density, increase the luminosity of the lights as per the dullness of the day lights		
	The city administration should be able to see the real time status of the Smart Lighting System on a city map view of the Lighting Operations Management software		
	The city administration should be able to operate the Smart Lighting System manually too.		
	The smart lighting system should be able to communicate the system issue or failure to the Lighting Operations Management software.		
	The smart lighting system are preferably a combination of LED lights and sensors		
	The individual lights are to be monitored by electronic controller using a long range radio frequency communication technology		
	The controller should be able to operate autonomously as per the defined schedules and light level sensors		
	Should enable Over the Air (OTA) firmware update		

2.7.6 ..... Switching Point Controller

2.7.6.1 Scope

The scope of this specification covers the manufacture, transport, installation, testing and commissioning of the complete Street lighting system, including the Civil Foundation Works and other allied works as per BOQ.

2.7.6.2 Switching Point Controller (SPC) Requirements

1. Wireless Technology – The complete system configuration and control shall be achieved remotely through wireless technology by using GPRS to communicate between switching point controller & Server and shall communicate through RF communication (ZigBee Mesh Topology) between Switching point controller & Street light Control Unit (node) of each street light
2. Manual ON/OFF/Dimming of lights of a particular switching point or networked switching points from Central Control Station.
3. Automatic ON/OFF/Dimming of lights of a particular switching point based on Sunrise/Sunset time depending on geographical location of switching point. Astronomical clock shall be built in feature of Switching point controller.
4. Automatic ON/OFF/Dimming of lights of a particular switching point or networked switching points based on preprogrammed time schedule.
5. Intensity Control/Dimming – Switching Point Controller shall able to communicate with Street Light Nodes through Zigbee RF mesh based communication and send commands to set/control Intensity level (10%-100%) of street Lights
6. Configuration & Control - Options are available to configure and control individual street lights (node) or a group of street lights (nodes) through Switching Point Controller
7. Remote Monitoring – Switching Point Controller shall able to measure and sends status such as
    a. Phase wise AC Voltage,
    b. Phase wise AC Current,
    c. Phase wise Power,
    d. Active Energy,
    e. Apparent Energy,
    f. Operating Hours of group of street lights power under SPC.

8. SPC shall also communicate with each Luminaire to get individual light status such as
    a. Voltage,
    b. Current,
    c. Power,
    d. Active Energy,
    e. Apparent Energy,
    f. Usage Hours etc.
9. Fault Monitoring - This system incorporates automatic fault detection algorithm to identify various faults and fault details can be viewed in Web Application. Faults Includes
    a. Low Voltage,
    b. High Voltage,
    c. Over Load,
    d. Short Circuit,
    e. Panel Door Open,
    f. Excess Power Consumption due to power thefts,
    g. Abnormal Power Variations,
    h. RF failure,
    i. Driver failure,
    j. Real Time Clock failure,
    k. EEPROM failure,
    l. GPRS failure.
10. System Protection – System shall protect Group of Lights powered through SPC from High Voltage, Low Voltage conditions. System has mechanism to cut off voltage to streetlights in such line fault conditions. These cut off levels should be programmable through web- application.
11. Battery Backup – Switching point controller should have maintenance free rechargeable sealed lead acid battery which can supports backup up to 72 hours.
12. 3-Phase Energy meter – SPC shall consists of Built in 3-phase energy meter with built in Voltage and Current sensors with RS485 interface. Energy meter shall be of IS13779, CBIP-304 certified.
13. Switching point controller Unit supports analog measurement and supports 2 x Analog voltage, 2 x Current input measurement channels

14. Switching point controller Unit supports 2 x Isolated Digital input and 2 x Isolated digital output channels
15. Switching point controller VA rating is designed for twice the lighting load requirement.
16. Safety – SPC shall have hardware consists of MCCB and Fuses which protects system and operators in case of electrical malfunction.
17. SPC shall have at least 2 nos. contactors and Isolators for proper load distribution and ease of wiring.
18. SPC Shall have powder coated Metallic Enclosure having ingress protection level of IP65 grade.

2.7.6.3 SPC Hardware Requirements -

S.No.	Parameter	Feature Description
1.	Operating Voltage Range	120V to 310V AC SPC shall able to operate even when input voltage of 440V between phase and neutral
2.	SPC Capacity	20KVA (6.6KVA per Phase) at 230V
3.	Energy Meter	SPC shall have Phase 4 Wire 10A-60A AC Energy Meter with IS: 13779. Energy Meter shall have built in Voltage and Current measurement sensor. No external sensors like CT or Shunts are permitted to use for Energy measurement Energy Meter shall have RS485 interface to communicate with Street Light Gateway
4.	3 phase Power Supply with Battery Charger	SPC shall have 3 phase Power Supply Unit with built in battery charger circuit to recharge 12V/7aH battery Operating Voltage Range – 120V to 310V with 440V Protection 3 Phase power supply shall have dual output voltages 24V and 12V.

S.No.	Parameter	Feature Description
		It shall have options to provide 24V voltage for Contactor operation. Shall operate with 3phase and 1 phase AC input Battery charger shall have short circuit protection, battery management capabilities, under voltage cutoff, over charging cutoff features.
5.	Battery	SPC Shall have battery preferably 12V/7Ah rechargeable as battery back up
6.	Fuses	SPC shall have 63A rated fuse for each phase
7.	MCCB	SPC Shall have 100A MCCB with reputed make
8.	Contactor	SPC shall have at least 2 3phase 4-wire DC/AC Operated Contactors with current rating of 60A or above.
9.	Isolators	SPC shall have at least 2 60A Isolators to isolate automation system during maintenance or fault condition
10.	Street Light Gateway	Operating Voltage: 12V-24V DC Communication with server – GSM/GPRS Quad band: 850/900/1800/1900MHz Communication method – TCP/IP Via GPRS Security - SSL Communication with Street Light Controllers – 2.4GHz Zigbee SLG incorporated in SPC shall have built in astronomical clock for ON/OFF/dimming luminaires based on GPS locations Manual ON/OFF/Dimming of lights of a particular switching point from Central Control Station

S.No.	Parameter	Feature Description
		SLG shall capable of adjusting Real Time clock based on server input and it can also support period sync based on predefined intervals. SLG Unit shall have analog measurement and supports 2 x Analog voltage, 2 x Current input measurement channels SLG Unit shall support 1 x Isolated Digital input and 1 x Isolated digital output channels SLG can be remotely configurable through server. SLG Shall have on board Serial Communication: RS485 Communication Protocol - Street Light Gateway supports RS485 MODBUS communication and HTTPS support for Wireless communication with server.
11.	Protections and Fault detections	SPC shall have 3 phase 10KV Surge Protection Device to protect SPC Circuits SPC shall have Door Open detect switch SPC shall capable of shut off power to street light luminaires when voltage drops below 120V and exceeds above 310V. Auto recovery shall happen during normal voltage operation. The voltage cut-off/cut-in and high voltage cut-off/cut-in shall be real time programmable as per field conditions SPC Shall have short circuit protection feature

S.No.	Parameter	Feature Description
		SPC shall report if Automation Bypassed using Isolators SPC shall support Contactor failures SPC shall report Power Supply Failure SPC shall Report E-meter communication failure SPC Shall measure Battery and Power Supply voltages. Shall provide voltage profile at web application SPC shall detect over loading due to power theft or other issues
12.	Antennas	SPC shall have external high gain (Minimum 5dBi) antennas for GPRS and 2.4GHz ZigBee communication. Proper Network Antennas shall be used for 2.4GHz ZigBee communication for better signal propagation
13.	Terminal Blocks	SPC Shall have 3 Terminal blocks of 100A Ratings. 1 at input side and 2 at output side
14.	OTA Upgrade	Street Light Gateway Software shall support OTA Upgrade facility through remote server
15.	Communication Module Certification	GPRS and ZigBee communication module used shall be CE/FCC certified
16.	Enclosure	Metallic, MS – Minimum 1.6mm body thickness and 2mm thickness for door It shall have lock mechanism
17.	IP	IP65
18.	Bus Bars	SPC Shall have Bus bars internally for proper wiring arrangements.
19.	Mounting Options	SPC shall have options for wall mounting as well as floor

S.No.	Parameter	Feature Description
		mounting

2.7.7 ..... Web Application & Server

2.7.7.1 Web based Application Software –

Enables comprehensive features to Monitor, control and manage streetlights, which displays live and historical data with remote configurations features.

Web application features –

1. Configuration and Control – Allows user to communicate with individual and networked switching points and Individual/Group of Streetlights remotely.
2. Fault Alarms/Alerts –
    a. Switching point failures,
    b. Network Down failures,
    c. Group Luminaires failure,
    d. excess voltage/current drawn,
    e. Mains power failure,
    f. Contactor failure.
3. Google Map – Allows user to trace switching points through Google maps.
4. Reports – Allows user to generate various reports like
    a. energy consumed,
    b. Device failure reports,
    c. Uptime %,
    d. Monthly burning reports of SPC and
    e. Burning hour report of each Luminaire.
5. Remote configuration – It shall be possible to configure switching points through we application. Remote configuration includes new ON/OFF/Dimming timings, RTC time, Real time data of each switching point, Energy meter parameters
6. Web application shall enable user safety with multiple user privileges and differentiates admin/general users.
7. Web application shall support asset management feature.
8. It shall able to configure and control Group and Individual Street Light Luminaires through web application.

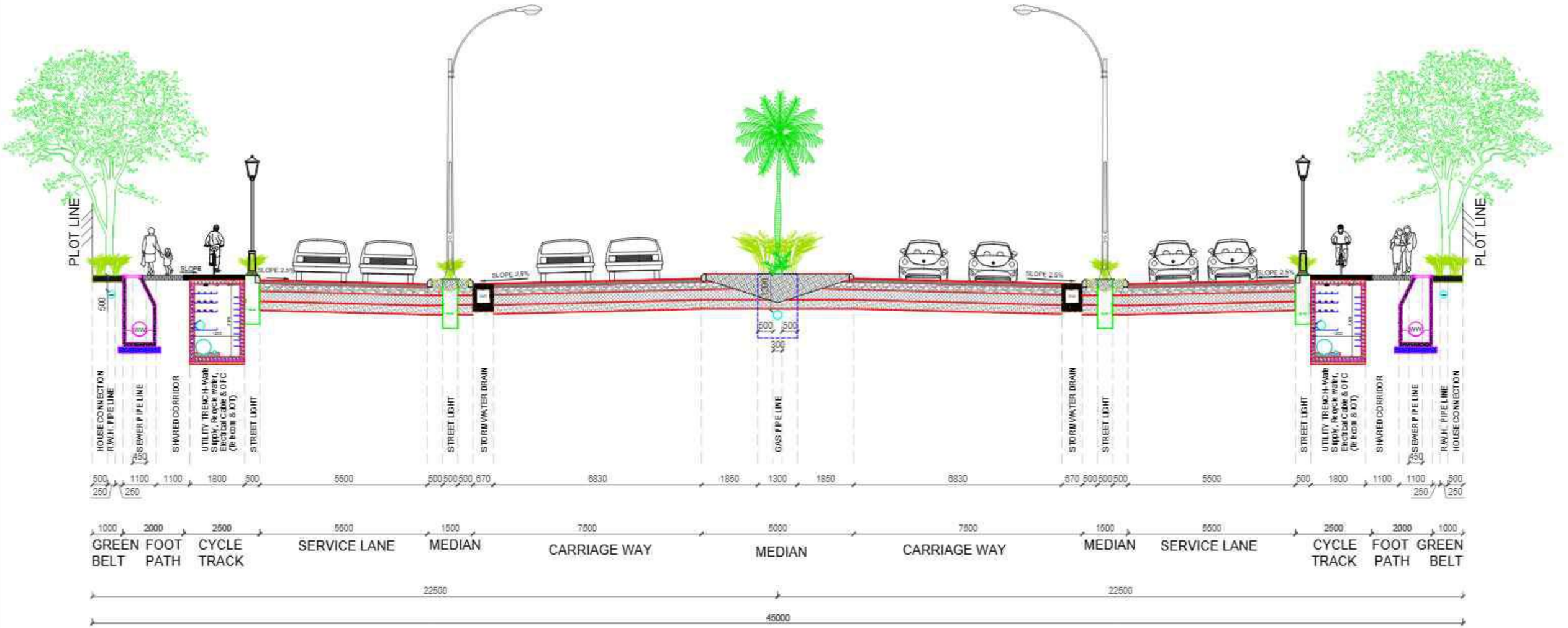
9. Web API – The system shall support Web APIs for City Platform Integration at command center
10. Web Application shall indicate user about command status – Success/Failure
11. System is fail proof with password protection
12. Heat map – Web application software shall enable user to identify system faults easily through user friendly heat maps
13. Dashboard – Web application shall provide comprehensive dashboard with real time status of switching point, real time faults of various switching points, power consumption, life power consumption, graphical representation of cumulative data etc.
14. SMS and Email alerts – Web based software offers SMS and Email alerts for various faults. Also, provides monthly reports through email.
15. Minimal interval of data update – 15 mins and programmable up to 1 min
16. Asset Management – Web application software shall support asset management feature and allows user to locate SPC and streetlight through GPS coordinates. It also enables user to identify each SPC with unique/Asset ID with additional information like Wattage, Make, Installation date, replacement date, Replacement defect tracking. It is also possible to link details of every streetlight with reference to particular switching point.

2.7.7.2 Server Requirements –

1. Cloud Based server shall be of dedicated Windows server (IIS) with minimum of 16GB RAM
    - software pre-requisites
        - ASP.NET4
        - MySQL Server
        - MySQL Workbench
2. Server/Cloud platform provider shall have capable to perform auto backup and restore facilities.
3. Server/Cloud platform provider shall have regular maintenance of the server and immediately address in case of server down.
4. Server/Cloud platform shall have minimum uptime of 99%
5. Server/Cloud should able to handle minimum of 1000 concurrent connection.

TENDER DRAWINGS

ROADS



45m ROW

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4												Concept
3												DPR/DPR
2											SHEET SIZE	Tender Drawing ✓
1												Revision R0
0			BBD	A.I.T.	P.B	S.B.R.	CONSULTANT : Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.		DRAWING TITLE :	TYPICAL CROSS SECTION - ROW 45M	A2	Date FEB. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY			DRAWING NO :	VSPL/IPD/2324-066/DPR/TCS/01		
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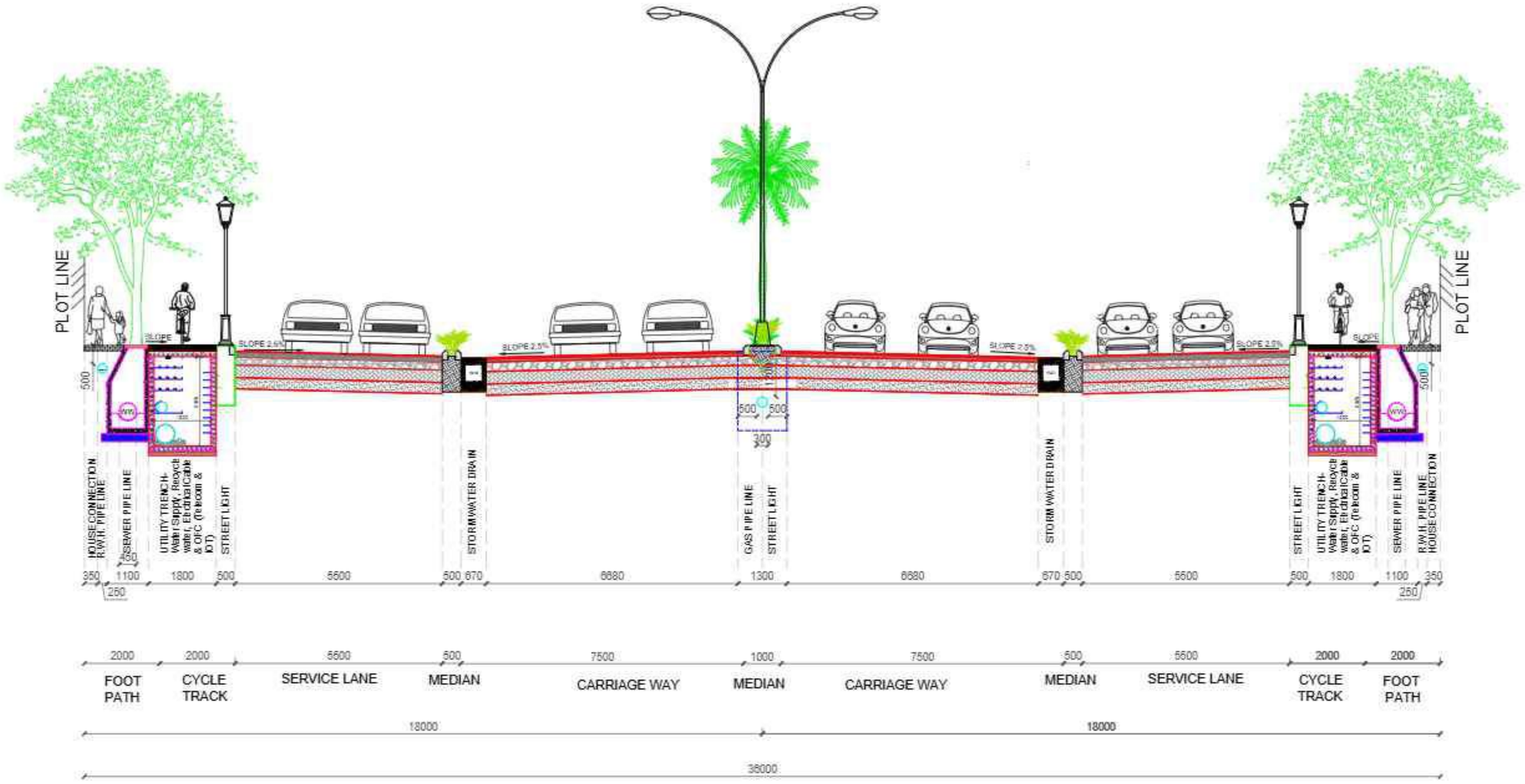
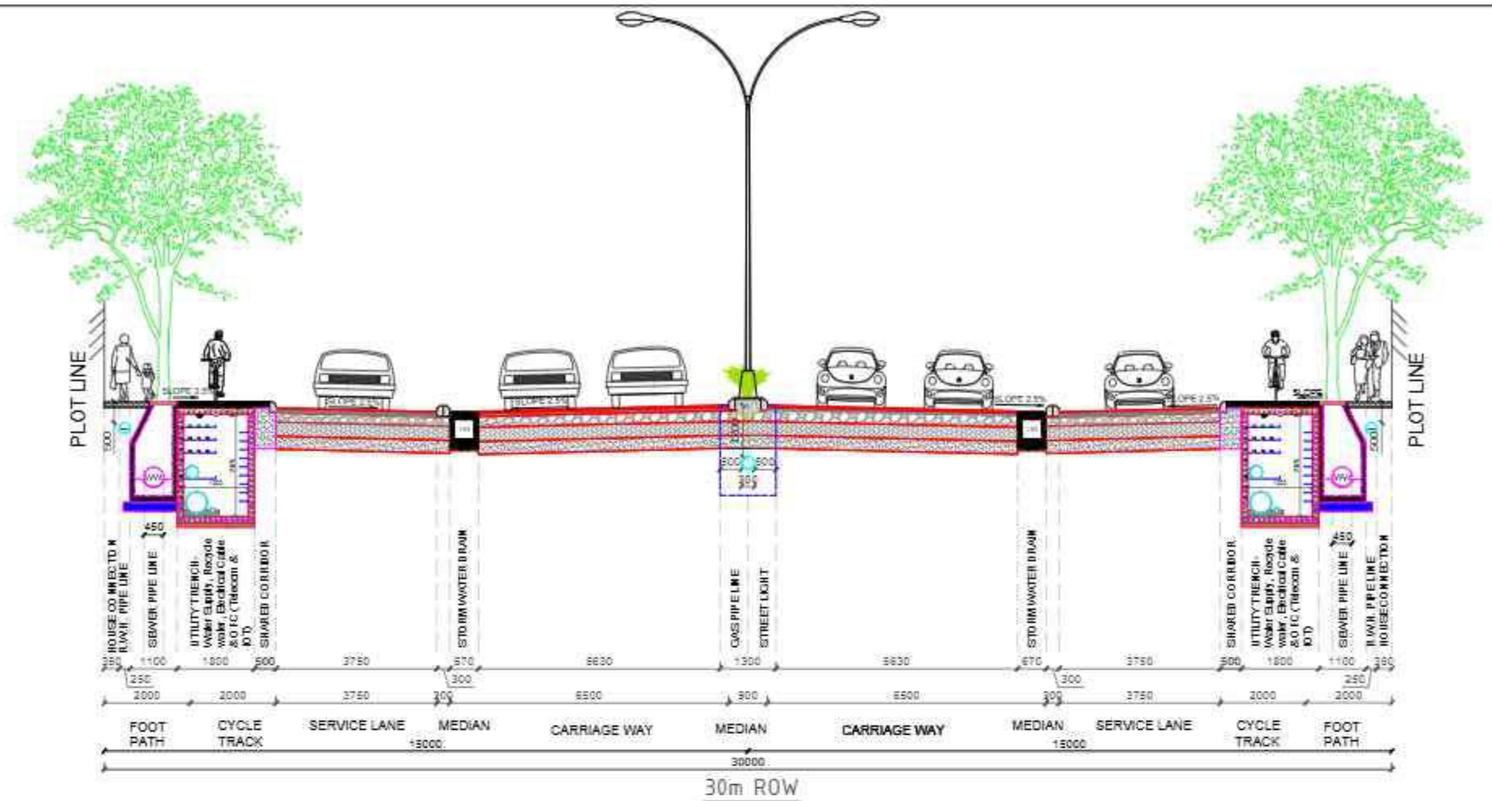
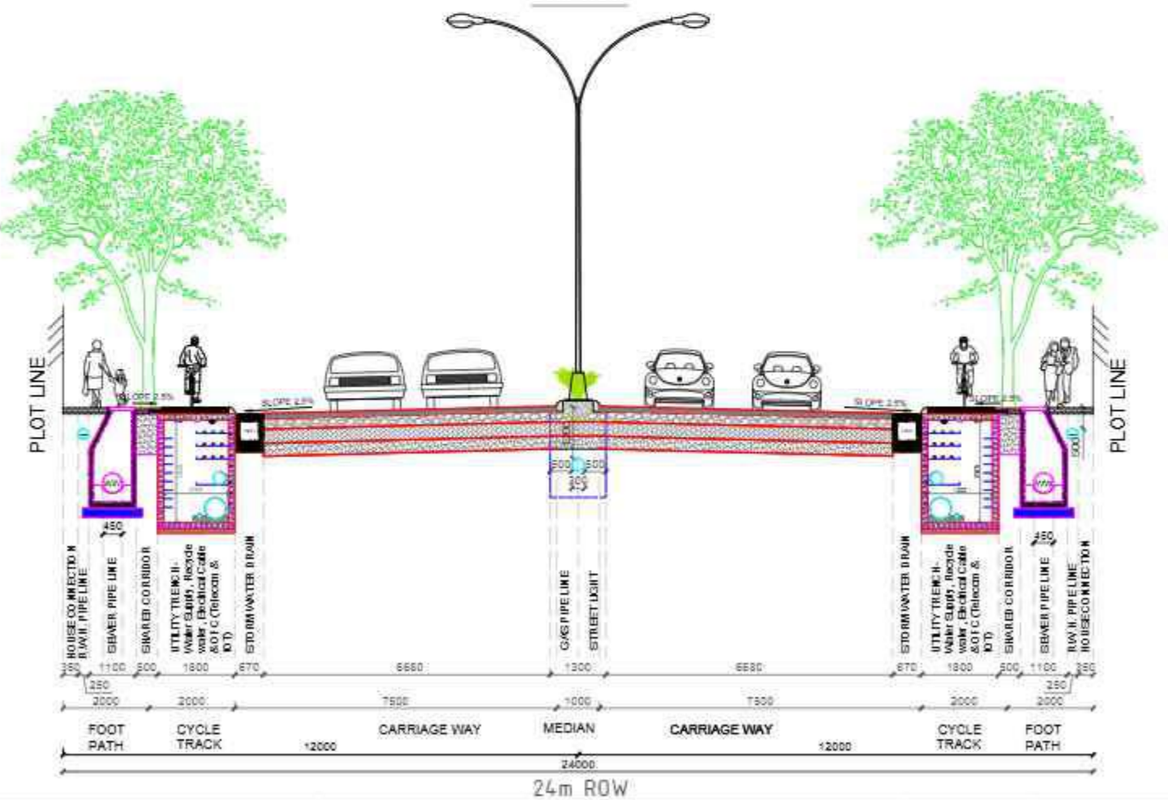


36m ROW

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (M)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.		N W E S	ISSUE RECORD / APPROVED FOR ISSUE
4												Concept
3												DPR/DPR
2												Tender Drawing ✓
1											SHEET SIZE	Revision RD
0			BBD	A.I.T.	P.B	S.B.R.	CONSULTANT :		DRAWING TITLE :	TYPICAL CROSS SECTION - ROW 36M	A2	Date FEB. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY	Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.		DRAWING NO :	VSPL/IPD/2324-066/DPR/TCS/02		
									GRAPHIC SCALE :			

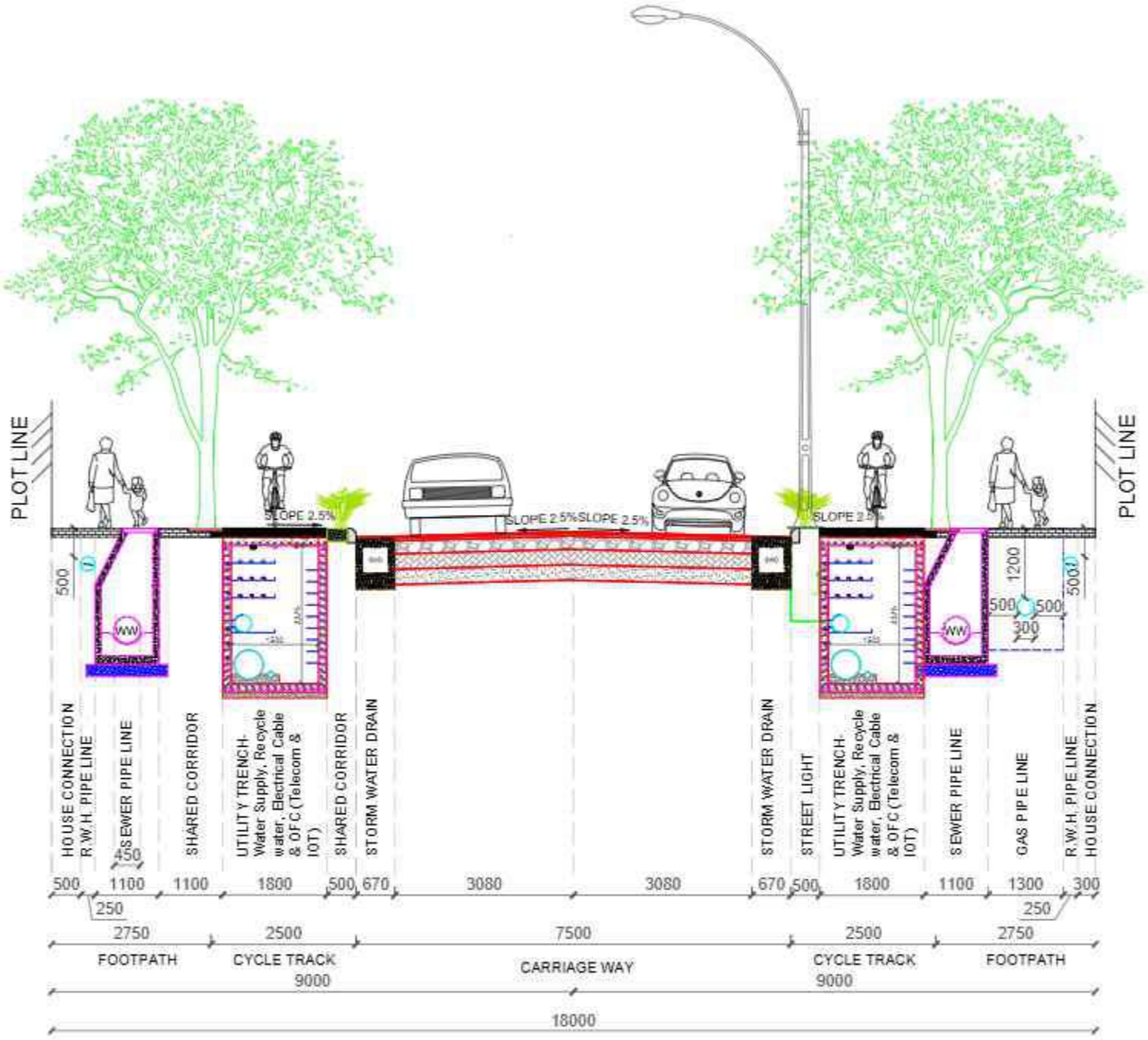


30m ROW



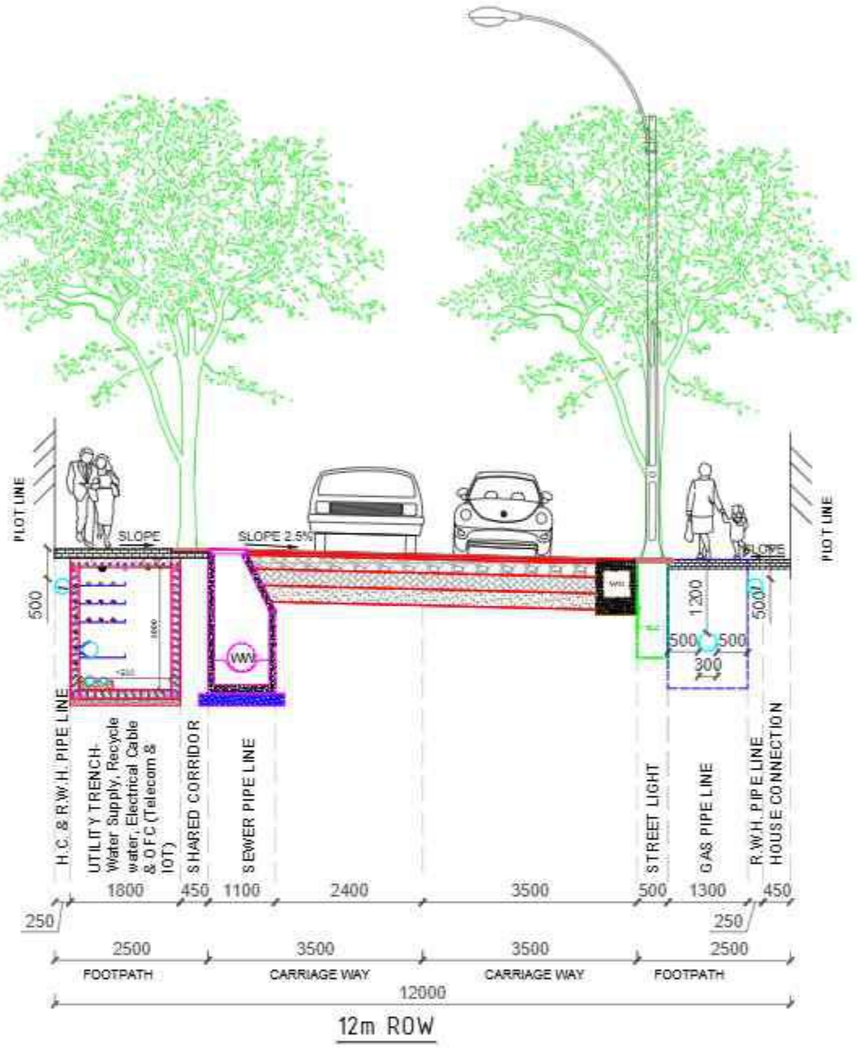
24m ROW

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (M)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.		N W E S	ISSUE RECORD / APPROVED FOR ISSUE
4												Concept /
3												DPR/DPR /
2							CONSULTANT : Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.		DRAWING TITLE :	TYPICAL CROSS SECTION - ROW 24 M & 30M		Tender Drawing / ✓
1									DRAWING NO :	VSPL/IPD/2324-066/DPR/TCS/03	SHEET SIZE A2	Revision / R0
0			BBD	A.J.T.	P.B	S.B.R			GRAPHIC SCALE :			Date / FEB. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY						

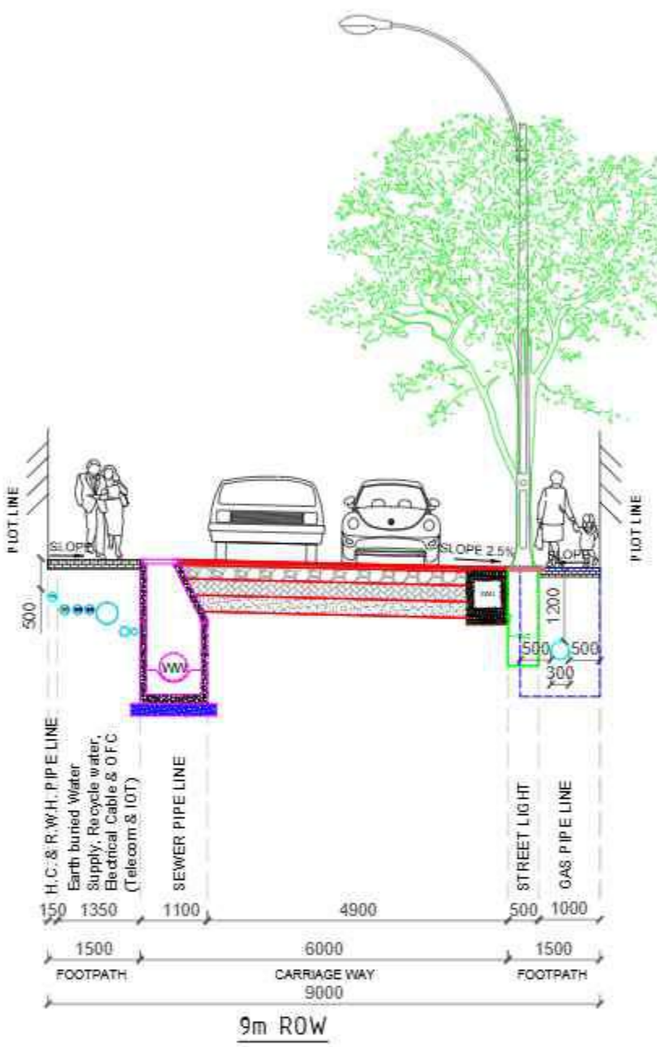


18m ROW

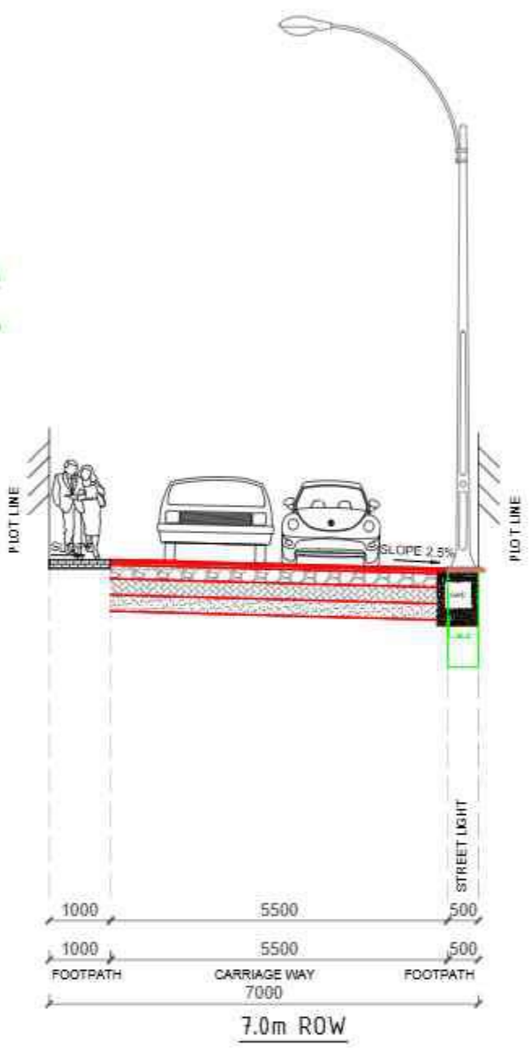
REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (M)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.		N W E S	ISSUE RECORD / APPROVED FOR ISSUE
4												Concept
3												DPR/DPR
2							CONSULTANT :		DRAWING TITLE :	TYPICAL CROSS SECTION - ROW 18M		Tender Drawing ✓
1							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.		DRAWING NO :	VSPL/IPD/2324-066/DPR/TCS/04	SHEET SIZE	Revision RD
0									GRAPHIC SCALE :	0 50 2500 5000	A2	Date FEB. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY						
			BBD	A.J.T.	P.B	S.B.R						



12m ROW



9m ROW



7.0m ROW

REVISION BLOCK		
5		
4		
3		
2		
1		
0		
REV.	DATE	DESCRIPTION

QUALITY ASSURANCE
The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency

DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY
BBD	A.I.T.	P.B	S.B.R

CLIENT :
Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT :
Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE : PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.

DRAWING TITLE : TYPICAL CROSS SECTION - ROW 7.5 M, 9M & 12M

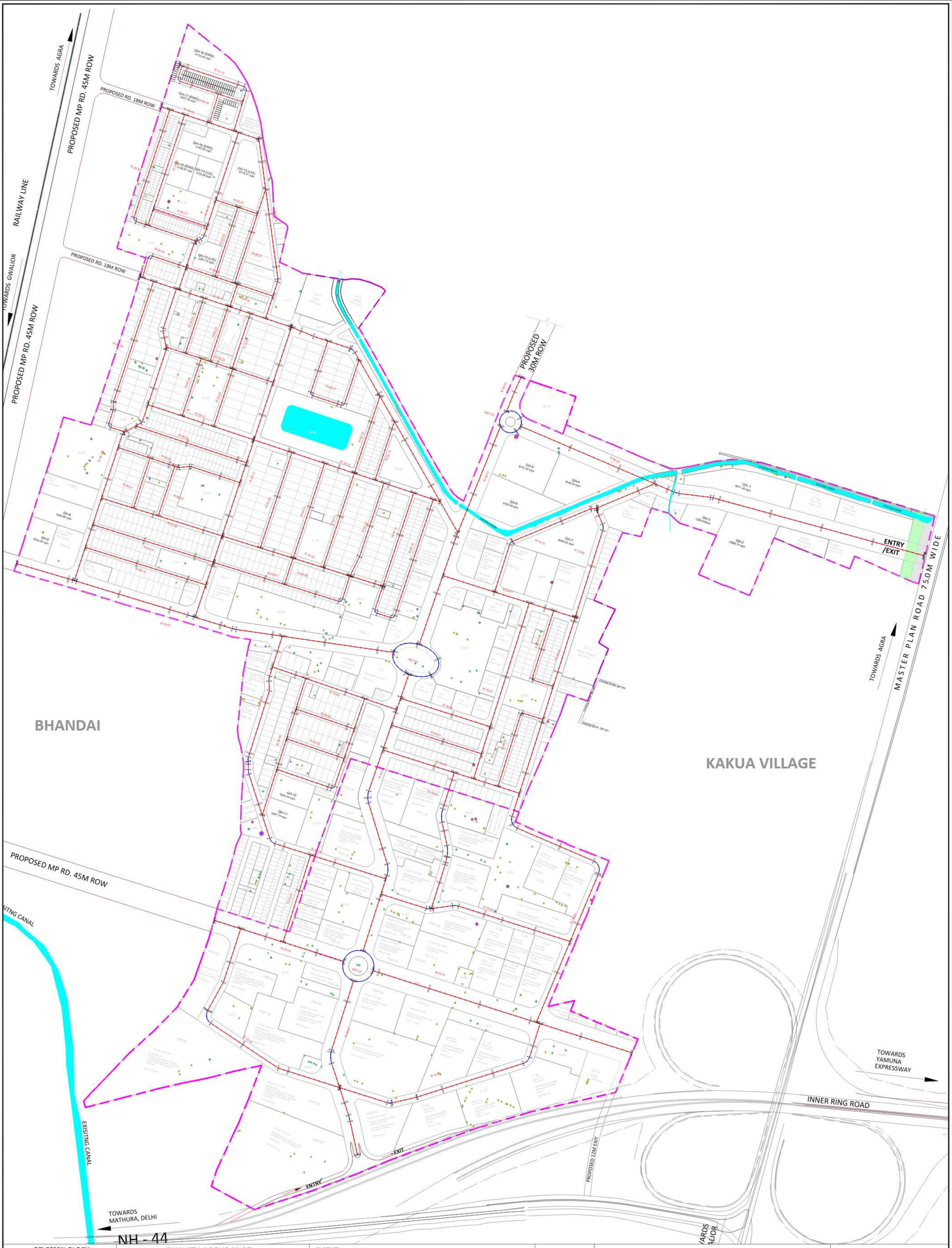
DRAWING NO : VSPL/IPD/2324-066/DPR/TCS/05

GRAPHIC SCALE : 0 50 2500 5000

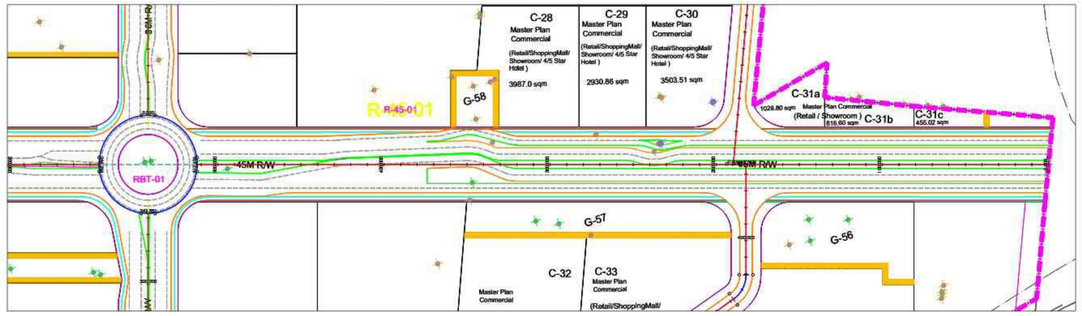
NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DPR/DPR	
Tender Drawing	✓
Revision	RD
Date	FEB. 2025

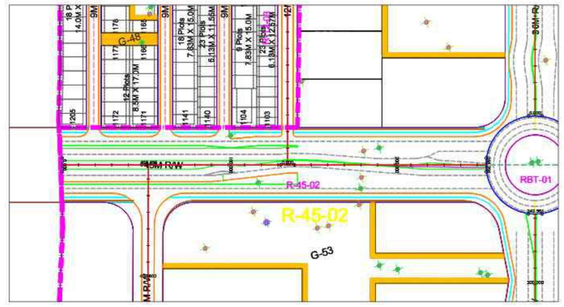
SHEET SIZE : A2



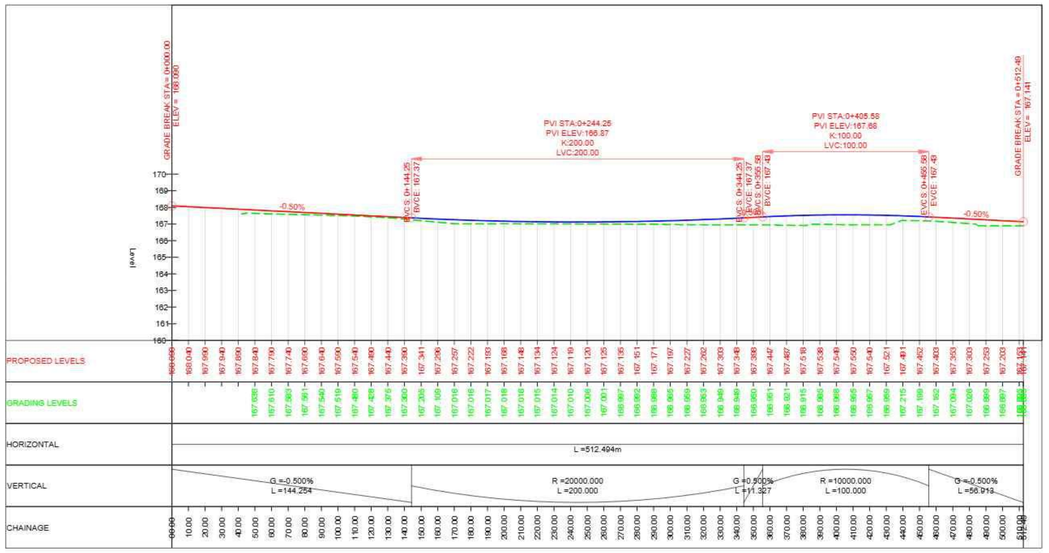
REVISION BLOCK							QUALITY ASSURANCE	CLIENT :	PROJECT TITLE :	NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)	
5							The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency	Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010	**PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.**		
4										ISSUE RECORD	APPROVED FOR ISSUE
3										Concept	
2								CONSULTANT :	DRAWING TITLE : ROAD NETWORK PLAN	DFR/DPR	
1								Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.	DRAWING NO : VSPL/TRB/2324-066/PLAN/01	Tender Drawing	✓
0									SCALE : 0 25 125 250	Revision	R0
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY				SHEET SIZE A1	Date Feb.2025



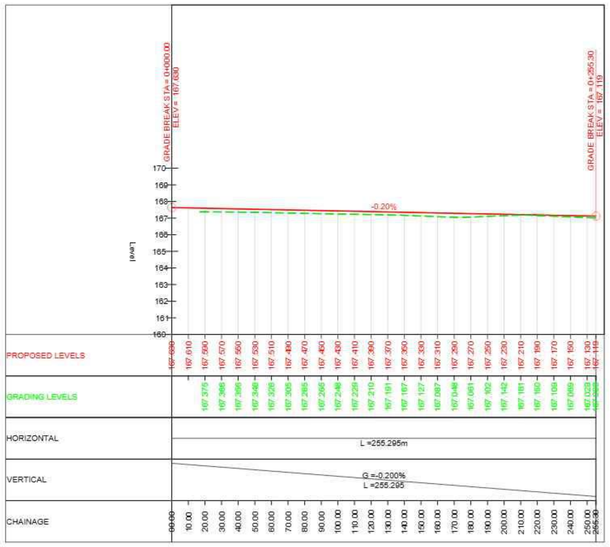
ROAD - R-45-01



ROAD - R-45-02



ROAD - R-45-01



ROAD - R-45-02

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)		
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.		N W E S	ISSUE RECORD	APPROVED FOR ISSUE
4												Concept	
3												DFR/DPR	
2							CONSULTANT :		DRAWING TITLE :	Plan & Profile for Road No - (R-45-01 & R-45-02)		Tender Drawing	✓
1							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.		DRAWING NO :	VSPL/TRB/2324-066/P&P/ 01	SHEET SIZE	Revision	R0
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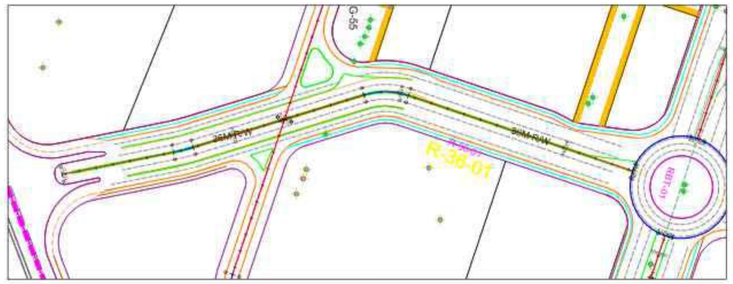
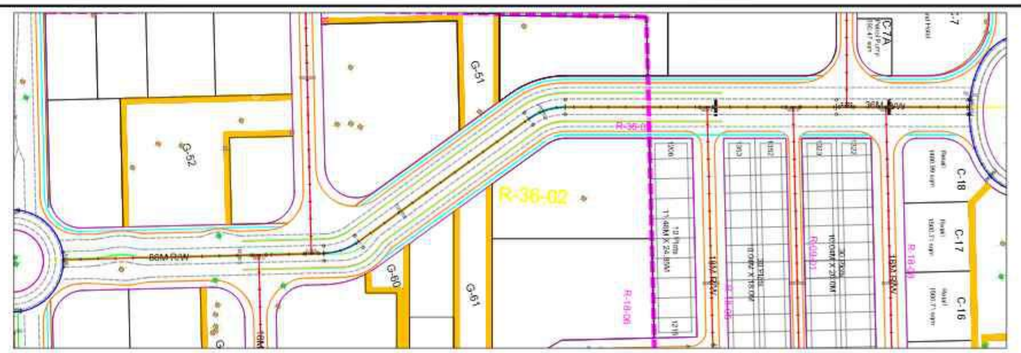
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY							



ROAD - R-36-01



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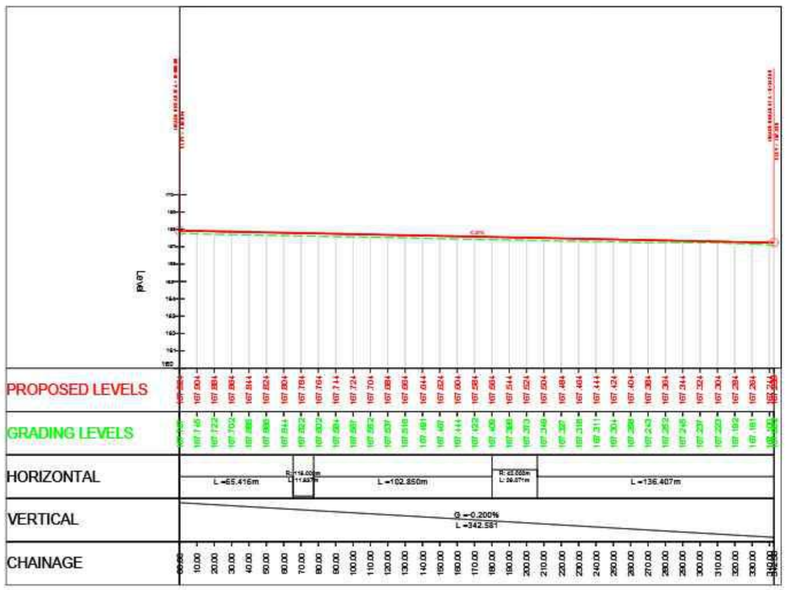
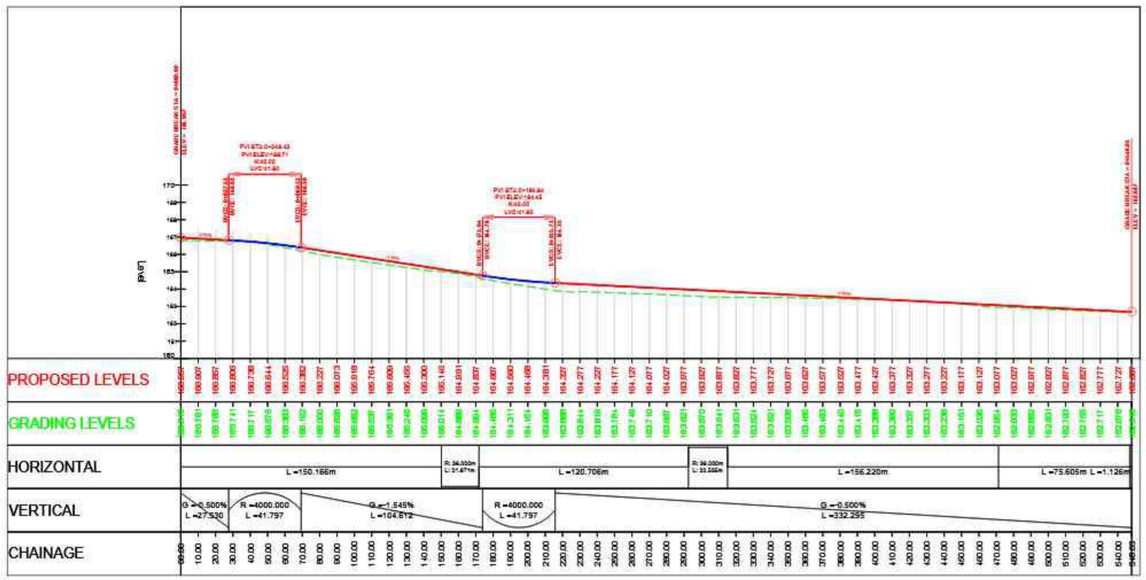


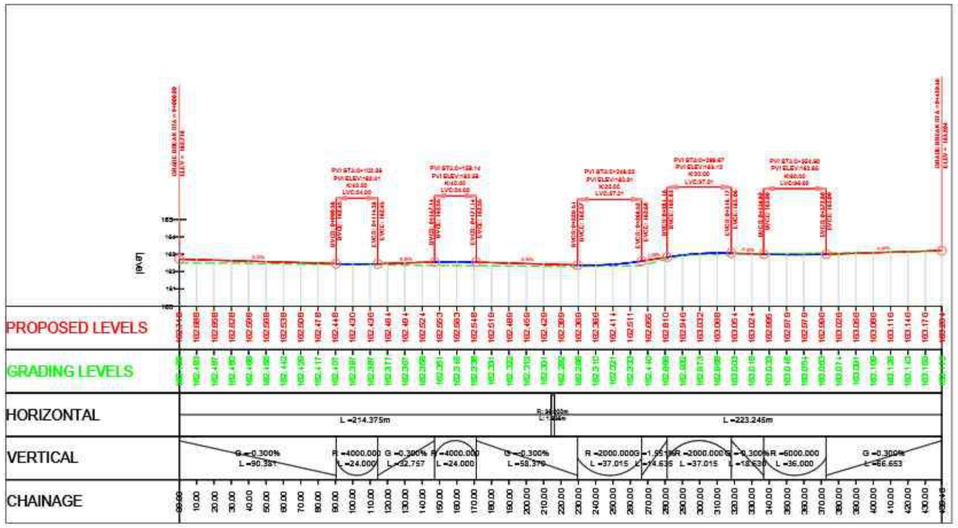
ROAD - R-36-01



ROAD - R-36-02

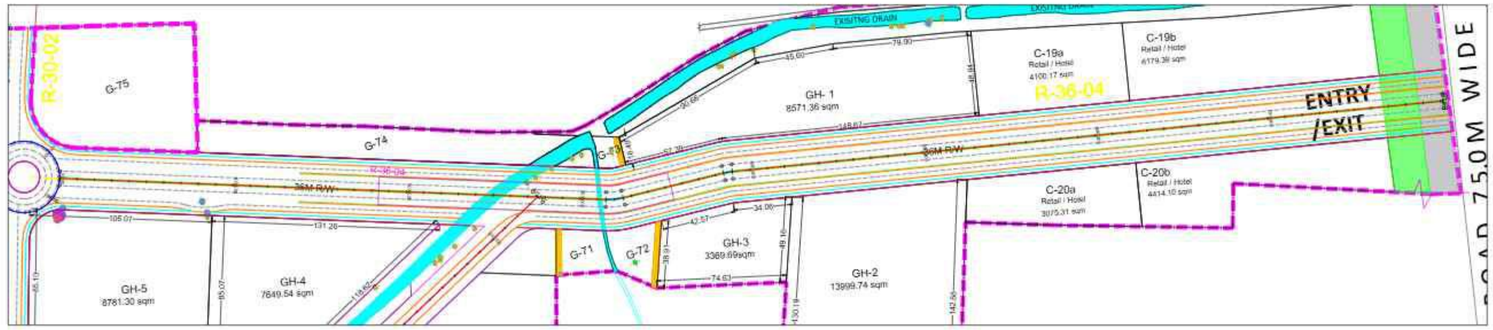
REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)		
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency					Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		**PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.**		ISSUE RECORD	APPROVED FOR ISSUE
4											N W E S	Concept	
3												DFR/DPR	
2							CONSULTANT :		DRAWING TITLE :	Plan & Profile for Road No - (R-36-01 & R-36-02)		Tender Drawing	✓
1								Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.	DRAWING NO :	VSPL/TRB/2324-066/P&P/ 02	SHEET SIZE	Revision	R0
0									SCALE :	H - 1:2500 V - 1:250	A1	Date	Feb. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY							

ROAD - R-36-03

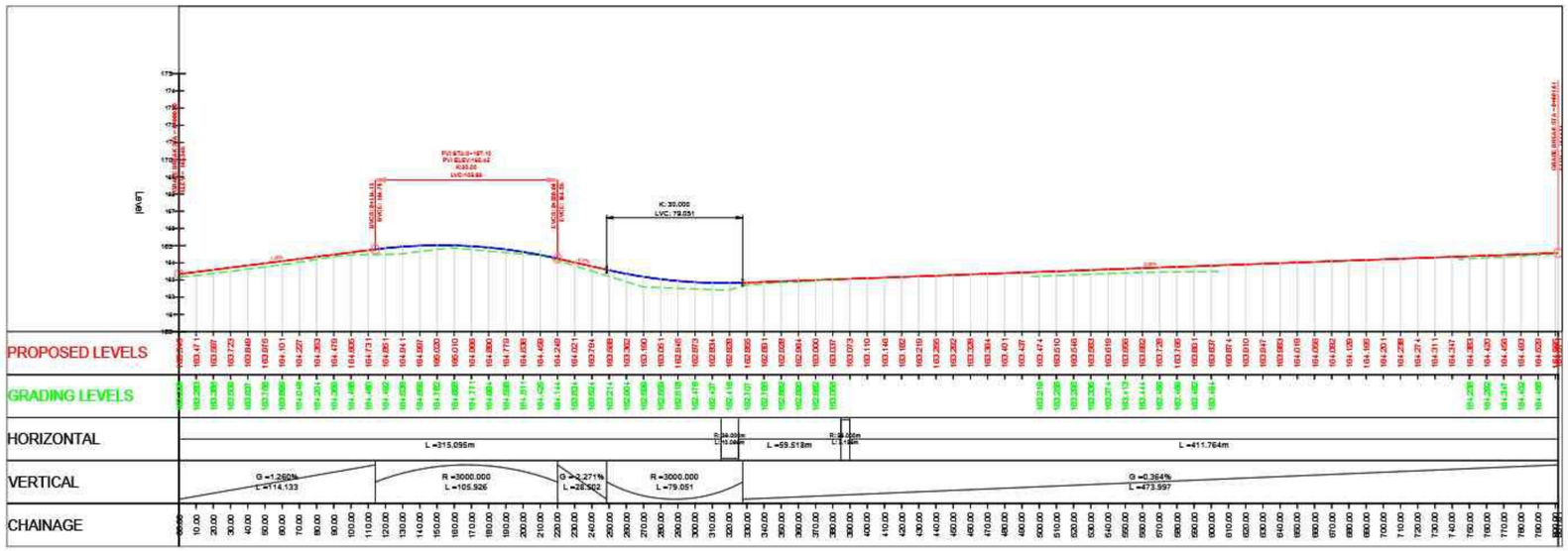


ROAD - R-36-03

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)		
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.		N W E S	ISSUE RECORD	APPROVED FOR ISSUE
4												Concept	
3												DFR/DPR	
2							CONSULTANT :		DRAWING TITLE :	Plan & Profile for Road No - (R-36-03)		Tender Drawing	✓
1							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.		DRAWING NO :	VSPL/TRB/2324-066/P&P/ 03	SHEET SIZE	Revision	R0
0									SCALE :	H - 1:2500 V - 1:250	A1	Date	Feb. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY							



ROAD - R-36-04



ROAD - R-36-04

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)		
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.		N W E S	ISSUE RECORD	APPROVED FOR ISSUE
4												Concept	
3												DFR/DPR	
2							CONSULTANT :	DRAWING TITLE :	Plan & Profile for Road No - (R-36-04)		SHEET SIZE	Tender Drawing	✓
1							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.	DRAWING NO :	VSPL/TRB/2324-066/P&P/ 05			Revision	R0
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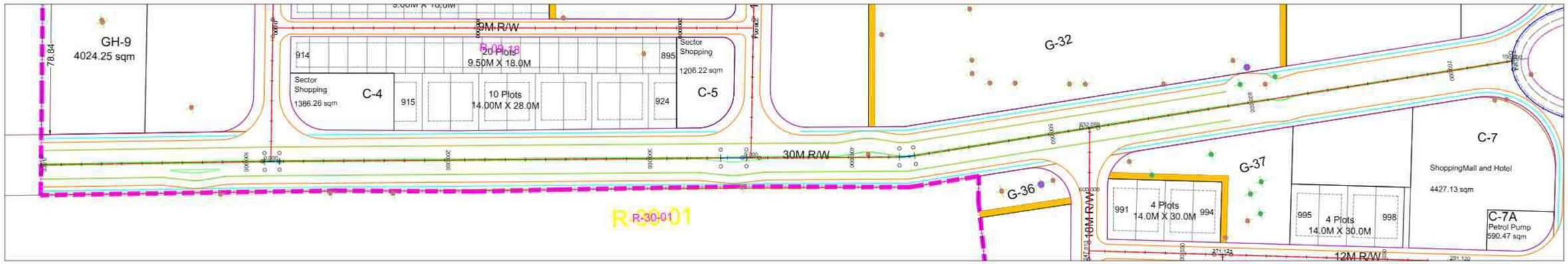
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY							



ROAD - RS-30-01

REVISION BLOCK						
5						
4						
3						
2						
1						
0						
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

QUALITY ASSURANCE
The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency

CLIENT :
Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT :
Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

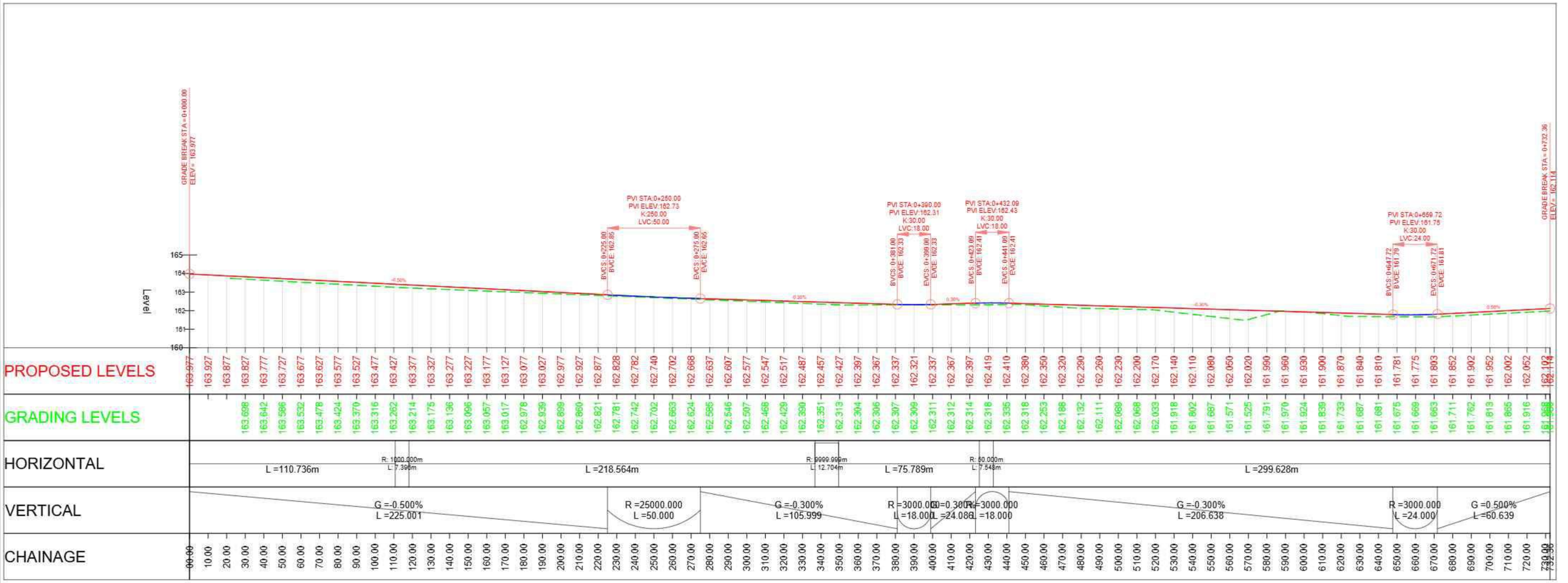
PROJECT TITLE :	**PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.**
DRAWING TITLE :	Plan & Profile for Road No - (R-30-01)
DRAWING NO :	VSPL/TRB/2324-066/P&P/05
SCALE :	H - 1:2500 V - 1:250

NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)

N W E S

ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DFR/DPR	
Tender Drawing	✓
Revision	R0
Date	Feb.2025

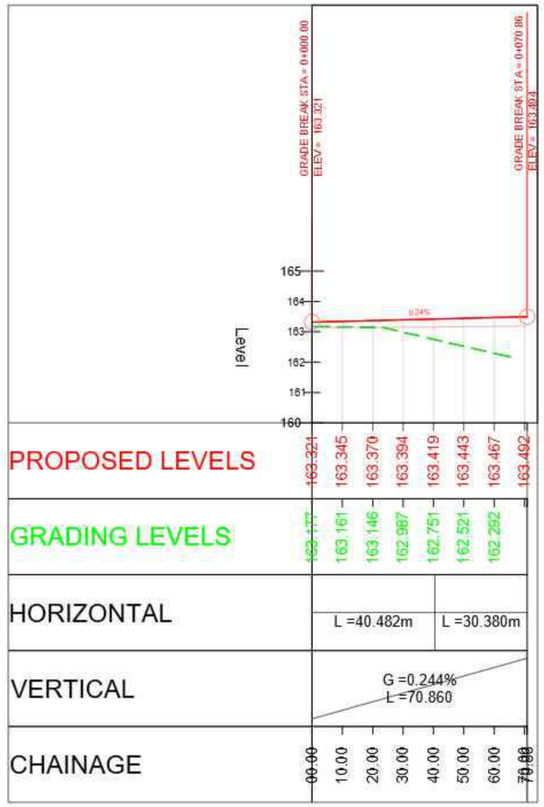
SHEET SIZE
A2



ROAD - RS-30-01

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.		N W E S	ISSUE RECORD / APPROVED FOR ISSUE
4												Concept /
3												DFR/DPR /
2							CONSULTANT :		DRAWING TITLE :	Plan & Profile for Road No - (R-30-01)		Tender Drawing / ✓
1							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.		DRAWING NO :	VSPL/TRB/2324-066/P&P/06	SHEET SIZE A2	Revision / R0
0									SCALE :	H - 1:2500 V - 1:250		Date / Feb. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY						

ROAD - RS-30-02



ROAD - RS-30-02

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)		
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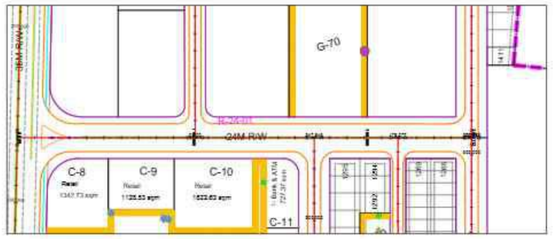
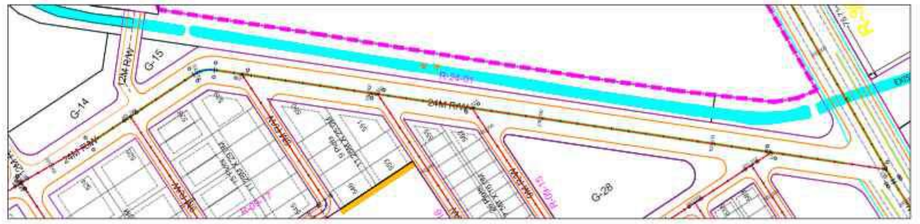
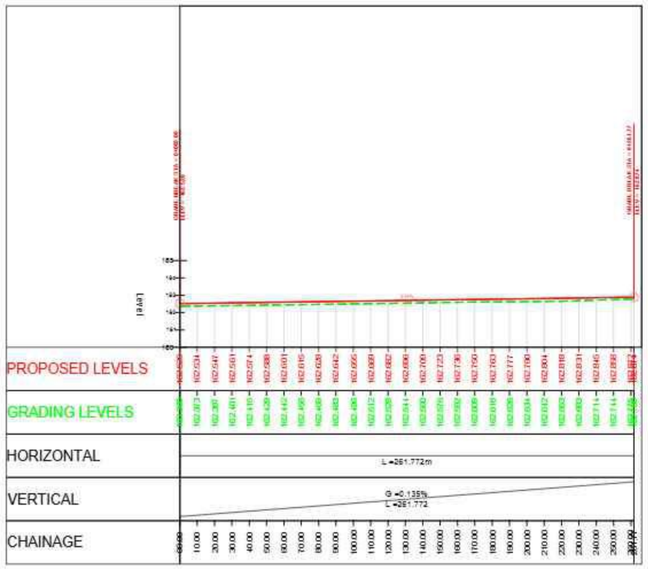
4											N W E S	Concept	
3												DFR/DPR	
2							CONSULTANT :		DRAWING TITLE :	Plan & Profile for Road No - (R-30-02)		Tender Drawing	✓
1									DRAWING NO :	VSPL/TRB/2324-066/P&P/07	SHEET SIZE	Revision	R0
0								Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.	SCALE :	H - 1:2500 V - 1:250	A2	Date	Feb. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY							



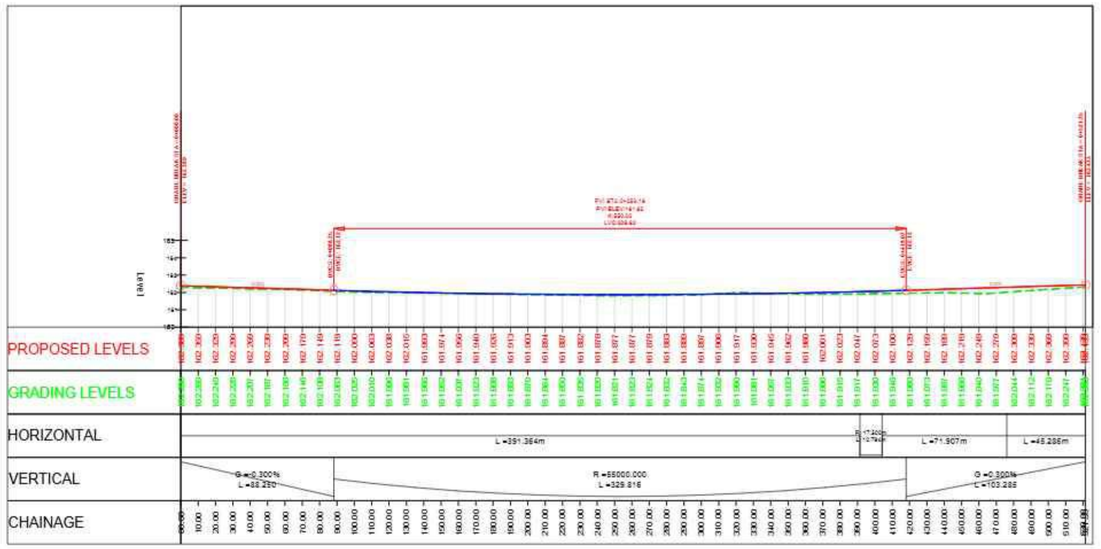
ROAD - R-24-01



ROAD - R-24-01_01

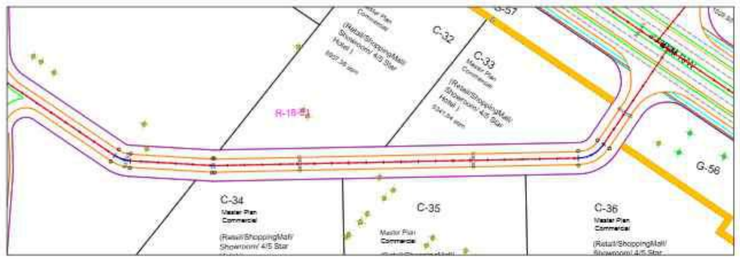


ROAD - R-24-01

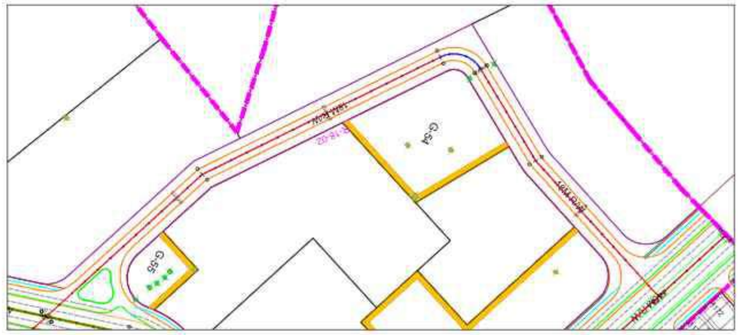


ROAD - R-24-01_01

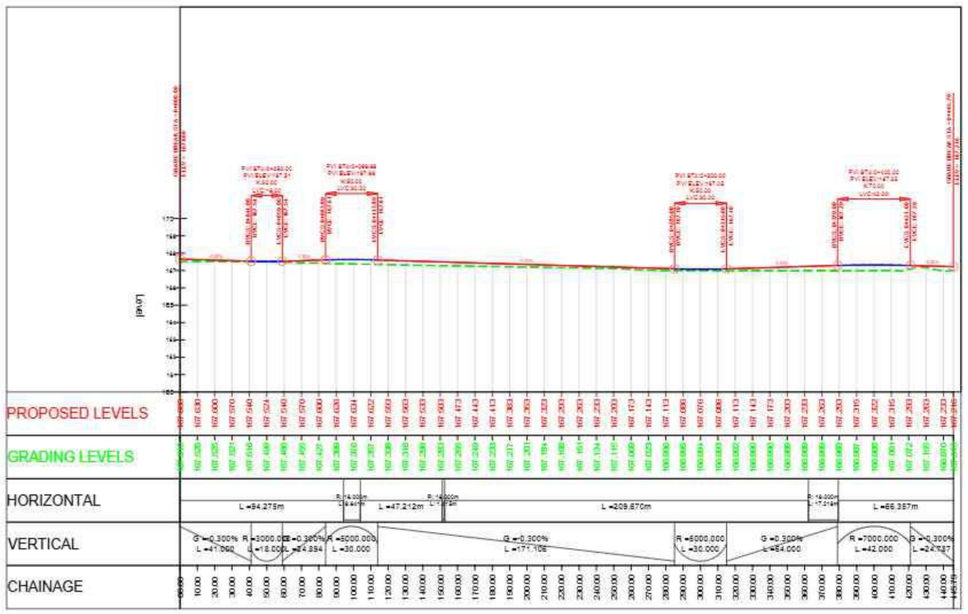
REVISION BLOCK			QUALITY ASSURANCE	CLIENT :	PROJECT TITLE :	NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency	Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010	**PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.**	N / W E / S ISSUE RECORD — APPROVED FOR ISSUE Concept DFR/DPR Tender Drawing ✓ Revision R0 Date Feb. 2025
4						
3						
2				CONSULTANT :	DRAWING TITLE :	Plan & Profile for Road No - (R-24-01 to R-24-01_01)
1					DRAWING NO :	VSPL/TRB/2324-066/P&P/08
0				Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.	SCALE :	H - 1:2500 V - 1:250
REV.	DATE	DESCRIPTION	DRAWN BY / DESIGNED BY / CHECKED BY / APPROVED BY		SHEET SIZE	A2



ROAD - R-18-01



ROAD - R-18-02



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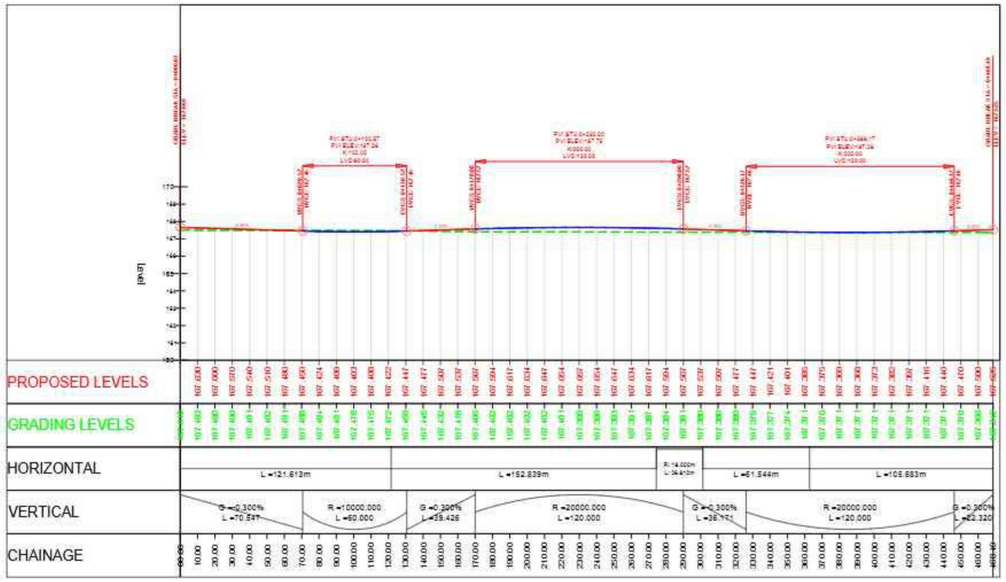

ROAD - R-18-02

REVISION BLOCK			QUALITY ASSURANCE	CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)	
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4									Concept
3									DFR/DPR
2				CONSULTANT :		DRAWING TITLE :	Plan & Profile for Road No - (R-18-01 to R-18-02)		Tender Drawing ✓
1				Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.		DRAWING NO :	VSPL/TRB/2324-066/P&P/09	SHEET SIZE	Revision R0
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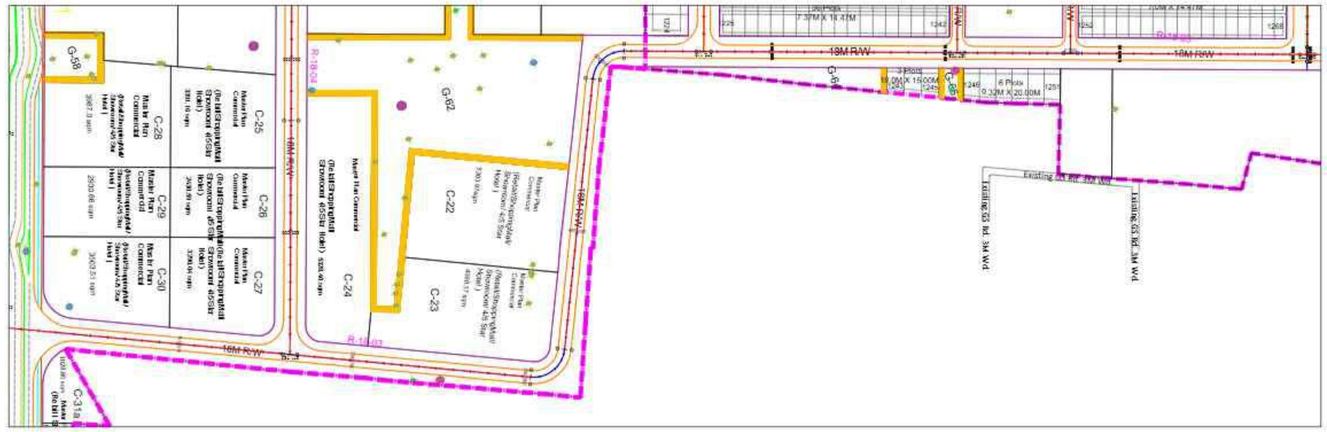
REV.	DATE	DESCRIPTION	DRAWN BY / DESIGNED BY / CHECKED BY / APPROVED BY						



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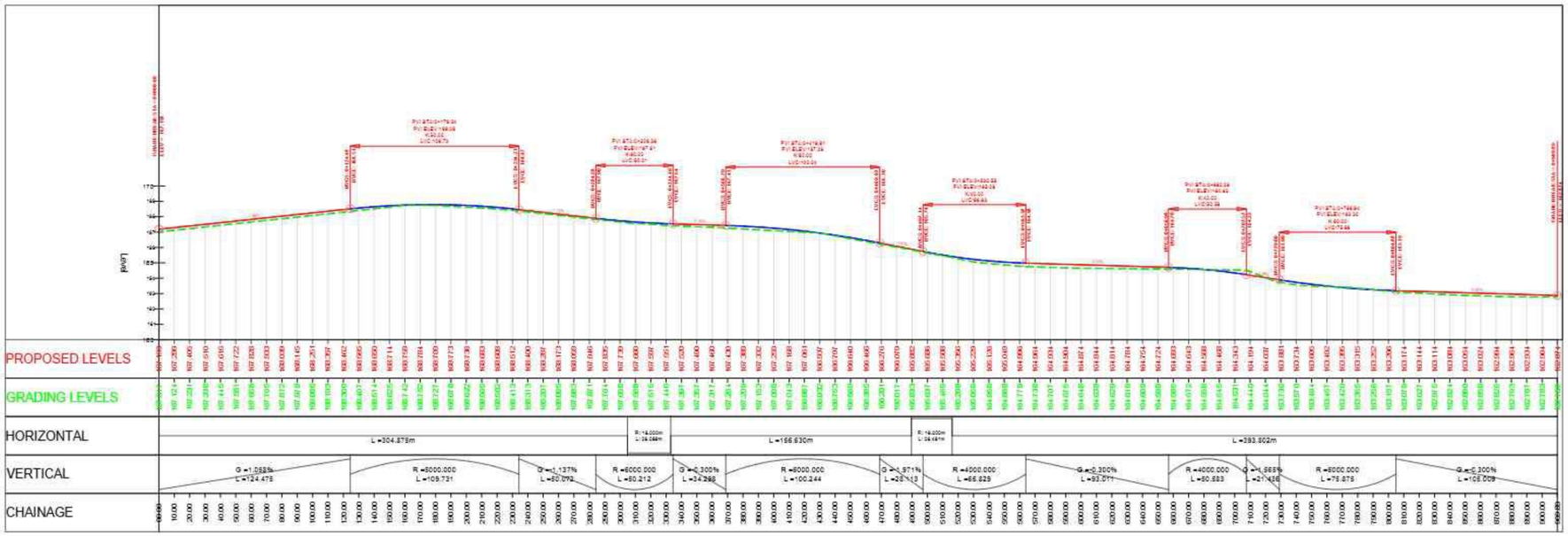

ROAD - R-18-03

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.		N W E S	ISSUE RECORD / APPROVED FOR ISSUE
4												Concept
3												DFR/DPR
2							CONSULTANT :		DRAWING TITLE :	Plan & Profile for Road No - (R-18-03)		Tender Drawing ✓
1							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.		DRAWING NO :	VSPL/TRB/2324-066/P&P/10	SHEET SIZE A2	Revision R0
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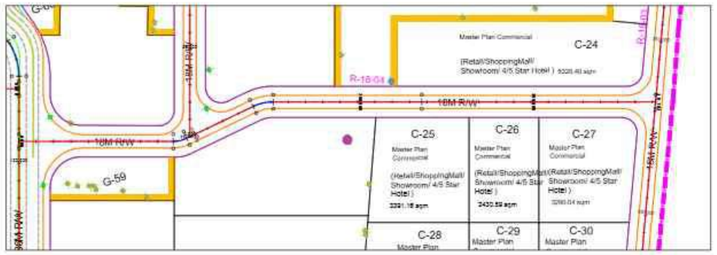
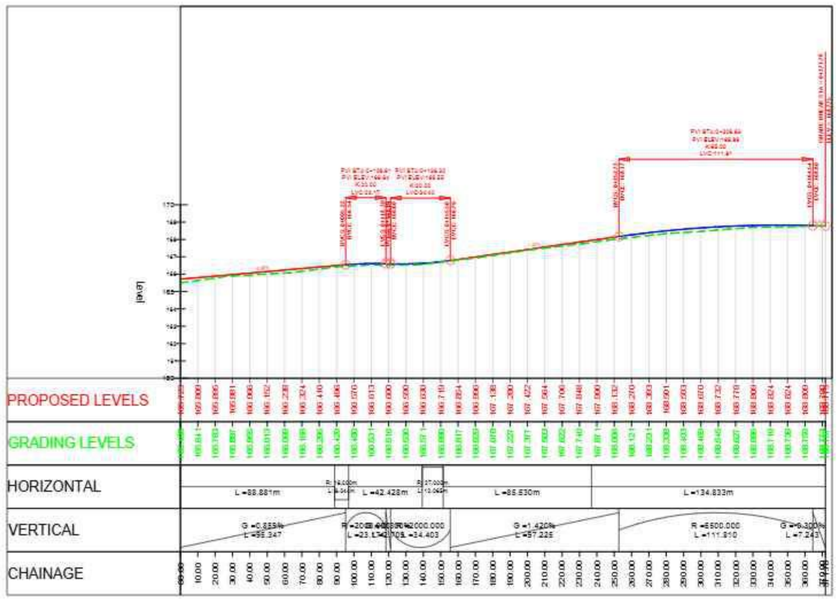
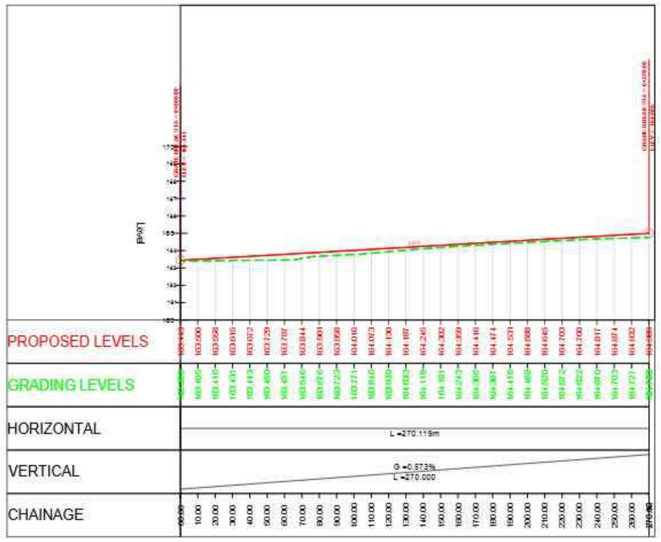


ROAD - R-18-04

ROAD - R-18-05



ROAD - R-18-04



ROAD - R-18-05

REVISION BLOCK			QUALITY ASSURANCE	CLIENT :	PROJECT TITLE :	NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency	Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010	**PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.**	ISSUE RECORD / APPROVED FOR ISSUE
4						Concept
3						DFR/DPR
2				CONSULTANT : Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.	DRAWING TITLE : Plan & Profile for Road No - (R-18-04 to R-18-05)	Tender Drawing ✓
1					DRAWING NO : VSPL/TRB/2324-066/P&P/11	Revision R0
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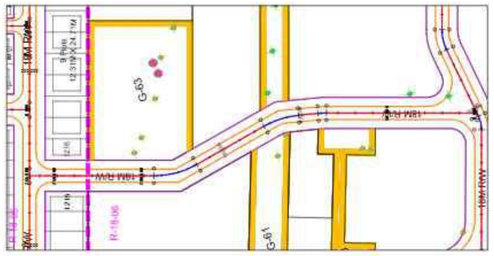
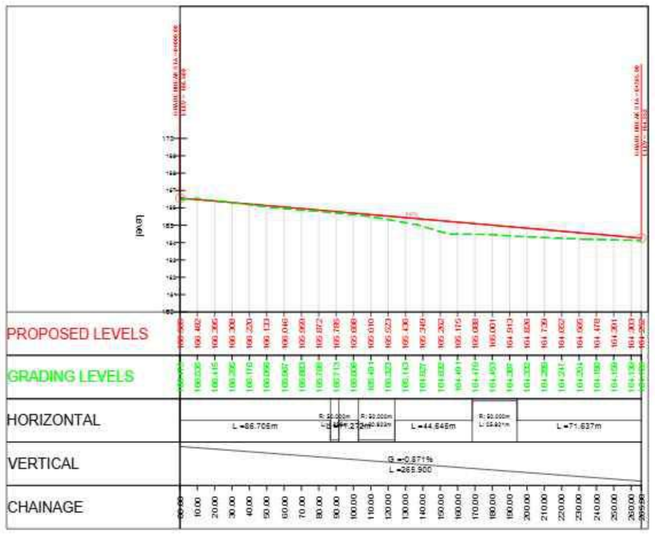
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

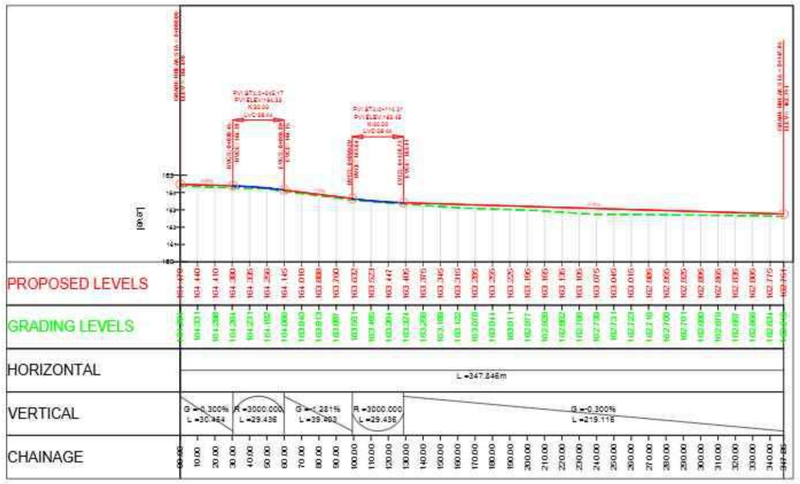


ROAD - R-18-06

ROAD - R-18-07



ROAD - R-18-06



ROAD - R-18-07

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)		
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4											N W E S	Concept	
3												DFR/DPR	
2							CONSULTANT :		DRAWING TITLE :	Plan & Profile for Road No - (R-18-06 to R-18-07)		Tender Drawing	✓
1							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.		DRAWING NO :	VSPL/TRB/2324-066/P&P/12	SHEET SIZE	Revision	R0
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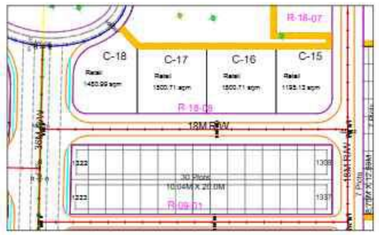
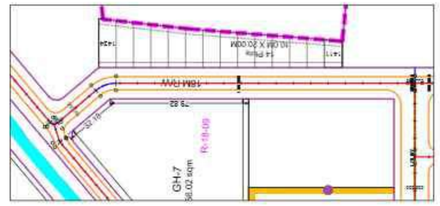
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY							



ROAD - R-18-08



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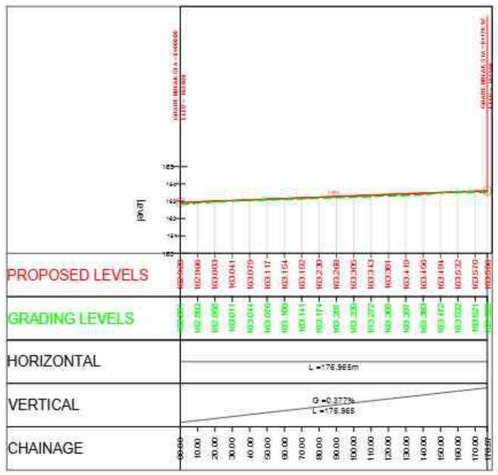

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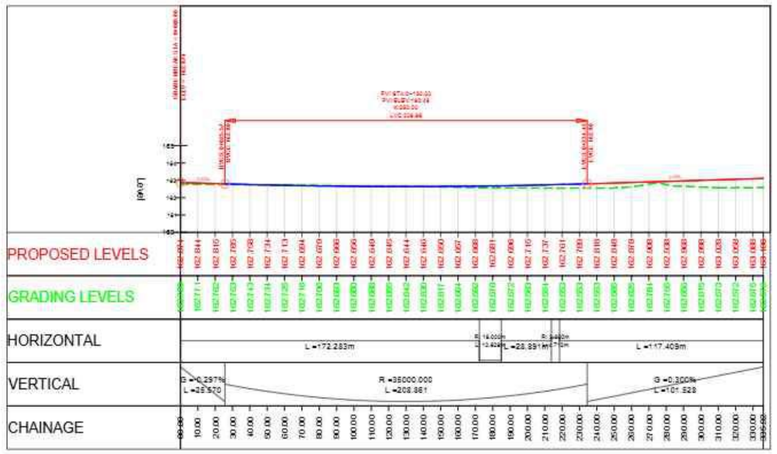
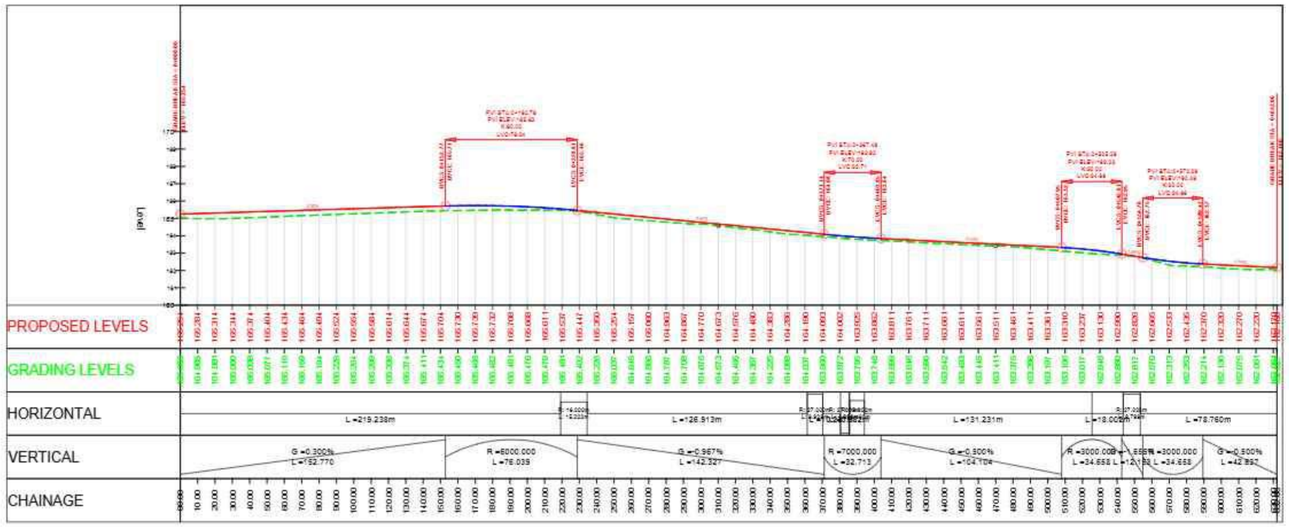


ROAD - R-18-09

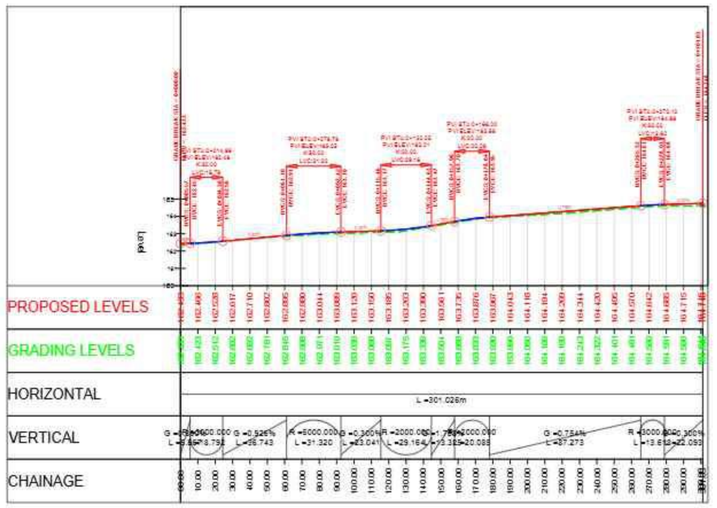
REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)		
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency					Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		**PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.**		ISSUE RECORD	APPROVED FOR ISSUE
4											N W E S	Concept	
3												DFR/DPR	
2							CONSULTANT :		DRAWING TITLE :	Plan & Profile for Road No - (R-18-08 to R-18-09)	SHEET SIZE	Tender Drawing	✓
1									DRAWING NO :	VSPL/TRB/2324-066/P&P/13		Revision	R0
0								Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.	SCALE :	H - 1:2500 V - 1:250	A2	Date	Feb. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY							

ROAD - R-18-10

ROAD - R-18-11



ROAD - R-18-10



ROAD - R-18-11

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)	
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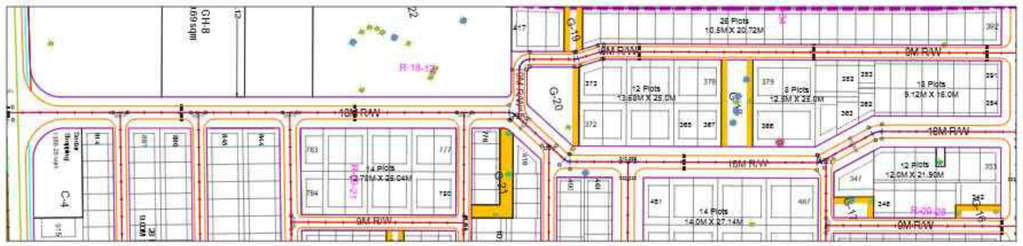
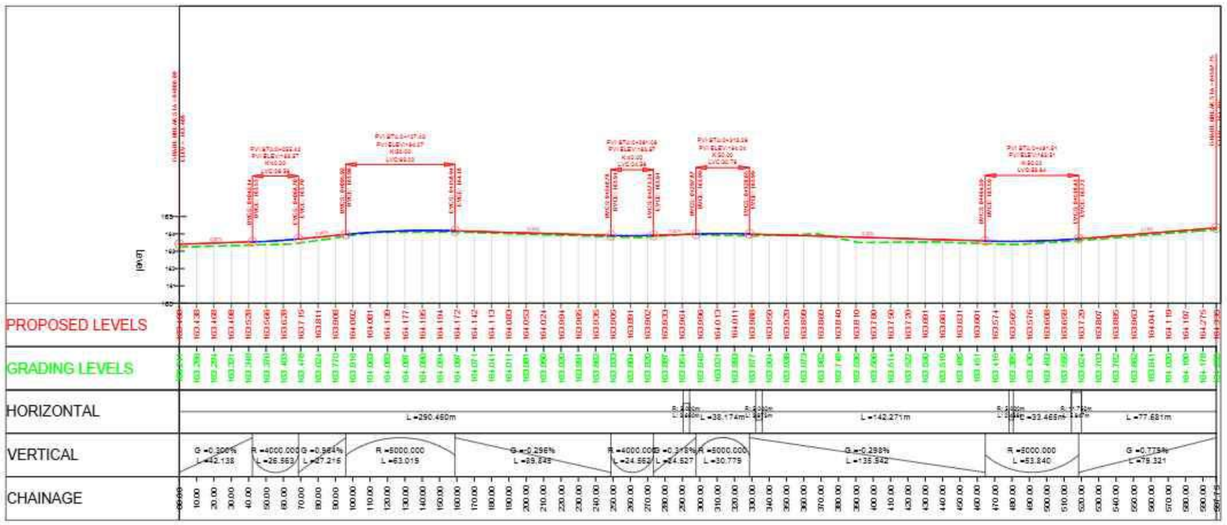
4												Concept
3												DFR/DPR
2							CONSULTANT :		DRAWING TITLE :	Plan & Profile for Road No - (R-18-10 to R-18-11)	SHEET SIZE	Tender Drawing ✓
1									DRAWING NO :	VSPL/TRB/2324-066/P&P/14		Revision R0
0							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.		SCALE :	H - 1:2500 V - 1:250	A2	Date Feb. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY						



ROAD - R-18-12

ROAD - R-18-13



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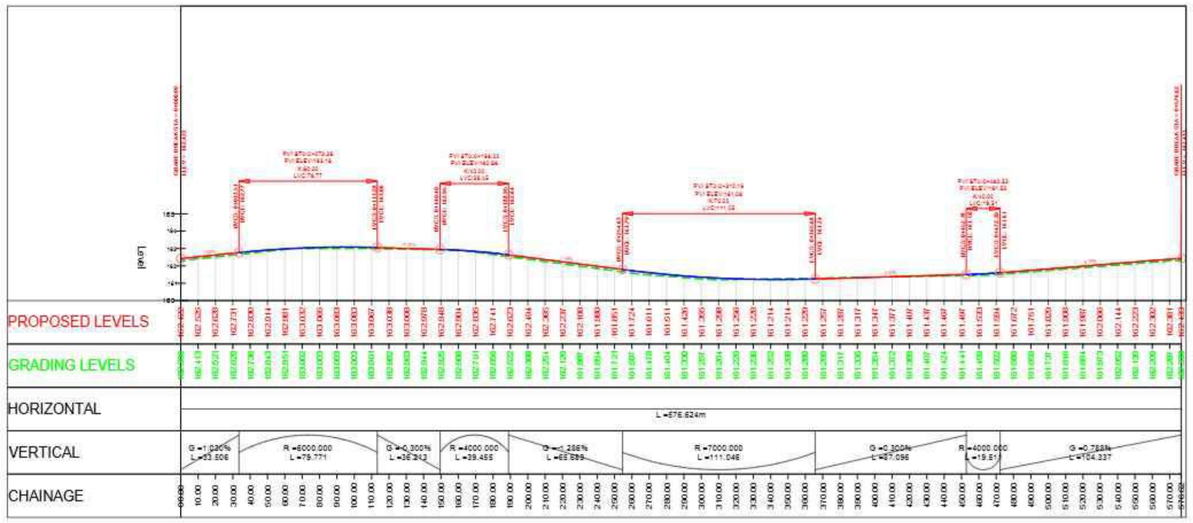

ROAD - R-18-13

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)	
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4												Concept
3												DFR/DPR
2							CONSULTANT :		DRAWING TITLE :	Plan & Profile for Road No - (R-18-12 to R-18-13)		Tender Drawing ✓
1							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.		DRAWING NO :	VSPL/TRB/2324-066/P&P/15	SHEET SIZE	Revision R0
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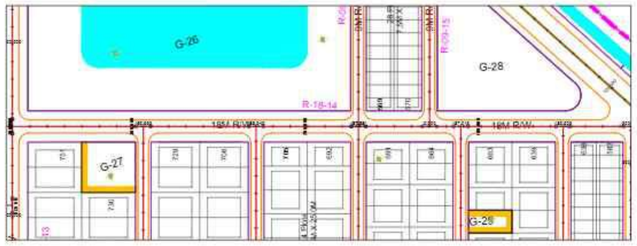
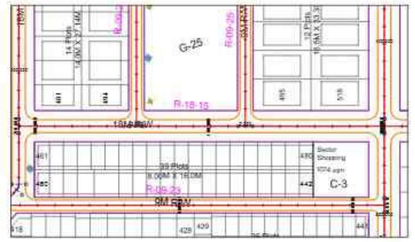
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY						



ROAD - R-18-14



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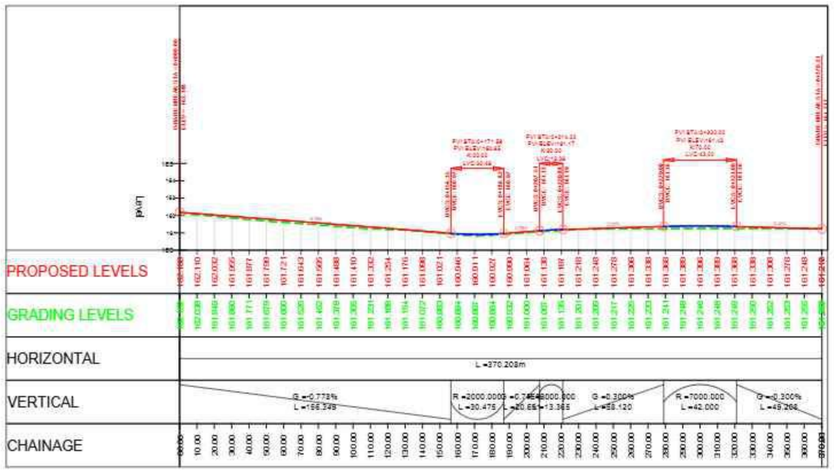

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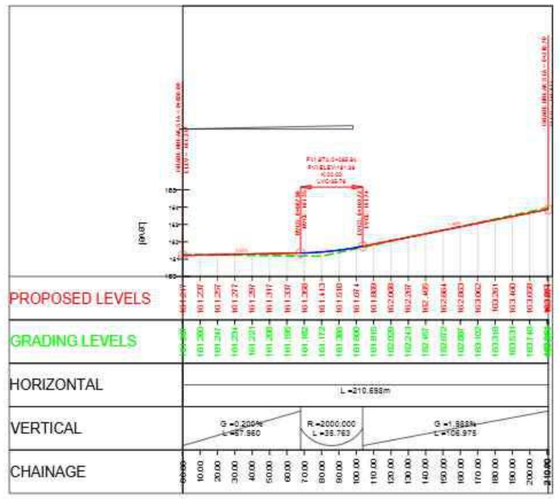

ROAD - R-18-15

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)	
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4												Concept
3												DFR/DPR
2							CONSULTANT :		DRAWING TITLE :	Plan & Profile for Road No - (R-18-14 to R-18-15)		Tender Drawing ✓
1									DRAWING NO :	VSPL/TRB/2324-066/P&P/16	SHEET SIZE	Revision R0
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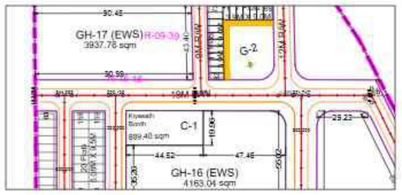
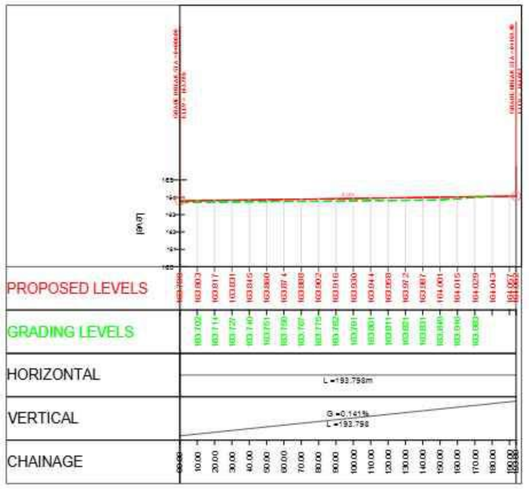
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY						

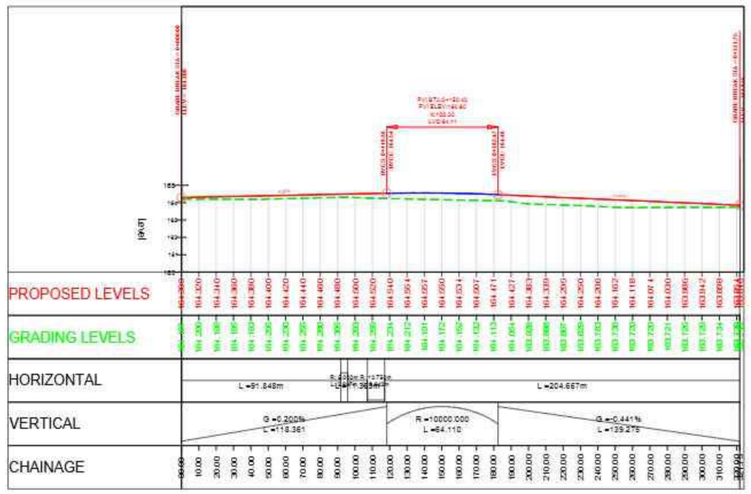


ROAD - R-18-16

ROAD - R-18-17



ROAD - R-18-16



ROAD - R-18-17

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)	
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4												Concept
3												DFR/DPR
2							CONSULTANT :		DRAWING TITLE :	Plan & Profile for Road No - (R-18-16 to R-18-17)	SHEET SIZE	Tender Drawing ✓
1							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.		DRAWING NO :	VSPL/TRB/2324-066/P&P/17		Revision R0
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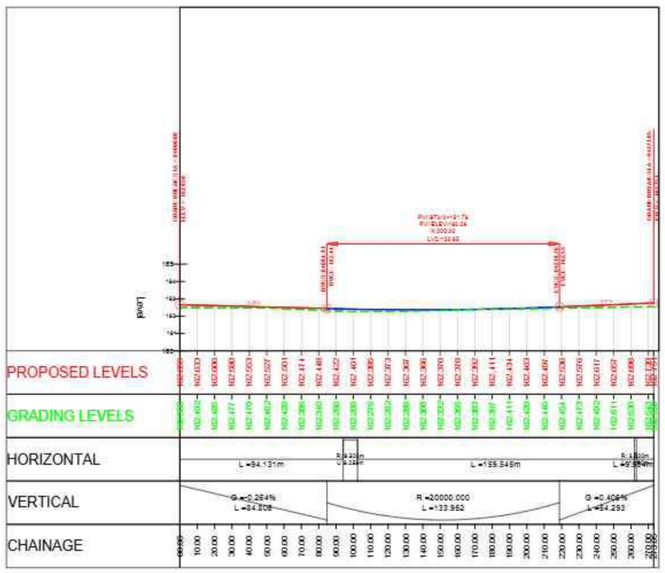
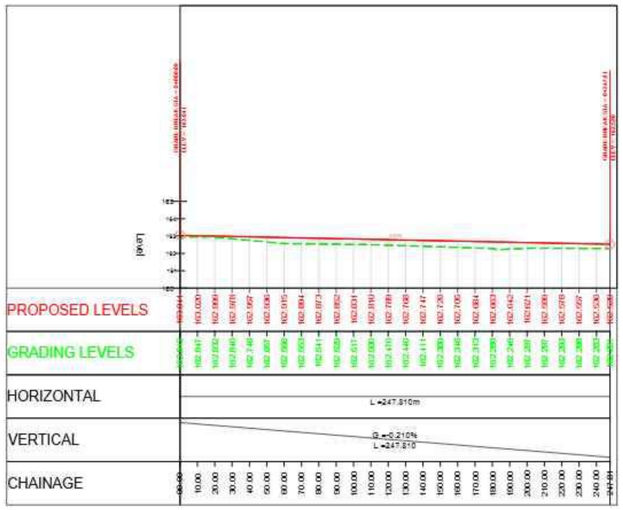
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY						

ROAD - R-12-01

ROAD - R-12-02



ROAD - R-12-01

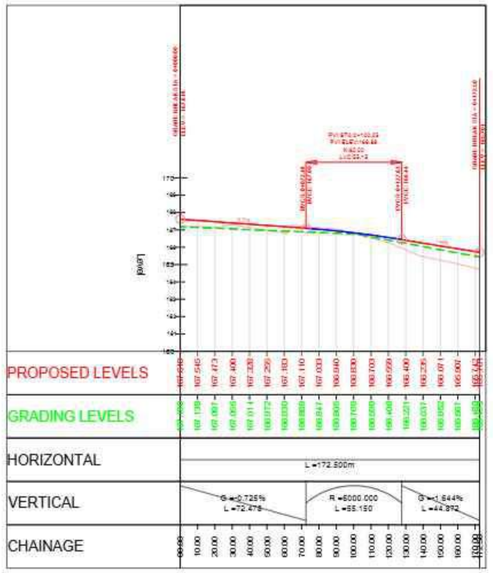


ROAD - R-12-02

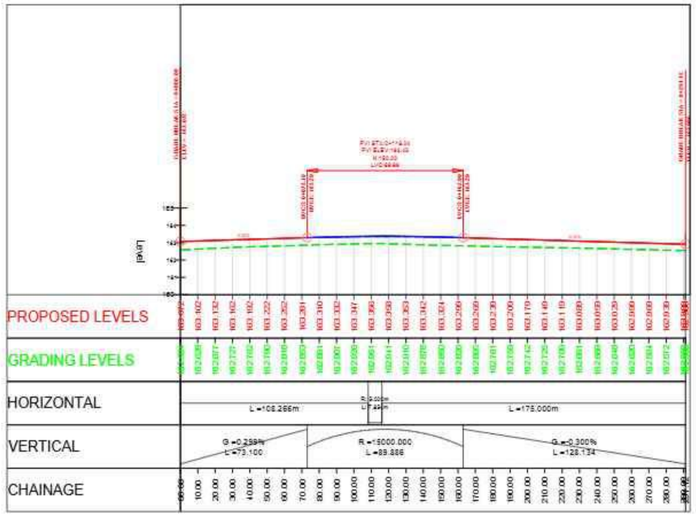
REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.		ISSUE RECORD	APPROVED FOR ISSUE
4											Concept	
3											DFR/DPR	
2							CONSULTANT :		DRAWING TITLE :	Plan & Profile for Road No - (R-12-01 to R-12-02)	Tender Drawing	✓
1									DRAWING NO :	VSPL/TRB/2324-066/P&P/18	Revision	R0
0							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.		SCALE :	H - 1:2500 V - 1:250	SHEET SIZE A2	Date Feb. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY						

ROAD - R-12-03

ROAD - R-12-04



ROAD - R-12-03



ROAD - R-12-04

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)		
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		**PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.**		N W E S	ISSUE RECORD	APPROVED FOR ISSUE
4												Concept	
3												DFR/DPR	
2							CONSULTANT :		DRAWING TITLE :	Plan & Profile for Road No - (R-12-03 to R-12-04)		Tender Drawing	✓
1							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.		DRAWING NO :	VSPL/TRB/2324-066/P&P/19	SHEET SIZE	Revision	R0
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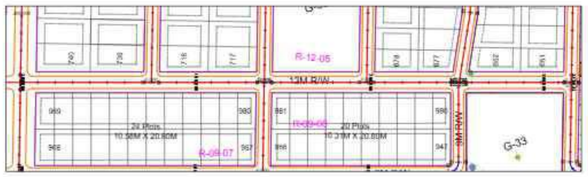
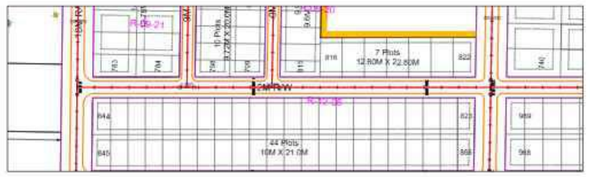
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY							



ROAD - R-12-05



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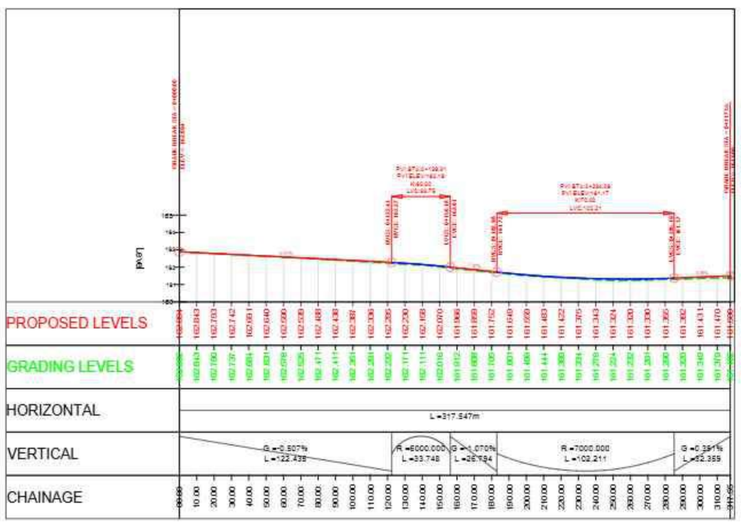

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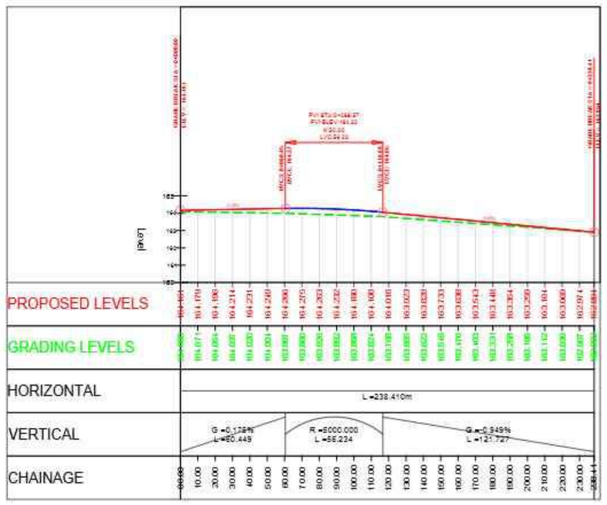


ROAD - R-12-06

REVISION BLOCK			QUALITY ASSURANCE			
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency			
4						
3						
2						
1						
0						
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

CLIENT :
Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT :
Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE :	**PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.**
DRAWING TITLE :	Plan & Profile for Road No - (R-12-05 to R-12-06)
DRAWING NO :	VSPL/TRB/2324-066/P&P/20
SCALE :	H - 1:2500 V - 1:250

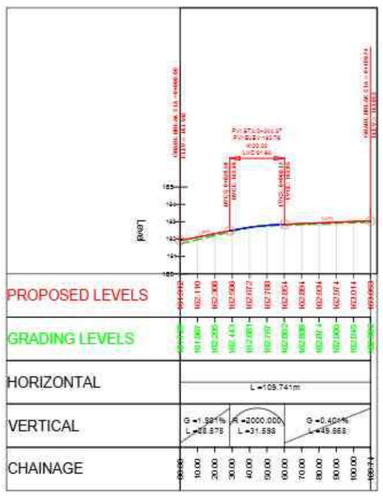
NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)

ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DFR/DPR	
Tender Drawing	✓
Revision	R0
Date	Feb. 2025

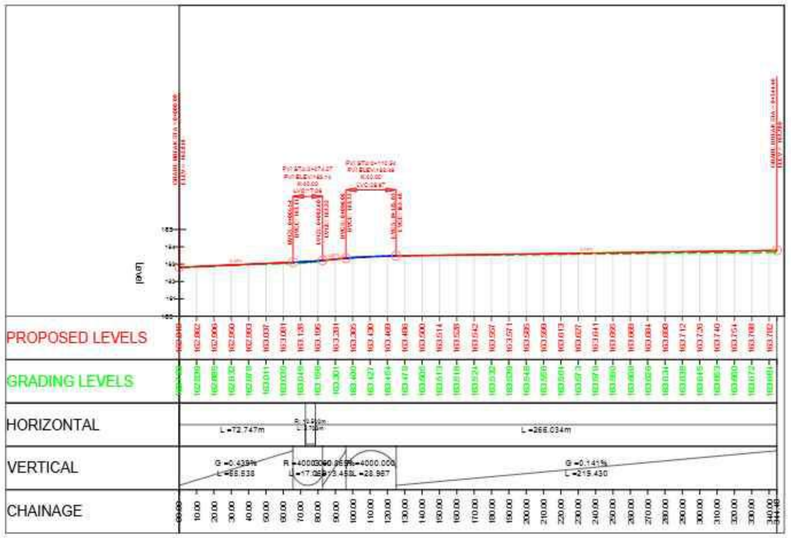
SHEET SIZE : A2

ROAD - R-12-07

ROAD - R-12-08

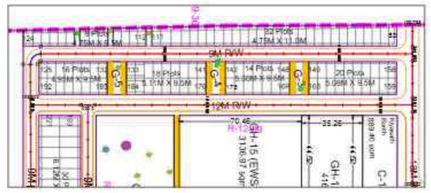


ROAD - R-12-07

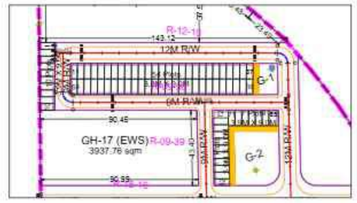


ROAD - R-12-08

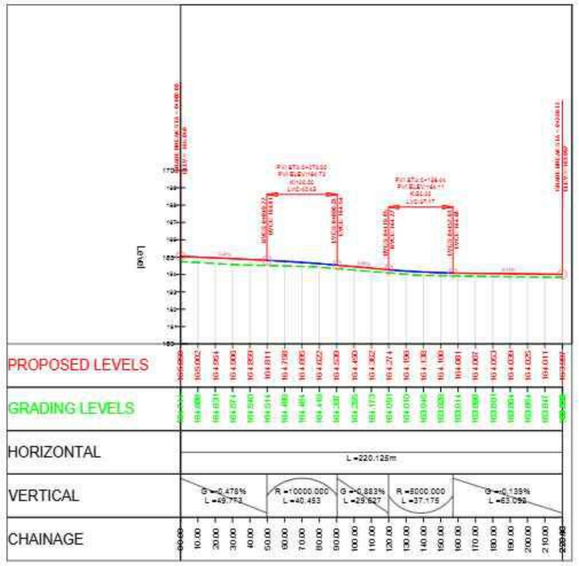
REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :	PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.	NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)		
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency					Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010			N / W E / S	ISSUE RECORD	APPROVED FOR ISSUE
4												Concept	
3												DFR/DPR	
2							CONSULTANT :	Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.	DRAWING TITLE :	Plan & Profile for Road No - (R-12-07 to R-12-08)	SHEET SIZE A2	Tender Drawing	✓
1									DRAWING NO :	VSPL/TRB/2324-066/P&P/21		Revision	R0
0									SCALE :	H - 1:2500 V - 1:250		Date	Feb. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY							



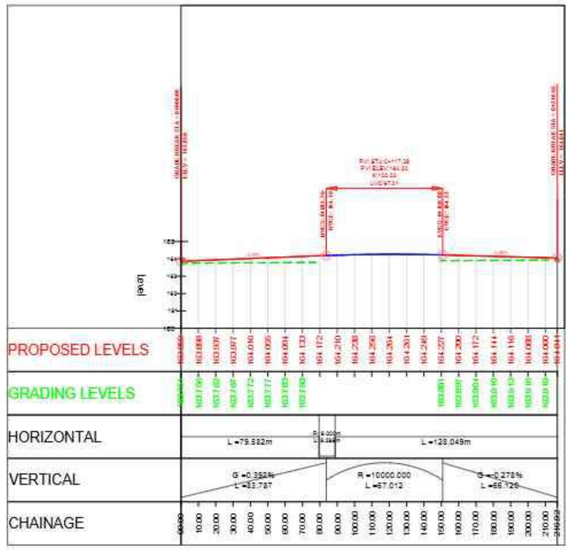
ROAD - R-12-09



ROAD - R-12-10



ROAD - R-12-09



ROAD - R-12-10

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.		N W E S	ISSUE RECORD / APPROVED FOR ISSUE
4												Concept
3												DFR/DPR
2							CONSULTANT :		DRAWING TITLE :	Plan & Profile for Road No - (R-12-09 to R-12-10)		Tender Drawing ✓
1							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.		DRAWING NO :	VSPL/TRB/2324-066/P&P/22	SHEET SIZE	Revision R0
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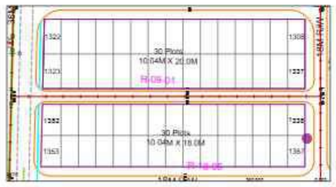
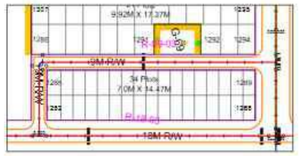
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY						



ROAD - R-09-01

ROAD - R-09-02



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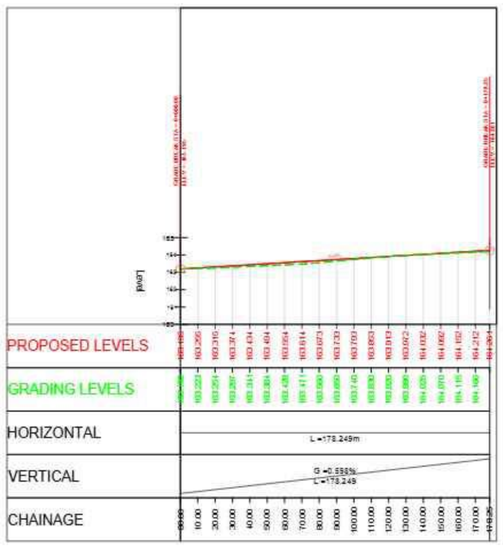
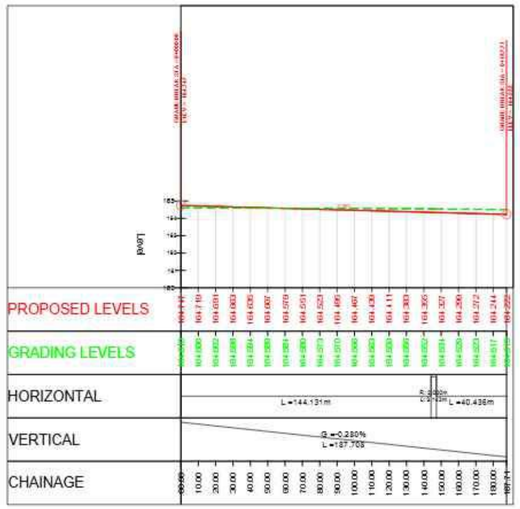
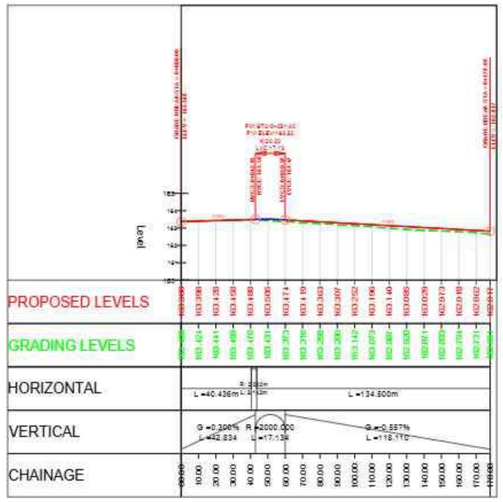


ROAD - R-09-01

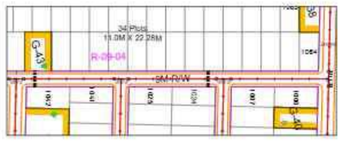


ROAD - R-09-02

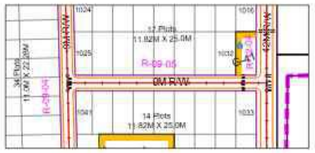


ROAD - R-09-03

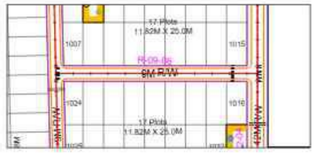
REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.		N W E S	ISSUE RECORD / APPROVED FOR ISSUE
4												Concept
3												DFR/DPR
2							CONSULTANT :		DRAWING TITLE :	Plan & Profile for Road No - (R-09-01 to R-09-03)		Tender Drawing ✓
1									DRAWING NO :	VSPL/TRB/2324-066/P&P/23	SHEET SIZE	Revision R0
0							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.		SCALE :	H - 1:2500 V - 1:250	A2	Date Feb. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY						



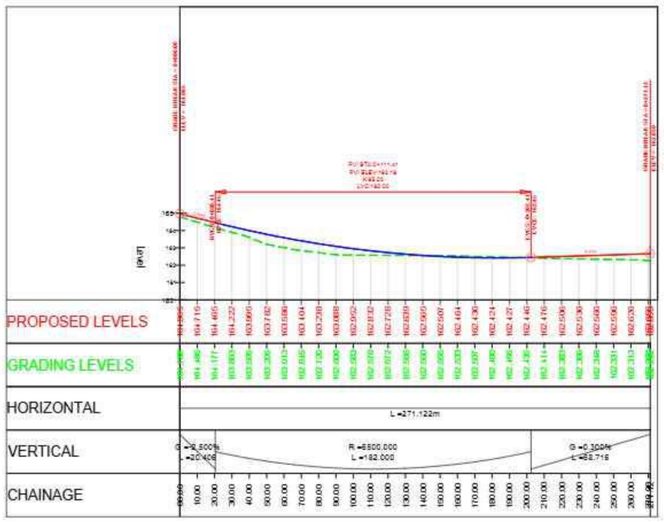
ROAD - R-09-04



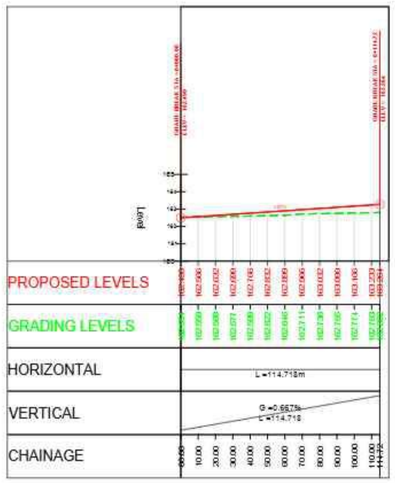
ROAD - R-09-05



ROAD - R-09-06



ROAD - R-09-04



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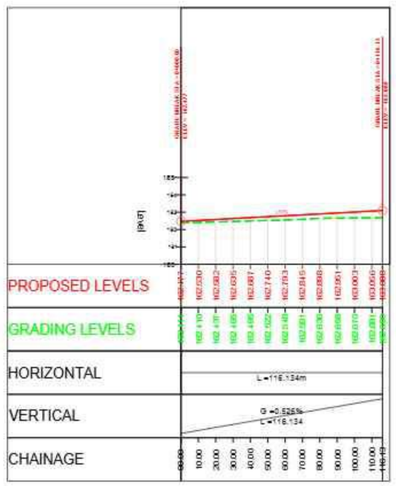

ROAD - R-09-06

REVISION BLOCK		
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0		
REV.	DATE	DESCRIPTION

QUALITY ASSURANCE

The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency

DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

CLIENT :

Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT :

Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE : **PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.**

DRAWING TITLE : Plan & Profile for Road No - (R-09-04 to R-09-06)

DRAWING NO : VSPL/TRB/2324-066/P&P/24

SCALE : H - 1:2500
V - 1:250

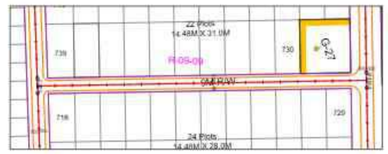
NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)

ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DFR/DPR	
Tender Drawing	✓
Revision	R0
Date	Feb. 2025

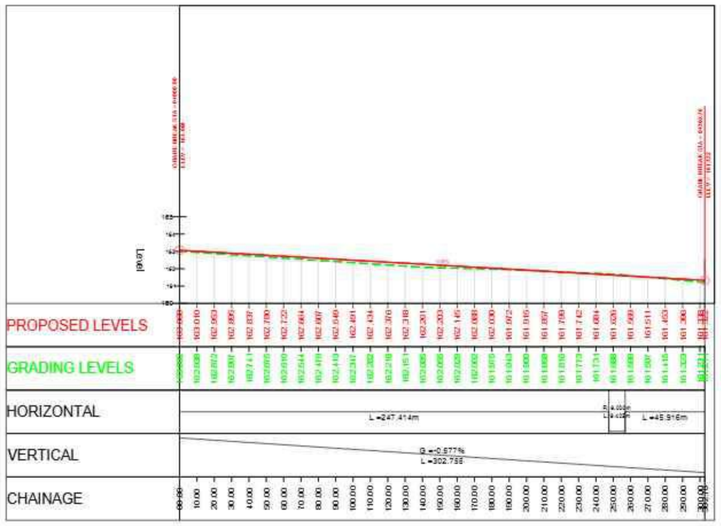
SHEET SIZE A2

ROAD - R-09-07

ROAD - R-09-08

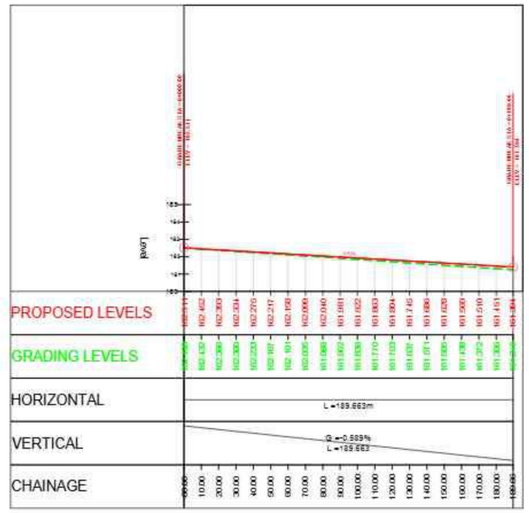


ROAD - R-09-09



ROAD - R-09-07

ROAD - R-09-08



ROAD - R-09-09

REVISION BLOCK			QUALITY ASSURANCE			
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4						
3						
2						
1						
0						
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

CLIENT :
Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT :
Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE : **PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.**

DRAWING TITLE : Plan & Profile for Road No - (R-09-07 to R-09-09)

DRAWING NO : VSPL/TRB/2324-066/P&P/25

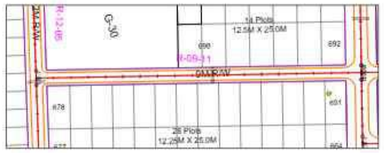
SCALE : H - 1:2500
V - 1:250

NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)

ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DFR/DPR	
Tender Drawing	✓
Revision	R0
Date	Feb. 2025

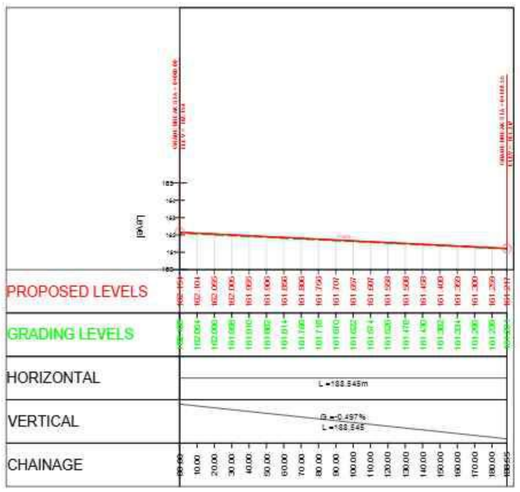
SHEET SIZE A2

ROAD - R-09-10

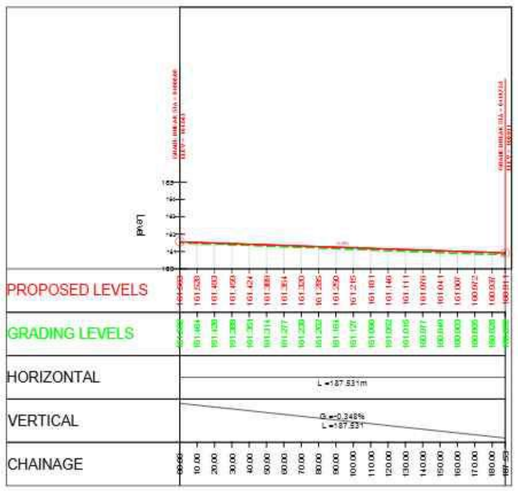


ROAD - R-09-11

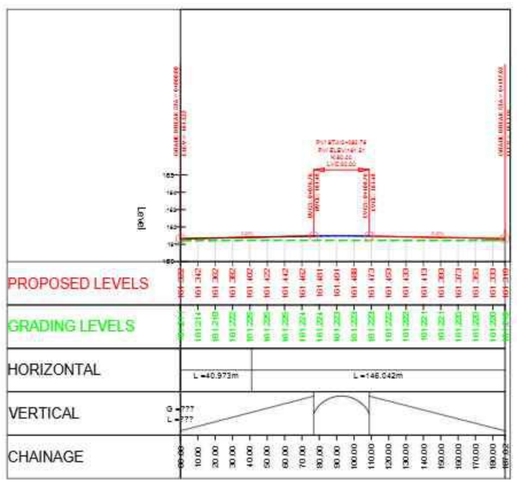
ROAD - R-09-12



ROAD - R-09-10



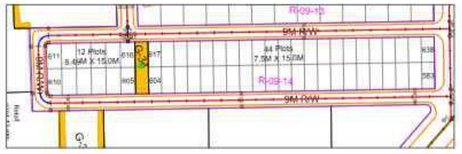
ROAD - R-09-11



ROAD - R-09-12

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.		N W E S	ISSUE RECORD / APPROVED FOR ISSUE
4												Concept
3												DFR/DPR
2							CONSULTANT :		DRAWING TITLE :	Plan & Profile for Road No - (R-09-10 to R-09-12)	SHEET SIZE	Tender Drawing ✓
1							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.		DRAWING NO :	VSPL/TRB/2324-066/P&P/26		Revision R0
0									SCALE :	H - 1:2500 V - 1:250	A2	Date Feb. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY						

ROAD - R-09-13



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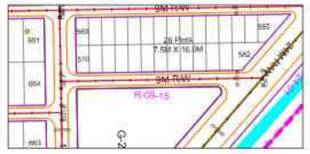

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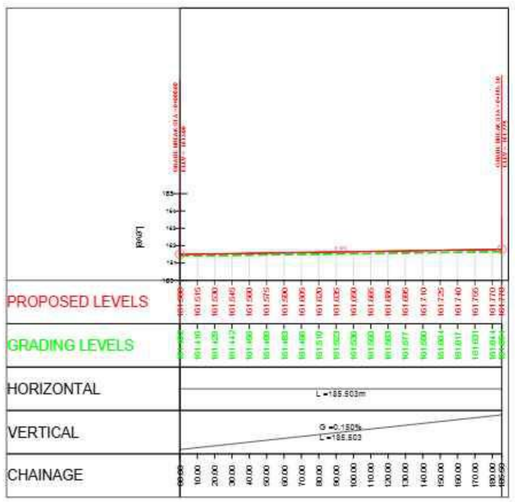
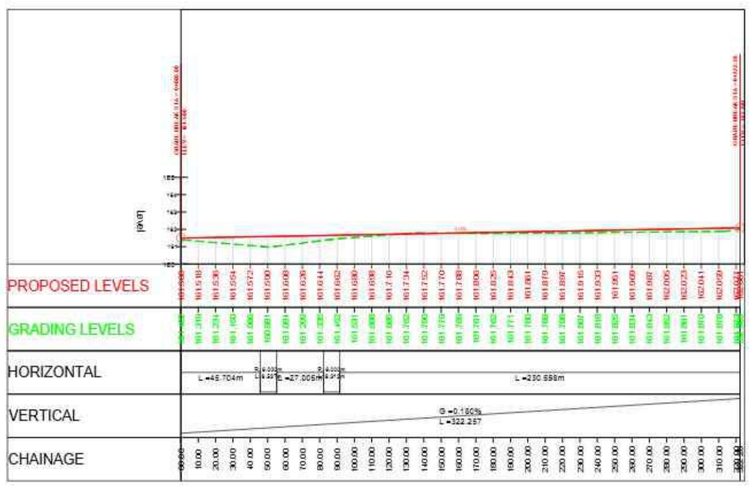


ROAD - R-09-13



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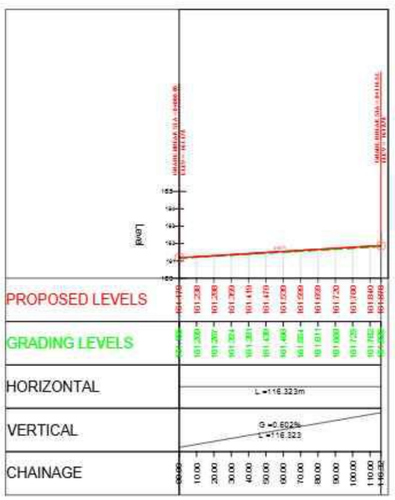


ROAD - R-09-15

REVISION BLOCK		
5		
4		
3		
2		
1		
0		
REV.	DATE	DESCRIPTION

QUALITY ASSURANCE
The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency

DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

CLIENT :
Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT :
Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE : **PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.**

DRAWING TITLE : Plan & Profile for Road No - (R-09-13 to R-09-15)

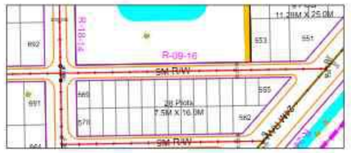
DRAWING NO : VSPL/TRB/2324-066/P&P/27

SCALE : H - 1:2500
V - 1:250

NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)

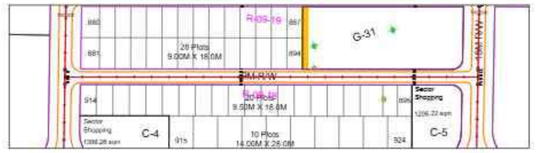
ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DFR/DPR	
Tender Drawing	✓
Revision	R0
Date	Feb. 2025

SHEET SIZE A2

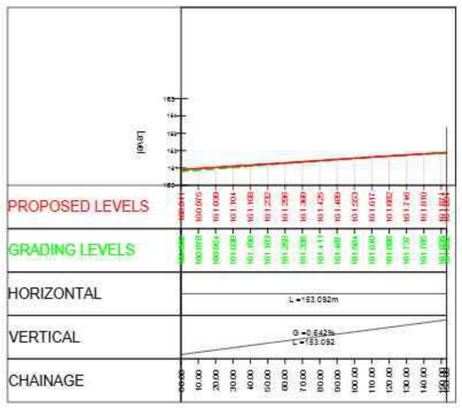


ROAD - R-09-16

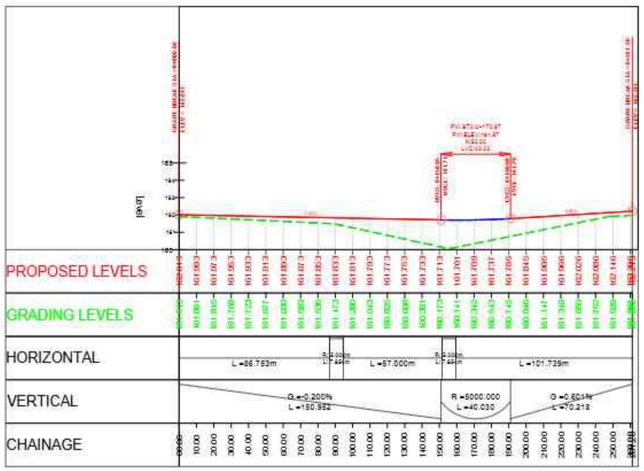
ROAD - R-09-17



ROAD - R-09-18



ROAD - R-09-16



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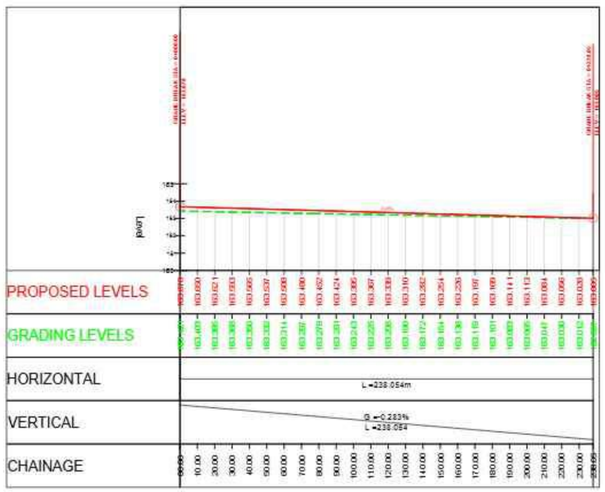
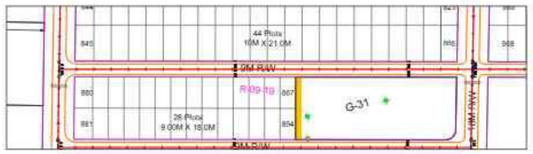


ROAD - R-09-18

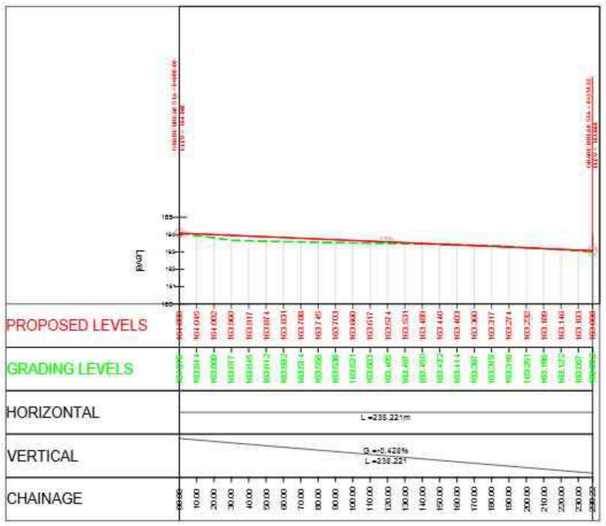
REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.		N W E S	ISSUE RECORD / APPROVED FOR ISSUE
4												Concept
3												DFR/DPR
2							CONSULTANT :		DRAWING TITLE :	Plan & Profile for Road No - (R-09-16 to R-09-18)		Tender Drawing ✓
1									DRAWING NO :	VSPL/TRB/2324-066/P&P/28	SHEET SIZE A2	Revision R0
0							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.		SCALE :	H - 1:2500 V - 1:250		Date Feb. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY						



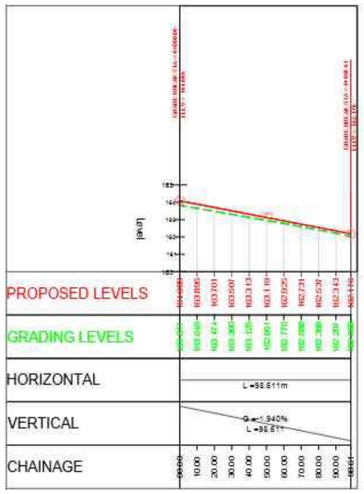
ROAD - R-09-19

ROAD - R-09-20

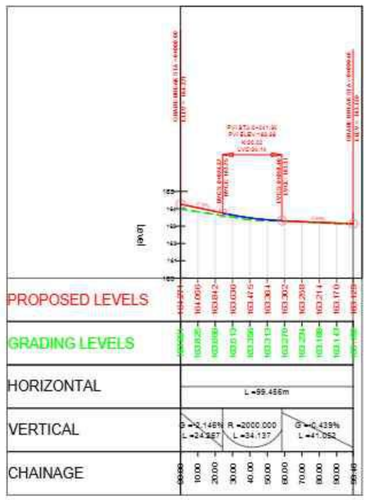
ROAD - R-09-21



ROAD - R-09-19



ROAD - R-09-20



ROAD - R-09-21

REVISION BLOCK			QUALITY ASSURANCE			
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4						
3						
2						
1						
0						
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

CLIENT :	Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010
CONSULTANT :	Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.
PROJECT TITLE :	**PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.**
DRAWING TITLE :	Plan & Profile for Road No - (R-09-19 to R-09-21)
DRAWING NO :	VSPL/TRB/2324-066/P&P/29
SCALE :	H - 1:2500 V - 1:250

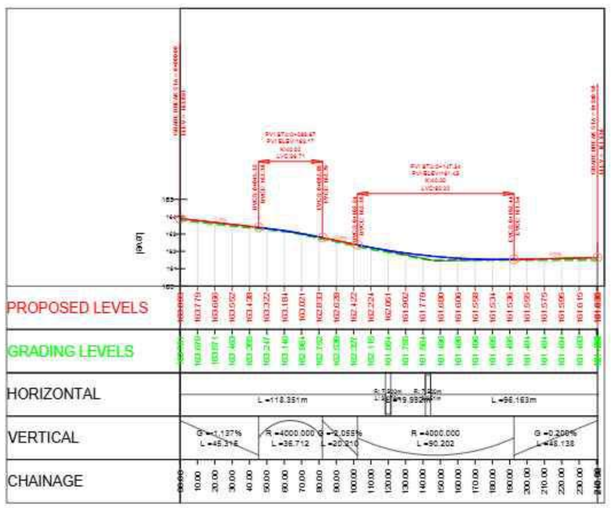
NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)

	ISSUE RECORD	APPROVED FOR ISSUE
	Concept	
	DFR/DPR	
SHEET SIZE A2	Tender Drawing	✓
	Revision	R0
	Date	Feb. 2025

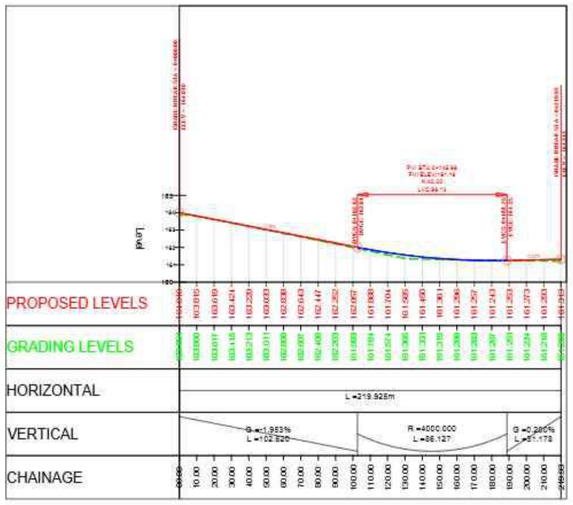
ROAD - R-09-22

ROAD - R-09-23

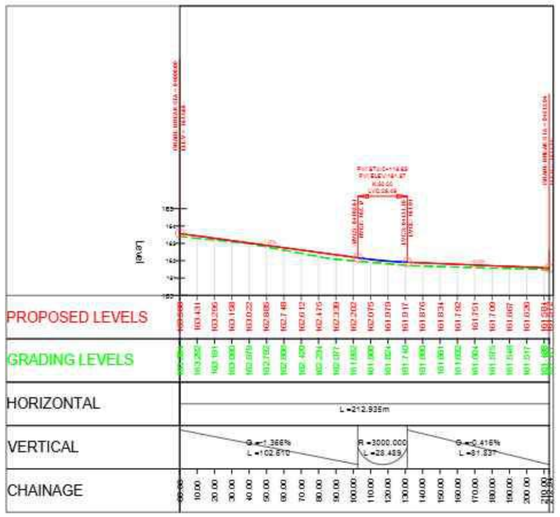
ROAD - R-09-24



ROAD - R-09-22



ROAD - R-09-23



ROAD - R-09-24

REVISION BLOCK			QUALITY ASSURANCE			
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4						
3						
2						
1						
0						
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

CLIENT :
Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT :
Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE : **PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.**

DRAWING TITLE : Plan & Profile for Road No - (R-09-22 to R-09-24)

DRAWING NO : VSPL/TRB/2324-066/P&P/30

SCALE : H - 1:2500
V - 1:250

NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)

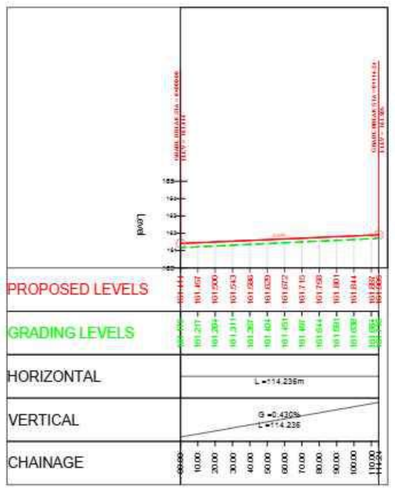
ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DFR/DPR	
Tender Drawing	✓
Revision	R0
Date	Feb. 2025

SHEET SIZE A2

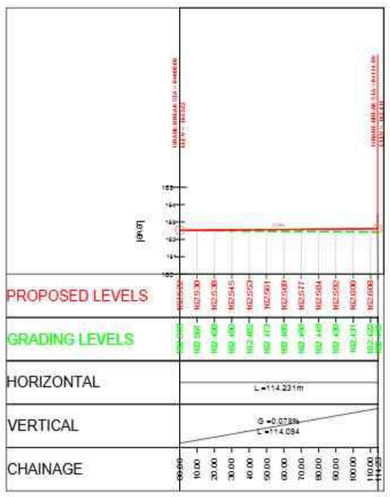
ROAD - R-09-25

ROAD - R-09-26

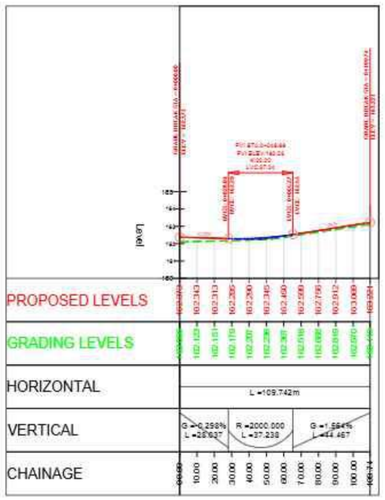
ROAD - R-09-27



ROAD - R-09-25



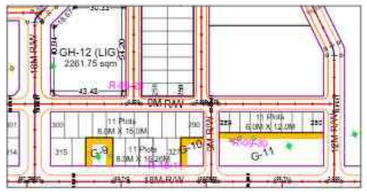
ROAD - R-09-26



ROAD - R-09-27

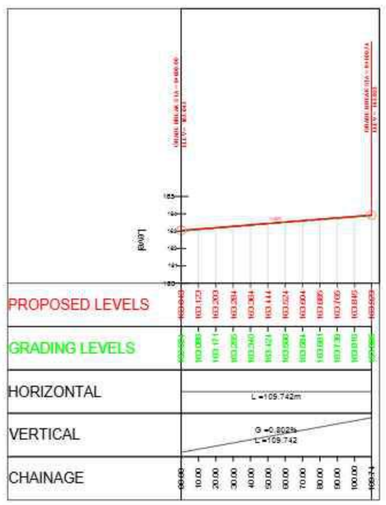
REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		**PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.**		N W E S	ISSUE RECORD / APPROVED FOR ISSUE
4												Concept
3												DFR/DPR
2							CONSULTANT :		DRAWING TITLE :	Plan & Profile for Road No - (R-09-25 to R-09-27)	SHEET SIZE	Tender Drawing ✓
1							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.		DRAWING NO :	VSPL/TRB/2324-066/P&P/31		Revision R0
0									SCALE :	H - 1:2500 V - 1:250	A2	Date Feb. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY						

ROAD - R-09-28

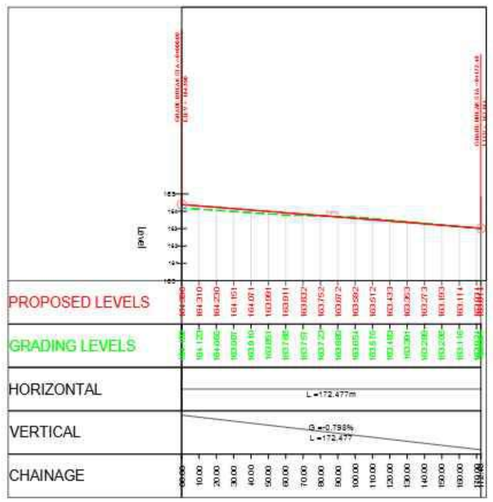


ROAD - R-09-29

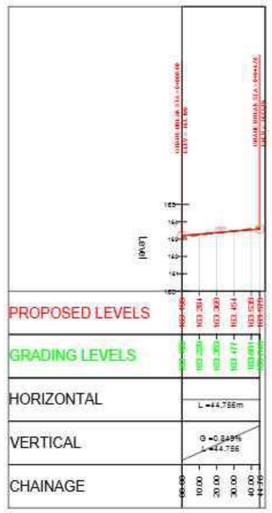
ROAD - R-09-30



ROAD - R-09-28

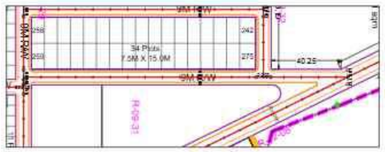


ROAD - R-09-29

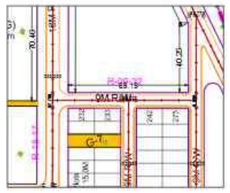


ROAD - R-09-30

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :	PROJECT TITLE :	NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010	**PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.**	ISSUE RECORD	APPROVED FOR ISSUE
4									Concept	
3									DFR/DPR	
2							CONSULTANT :	DRAWING TITLE :	Tender Drawing	✓
1							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.	Plan & Profile for Road No - (R-09-28 to R-09-30)	Revision	R0
0								DRAWING NO : VSPL/TRB/2324-066/P&P/32	Date	Feb. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY		SCALE : H - 1:2500 V - 1:250	SHEET SIZE A2	

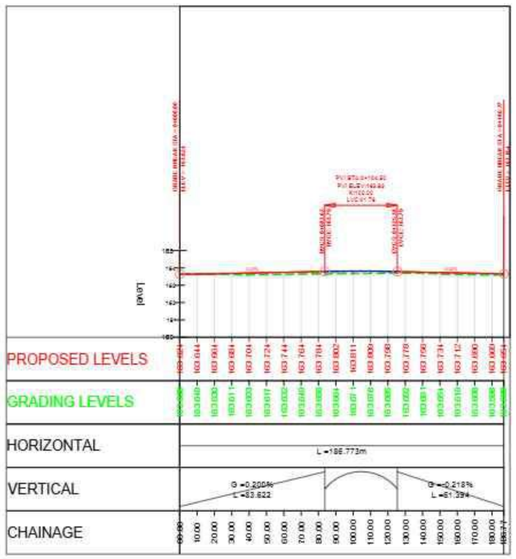


ROAD - R-09-31

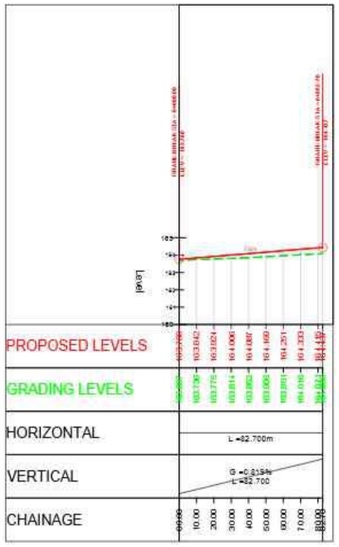


ROAD - R-09-32

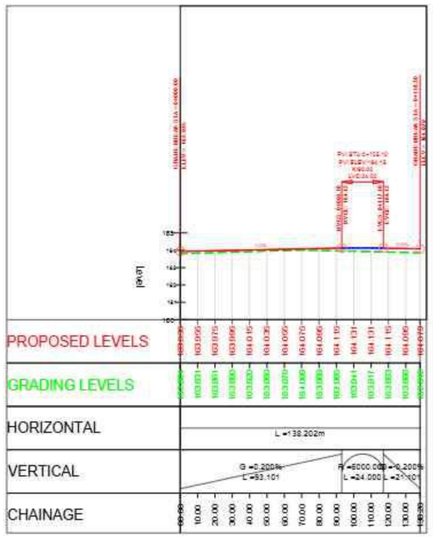
ROAD - R-09-33



ROAD - R-09-31

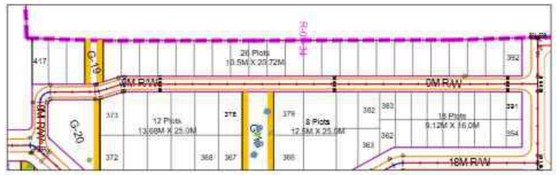


ROAD - R-09-32



ROAD - R-09-33

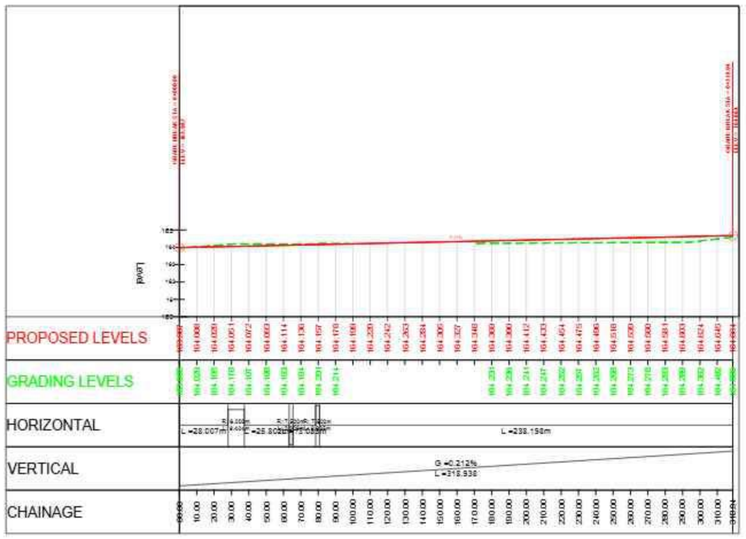
REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.		N W E S	ISSUE RECORD / APPROVED FOR ISSUE
4												Concept
3												DFR/DPR
2							CONSULTANT :		DRAWING TITLE :	Plan & Profile for Road No - (R-09-31 to R-09-33)	SHEET SIZE	Tender Drawing ✓
1									DRAWING NO :	VSPL/TRB/2324-066/P&P/33		Revision R0
0									SCALE :	H - 1:2500 V - 1:250	A2	Date Feb. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY	Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.					



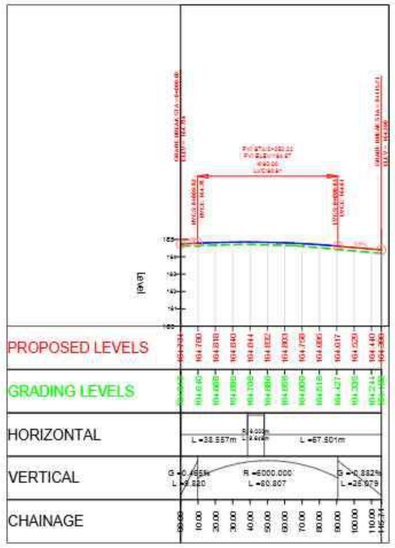
ROAD - R-09-34

ROAD - R-09-35

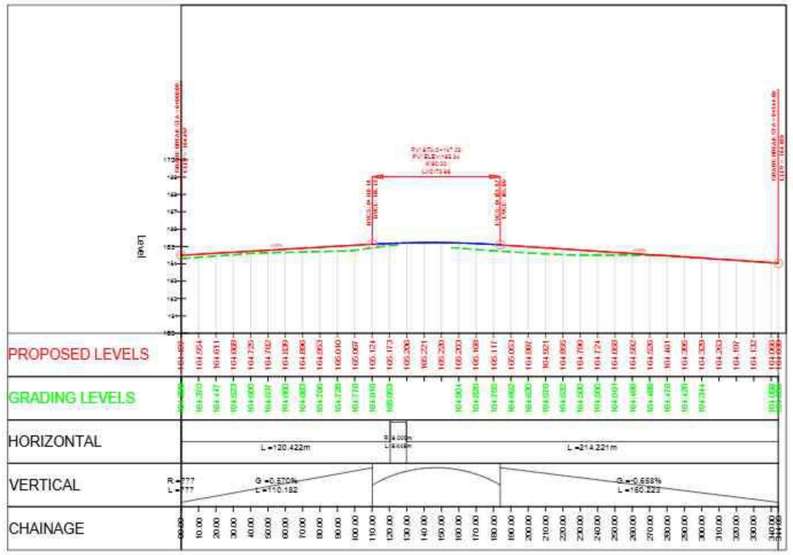
ROAD - R-09-36



ROAD - R-09-34



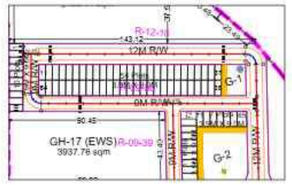
ROAD - R-09-35



ROAD - R-09-36

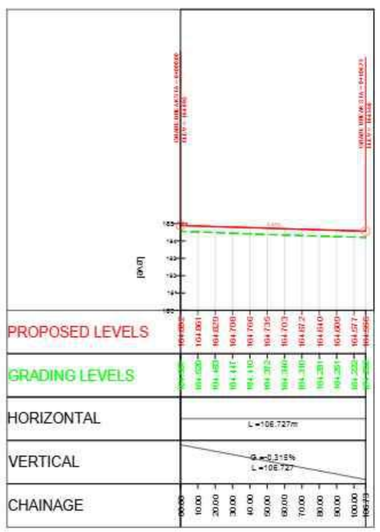
REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency					Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		**PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.**		
4											N / W E / S	ISSUE RECORD / APPROVED FOR ISSUE
3												Concept
2							CONSULTANT :		DRAWING TITLE :	Plan & Profile for Road No - (R-09-34 to R-09-36)		DFR/DPR
1								Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.	DRAWING NO :	VSPL/TRB/2324-066/P&P/34	SHEET SIZE	Tender Drawing ✓
0									SCALE :	H - 1:2500 V - 1:250	A2	Revision R0
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY						Date Feb. 2025

ROAD - R-09-37

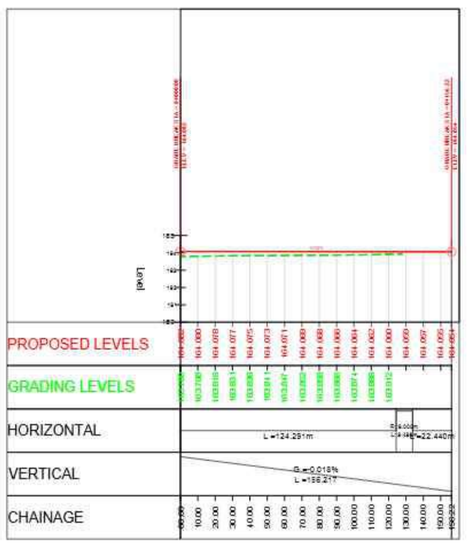


ROAD - R-09-38

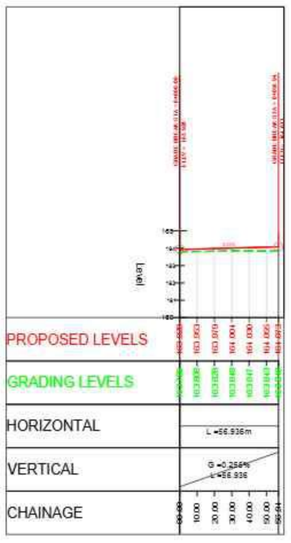
ROAD - R-09-39



ROAD - R-09-37

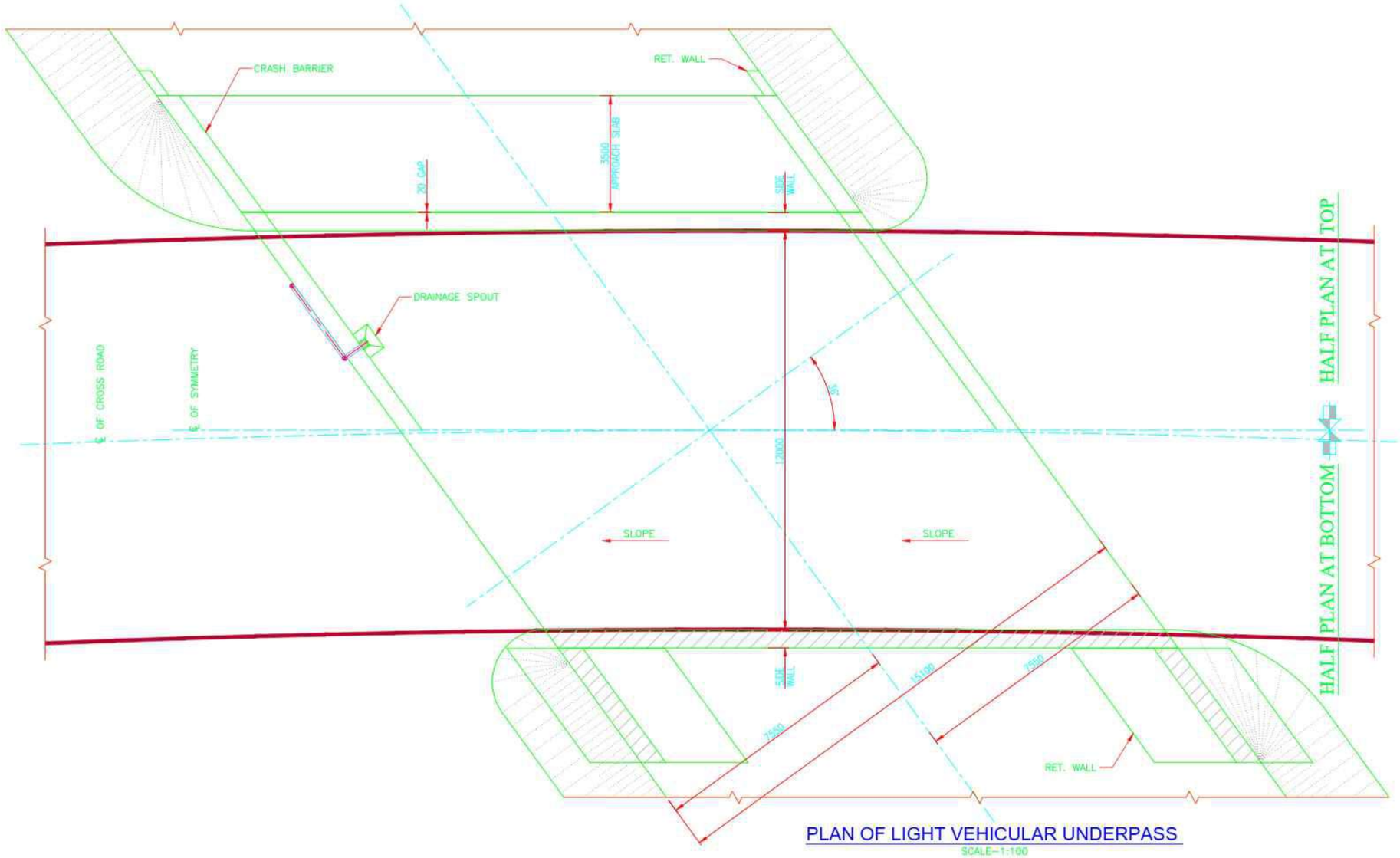


ROAD - R-09-38



ROAD - R-09-39

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :	PROJECT TITLE :	NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010	**PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.**	N W E S	ISSUE RECORD / APPROVED FOR ISSUE
4										Concept
3										DFR/DPR
2							CONSULTANT :	DRAWING TITLE : Plan & Profile for Road No - (R-09-37 to R-09-39)		Tender Drawing ✓
1							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.	DRAWING NO : VSPL/TRB/2324-066/P&P/35	SHEET SIZE	Revision R0
0								SCALE : H - 1:2500 V - 1:250	A2	Date Feb. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY				



PLAN OF LIGHT VEHICULAR UNDERPASS

SCALE–1:100

Sl. No	Design Chainage (km)	Span Arrangement (m)	Width (m)	Road no	Type of Structure	Recommendation
1	0+105	1X12X4.5	15.1	R12-01	LVUP	Reconstruction-(culvert)
2	0+140	1X12X4.5	15.1	R12-01	LVUP	Reconstruction-(culvert)

NOTES :-

1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN M UNLESS MENTIONED OTHERWISE.
2. DIMENSIONS ARE NOT TO BE SCALED, ONLY WRITTEN DIMENSIONS ARE TO BE FOLLOWED.
3. GRADE OF CONCRETE:–
   FOR RCC BOX M35
   FOR LEVELING COURSE M15
   CRASH BARRIER M40
   APPROACH SLAB M30
4. HIGH STRENGTH DEFORMED BARS SHALL BE OF GRADE Fe500D CONFORMING TO IS:1786–1985.
5. LAYING, COMPACTION & EXTENT OF BACKFILL BEHIND THE BOX WALLS SHALL CONSIST OF SELECTED EARTH CONFORMING TO THE APPENDIX–6 OF IRC:78–2014 HAVING PROPERTIES C=0, ϕ>30° & DENSITY=20KN/m.

REVISION BLOCK							
5							
4							
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2							
1							
0							
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY	

QUALITY ASSURANCE
The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency

CLIENT :
Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT :
Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE : **PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.**

DRAWING TITLE : GENERAL ARRANGEMENT DRAWING OF LIGHT VEHICULAR UNDERPASS (SPAN 1 x 12.0m x 4.5m)

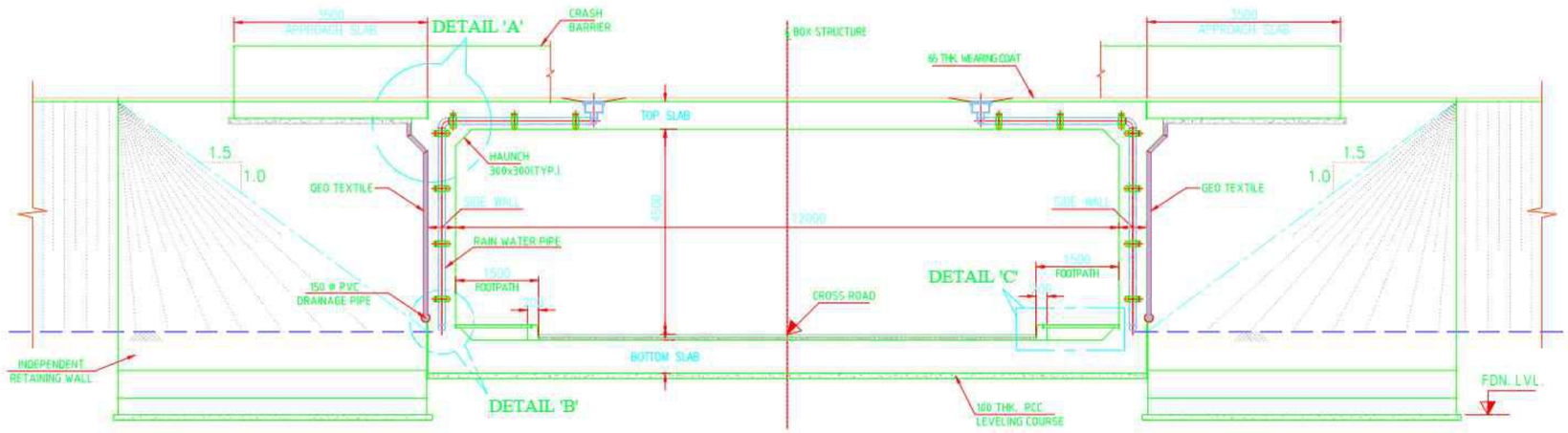
DRAWING NO : VSPL/2324-066/TRB/DPR/STR/LVUP-01(Sht. 1 of 2)

SCALE :

NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)

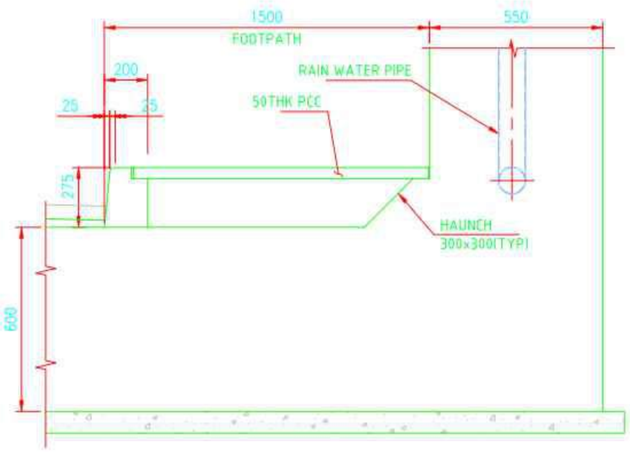
SHEET SIZE A2

ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DFR/DPR	
Tender Drawing	✓
Revision	R0
Date	Feb. 2025



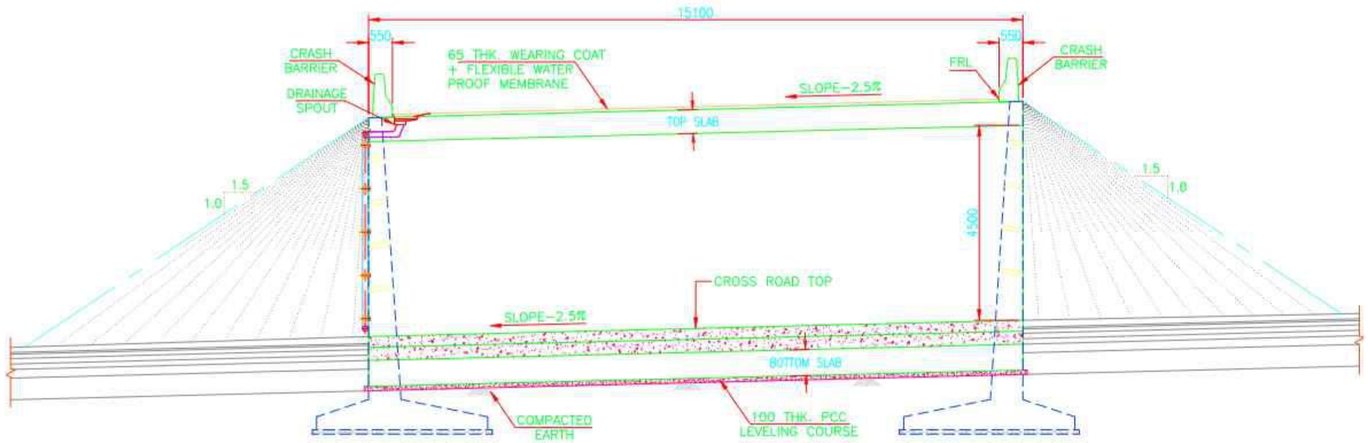
CROSS SECTION OF LIGHT VEHICULAR UNDERPASS

SCALE–1:75



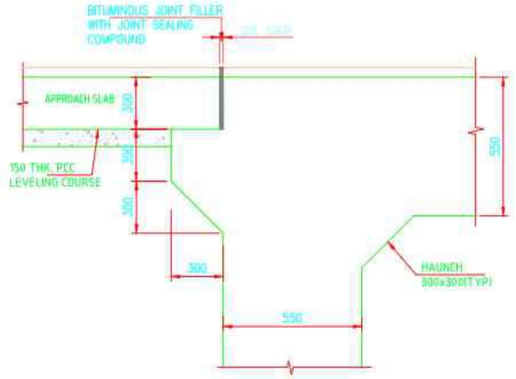
DETAIL - C

(Scale 1:20)



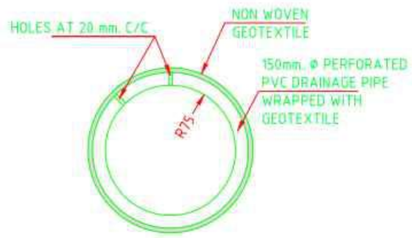
LONGITUDINAL SECTION OF LIGHT VEHICULAR UNDERPASS

SCALE–1:100



DETAIL - A

(Scale 1:25)



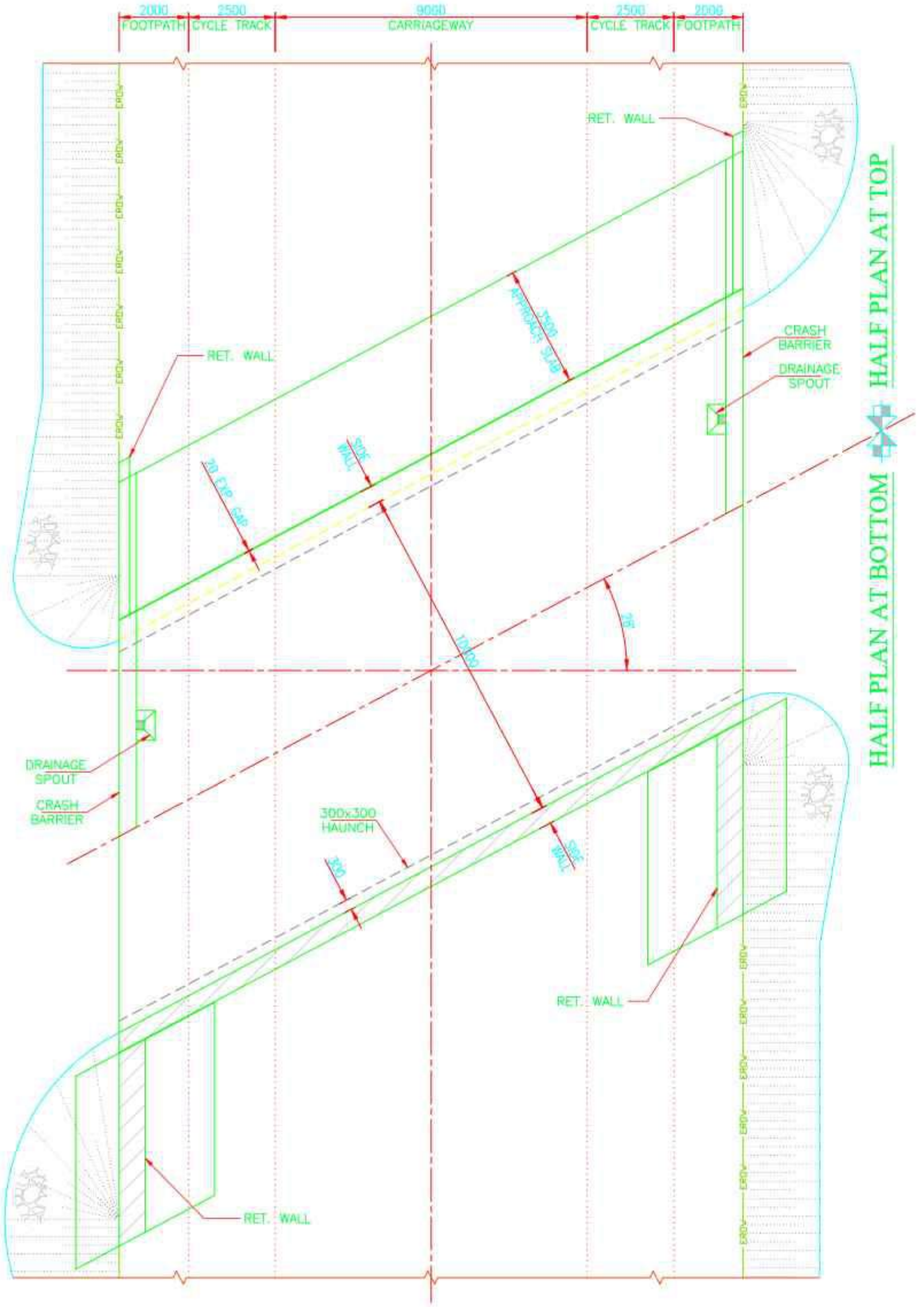
DETAIL - B

(Scale 1:5)

NOTES:–

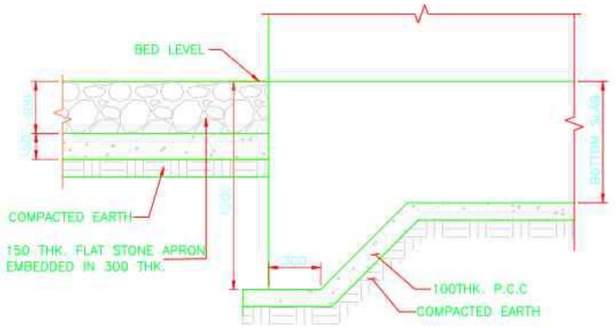
1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN M UNLESS MENTIONED OTHERWISE.
2. FOR ALL OTHER NOTE REFER DWG NO: VSPL/2324–066/TRB/DPR/STR/LVUP–01 (Sht. 01)
3. FOR CRASH BARRIER, DRAINAGE SPOUT DETAILS SEPERATE DRAWING WILL BE PROVIDED. VSPL/2324–012/TRB/DDN/STR/MISC–01.

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.		N W E S	ISSUE RECORD / APPROVED FOR ISSUE
4												Concept
3												DFR/DPR
2							CONSULTANT :		DRAWING TITLE :	GENERAL ARRANGEMENT DRAWING OF LIGHT VEHICULAR UNDERPASS (SPAN 1 x 12.0m x 4.5m)		Tender Drawing ✓
1							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.		DRAWING NO :	VSPL/2324-066/TRB/DPR/STR/LVUP-01(Sht. 2 of 2)	SHEET SIZE	Revision R0
0									SCALE :		A2	Date Feb. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY						



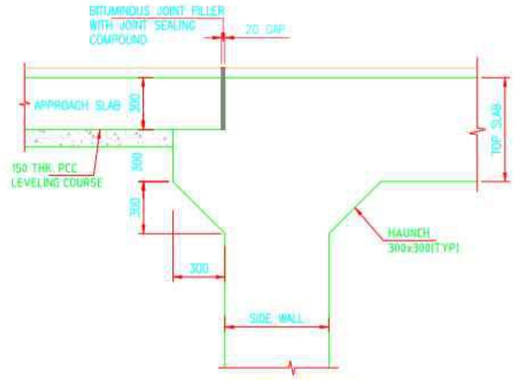
PLAN OF MINOR BRIDGE

SCALE–1:125



DETAIL - A

(Scale 1:25)



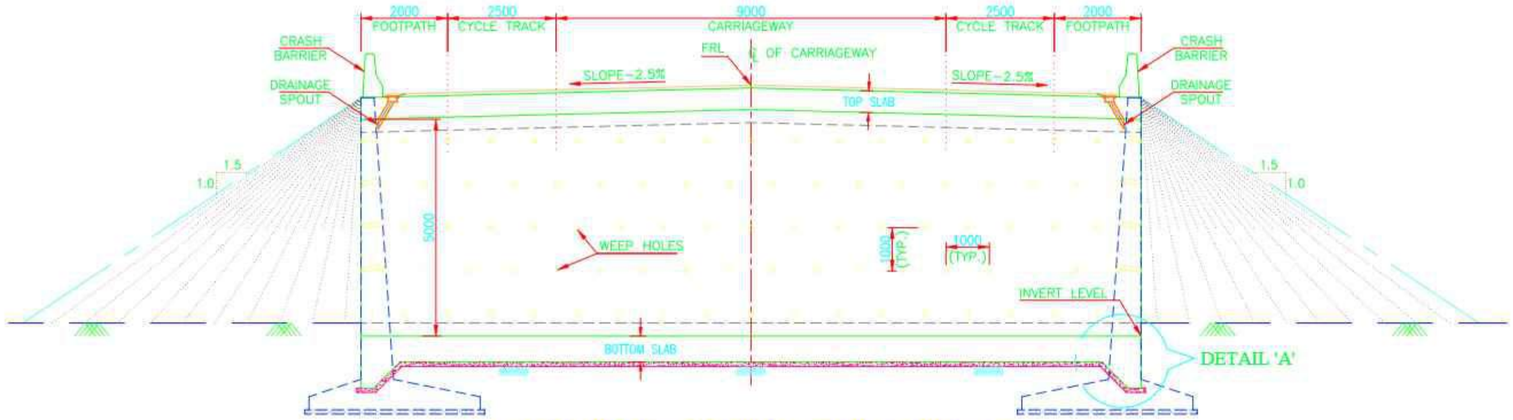
DETAIL - B

(Scale 1:25)

NOTES :–

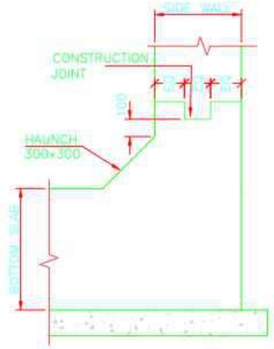
1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN M UNLESS MENTIONED OTHERWISE.
2. DIMENSIONS ARE NOT TO BE SCALED, ONLY WRITTEN DIMENSIONS ARE TO BE FOLLOWED.
3. GRADE OF CONCRETE USED:
   a) RCC BOX, RETURN WALL M35
   b) CRASH BARRIER M40
   c) APPROACH SLAB M30
   d) PCC LEVELLING COURSE M15
   e) CURTAIN WALL M20
4. HIGH STRENGTH DEFORMED BARS SHALL BE OF GRADE Fe500 CONFORMING TO IS: 1786–1985
5. DESIGN OF BRIDGE IS BASED ON LIVE LOAD COMBINATION OF 3–LANES OF CLASS A OR 1–LANE OF CLASS A + 1–LANE OF 70R WHICHEVER PRODUCE SEVERE EFFECT.
6. LAYING, COMPACTION & EXTENT OF BACKFILL BEHIND ABUTMENT & RETAINING WALLS SHALL CONSIST OF SELECTED EARTH CONFORMING TO THE APPENDIX–6 OF IRC:78–2014 HAVING PROPERTIES C=0, $\phi > 30°$ & DENSITY=20KN/m^3
7. WEEP HOLES ON THE ABUTMENT & RETAINING WALLS SHALL BE SPACED 1000 c/c HORIZONTALLY & VERTICALLY IN STAGGERED MANNER FROM 500MM ABOVE LWL TO HFL.
8. SPREADING AND COMPACTION OF SAND FILL WILL BE DONE IN ACCORDANCE WITH CLAUSE 401:3.2 OF SPECIFICATION FOR ROAD AND BRIDGE WORKS BY MoRT&H.
9. ALL STRUCTURAL DIMENSIONS DRAWN ARE BASED ON PRELIMINARY DESIGNS.

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.		N W E S	ISSUE RECORD / APPROVED FOR ISSUE
4												Concept
3												DFR/DPR
2							CONSULTANT :		DRAWING TITLE :	GENERAL ARRANGEMENT DRAWING OF MINOR BRIDGE (SPAN 1 x 10.0m x 5.0m)		Tender Drawing ✓
1							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.		DRAWING NO :	VSPL/2324-066/TRB/DPR/STR/MNB-01 (Sht. 1 of 2)	SHEET SIZE A2	Revision R0
0									SCALE :			Date Feb. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY						



LONGITUDINAL SECTION OF MINOR BRIDGE

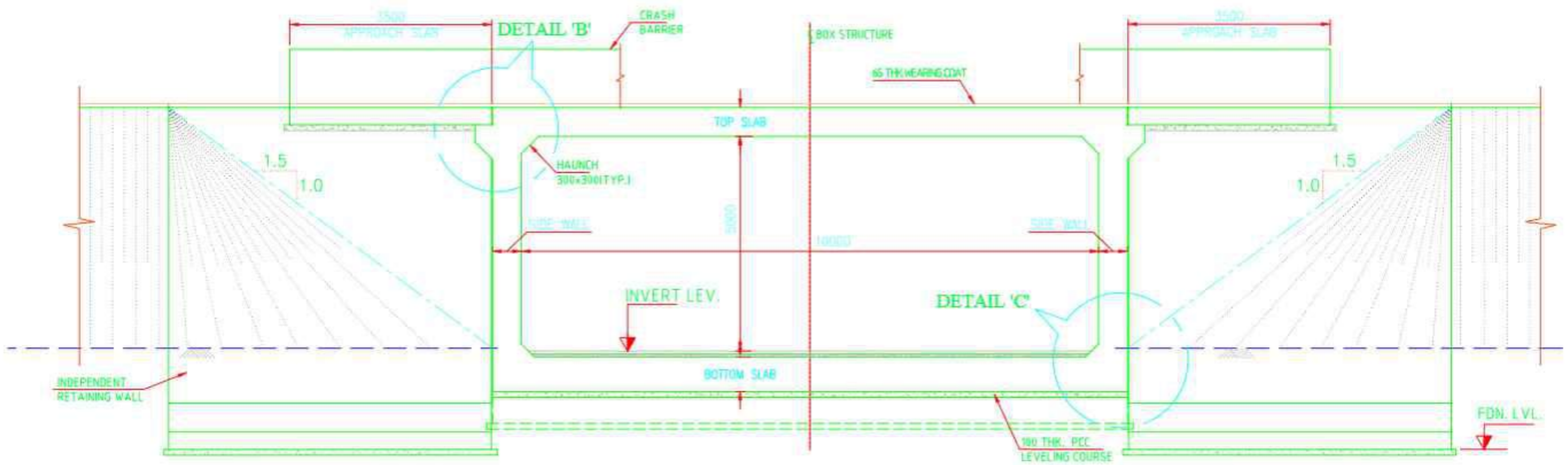
SCALE-1:100



DETAIL - C

(Scale 1:25)

Sl. No	Design Chainage (km)	Span Arrangement (m)	Skew Angle	Width (m)	Road no	Type of Structure	Recommendation
1	0+300	1 X 10	56	36	R36-04	Minor Bridge	New Construction
2	0+256	1 X 10	28	18	R18-13	Minor Bridge	New Construction
3	0+291	1 X 10	4	36	R36-03	Minor Bridge	New Construction



CROSS SECTION OF MINOR BRIDGE

SCALE-1:75

NOTES:-

1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN M UNLESS MENTIONED OTHERWISE.
2. FOR ALL OTHER NOTE REFER DWG NO: VSPL/2324-066/TRB/DPR/STR/MNB-01 (Sht. 01)
3. FOR CRASH BARRIER, DRAINAGE SPOUT DETAILS SEPERATE DRAWING WILL BE PROVIDED VSPL/2324-012/TRB/DDN/STR/MISC-01.

REVISION BLOCK							
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REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY	

QUALITY ASSURANCE

The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency

CLIENT :

Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT :

Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE : **PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.**

DRAWING TITLE : GENERAL ARRANGEMENT DRAWING OF MINOR BRIDGE (SPAN 1 x 10.0m x 5.0m)

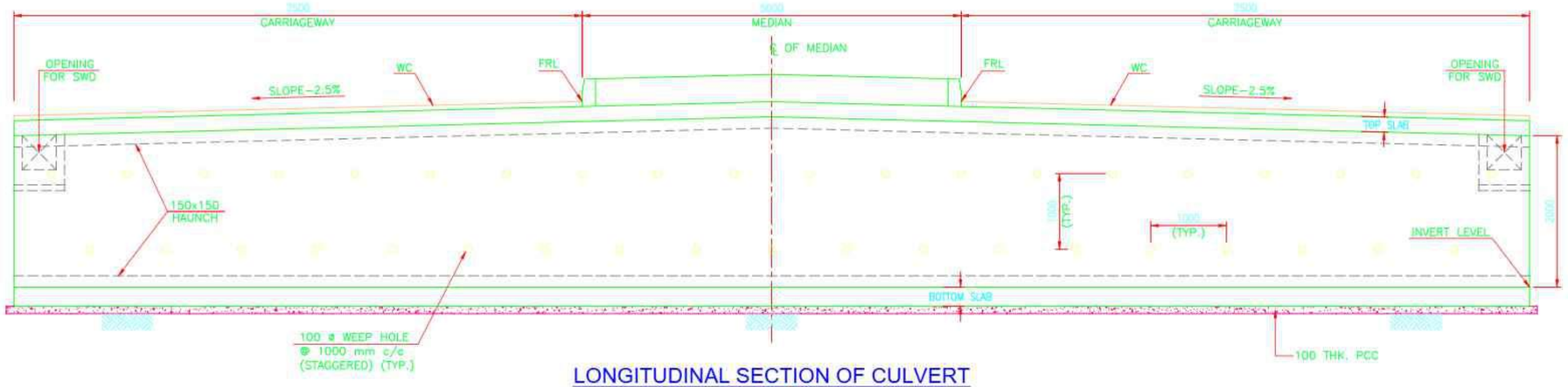
DRAWING NO : VSPL/2324-066/TRB/DPR/STR/MNB-01 (Sht. 2 of 2)

SCALE :

NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)

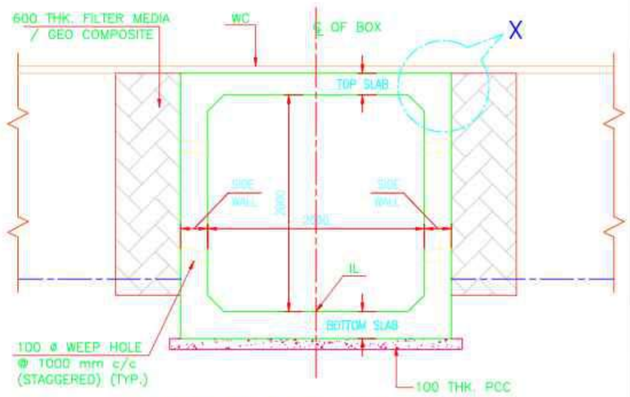
SHEET SIZE A2

ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DFR/DPR	
Tender Drawing	✓
Revision	R0
Date	Feb. 2025



LONGITUDINAL SECTION OF CULVERT

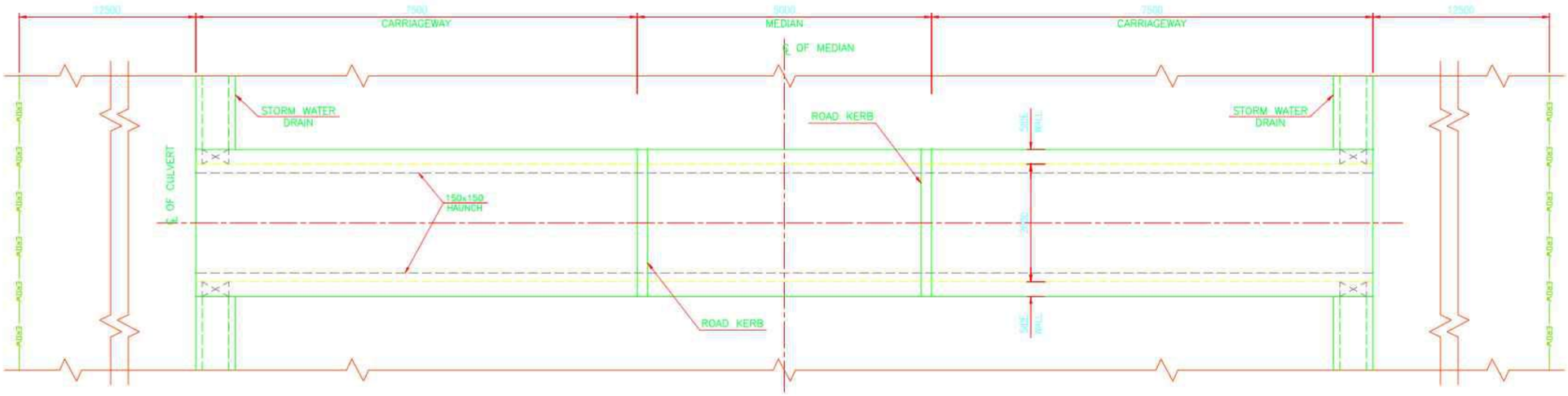
SCALE–1:50



CROSS SECTION OF CULVERT

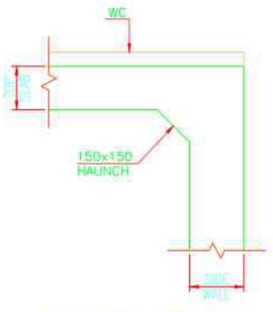
SCALE–1:40

Sn	Road no	No of Vent	Span	Height	Bottom Slab Thickness	Outer Wall Thickness	Top Slab Thickness	Width	Remarks
1	R-45-03	1	2	2	0.250	0.250	0.250	20.00	New Construction
2		1	2	2	0.250	0.250	0.250	20.00	New Construction
3		1	2	2	0.250	0.250	0.250	20.00	New Construction



PLAN OF CULVERT

SCALE–1:60



DETAIL - 'X'

SCALE–1:20

NOTES :-

1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN M UNLESS MENTIONED OTHERWISE.
2. DIMENSIONS ARE NOT TO BE SCALED, ONLY WRITTEN DIMENSIONS ARE TO BE FOLLOWED.
3. ALL CONCRETE SHALL BE DESIGN MIX & MINIMUM GRADE OF WHICH IN VARIOUS COMPONENTS SHALL BE AS FOLLOWS:–
   RCC BOX M30
   PCC LEVELING COURSE M15
4. HIGH STRENGTH DEFORMED BARS SHALL BE OF GRADE Fe500D CONFORMING TO IS:1786–1985.
5. LAYING, COMPACTION & EXTENT OF BACKFILL BEHIND THE BOX WALLS SHALL CONSIST OF SELECTED EARTH CONFORMING TO THE APPENDIX–6 OF IRC:78–2014 HAVING PROPERTIES C=0, Φ>30° & DENSITY=20KN/m.

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.		N W E S	ISSUE RECORD / APPROVED FOR ISSUE
4												Concept
3												DFR/DPR
2							CONSULTANT :		DRAWING TITLE :	GENERAL ARRANGEMENT DRAWING OF BOX CULVERT (SPAN 1 x 2.0m x 2.0m)		Tender Drawing ✓
1							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.		DRAWING NO :	VSPL/2324-066/TRB/DPR/STR/BC-01	SHEET SIZE	Revision R0
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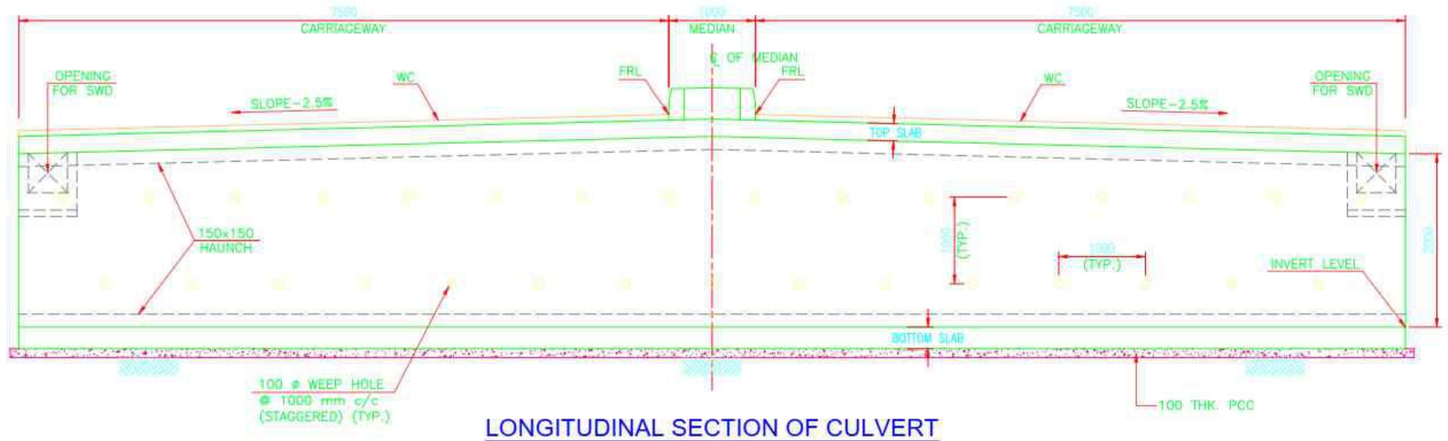
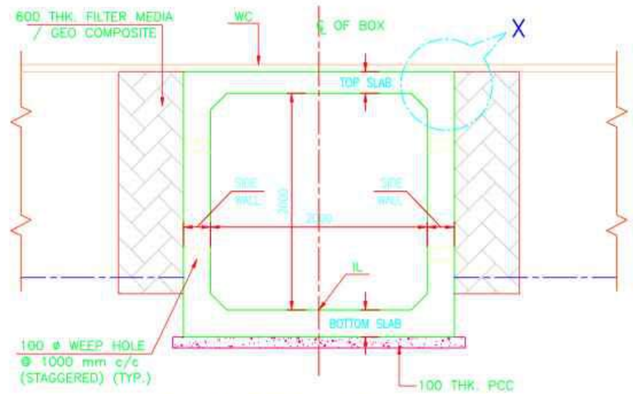
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY						



LONGITUDINAL SECTION OF CULVERT

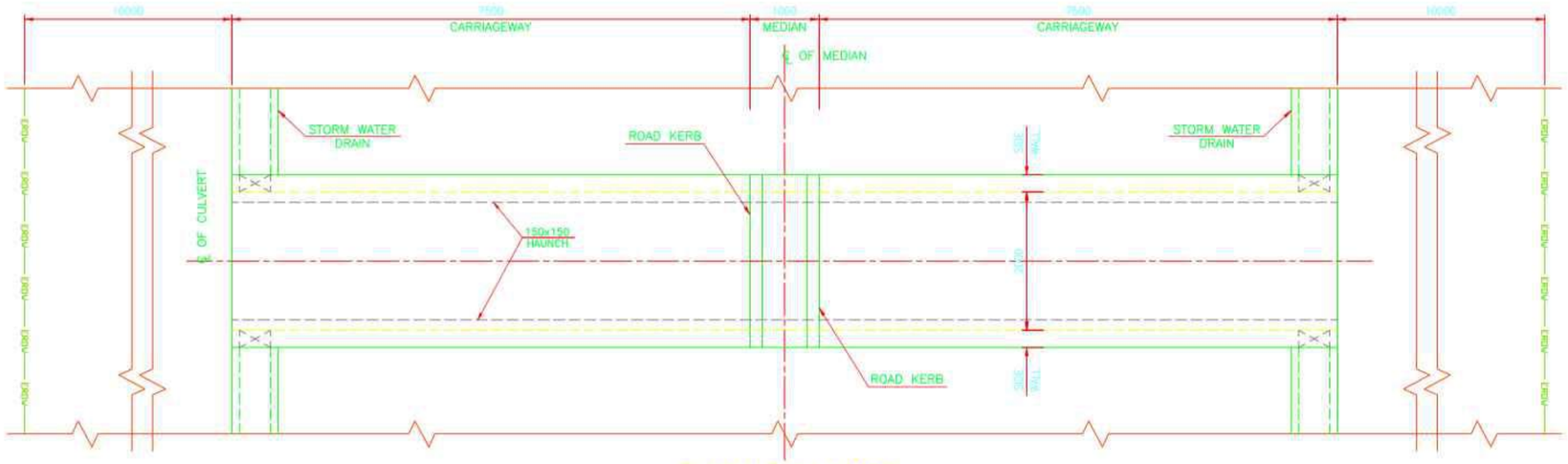
SCALE-1:50



CROSS SECTION OF CULVERT

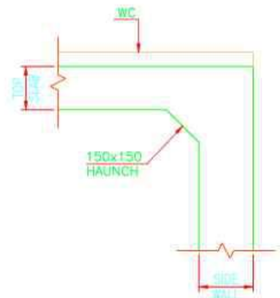
SCALE-1:40

Sn	Road no	No of Vent	Span	Height	Bottom Slab Thickness	Outer Wall Thickness	Top Slab Thickness	Width	Remarks
1	R-36-01	1	2	2	0.250	0.250	0.250	16.00	New Construction
2		1	2	2	0.250	0.250	0.250	16.00	New Construction
3	R-36-02	1	2	2	0.250	0.250	0.250	16.00	New Construction
4		1	2	2	0.250	0.250	0.250	16.00	New Construction
5	R-36-03	1	2	2	0.250	0.250	0.250	16.00	New Construction
6		1	2	2	0.250	0.250	0.250	16.00	New Construction
7	R-36-04	1	2	2	0.250	0.250	0.250	16.00	New Construction
8		1	2	2	0.250	0.250	0.250	16.00	New Construction
9		1	2	2	0.250	0.250	0.250	16.00	New Construction



PLAN OF CULVERT

SCALE-1:60



DETAIL - 'X'

SCALE-1:20

NOTES: -

1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN M UNLESS MENTIONED OTHERWISE.
2. DIMENSIONS ARE NOT TO BE SCALED, ONLY WRITTEN DIMENSIONS ARE TO BE FOLLOWED.
3. ALL CONCRETE SHALL BE DESIGN MIX & MINIMUM GRADE OF WHICH IN VARIOUS COMPONENTS SHALL BE AS FOLLOWS:-
   RCC BOX M30
   PCC LEVELING COURSE M15
4. HIGH STRENGTH DEFORMED BARS SHALL BE OF GRADE Fe500D CONFORMING TO IS:1786-1985.
5. LAYING, COMPACTION & EXTENT OF BACKFILL BEHIND THE BOX WALLS SHALL CONSIST OF SELECTED EARTH CONFORMING TO THE APPENDIX-6 OF IRC:78-2014 HAVING PROPERTIES C=0, ϕ>30° & DENSITY=20KN/m.

REVISION BLOCK							
5							
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REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY	

QUALITY ASSURANCE
The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency

CLIENT :
Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT :
Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE :
PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.

DRAWING TITLE :
GENERAL ARRANGEMENT DRAWING OF BOX CULVERT (SPAN 1 x 2.0m x 2.0m)

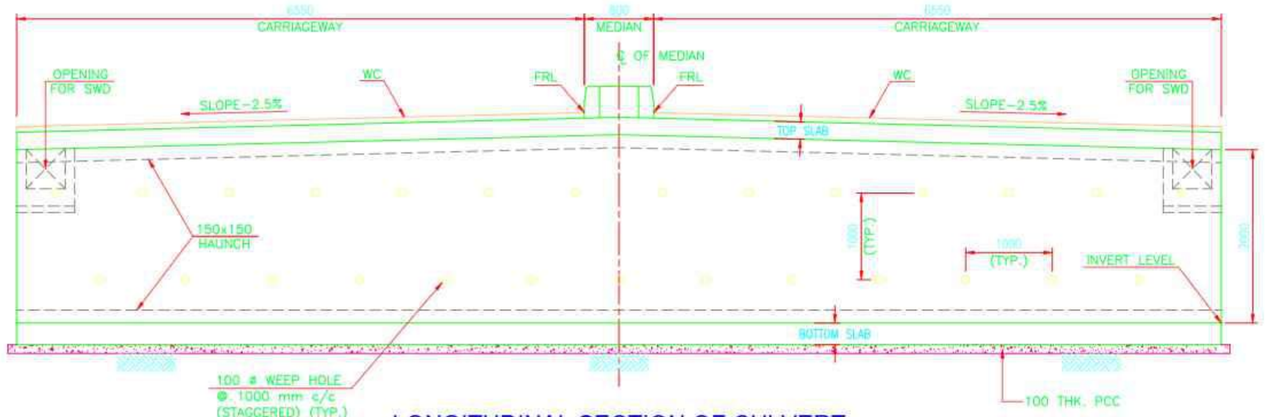
DRAWING NO : VSPL/2324-066/TRB/DPR/STR/BC-02

SCALE :

NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)

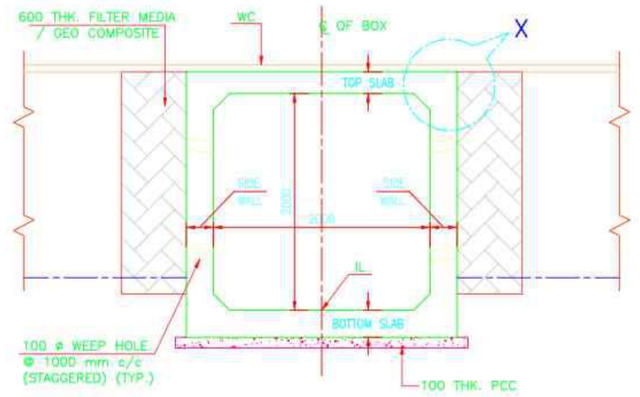
SHEET SIZE A2

ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DFR/DPR	
Tender Drawing	✓
Revision	R0
Date	Feb. 2025



LONGITUDINAL SECTION OF CULVERT

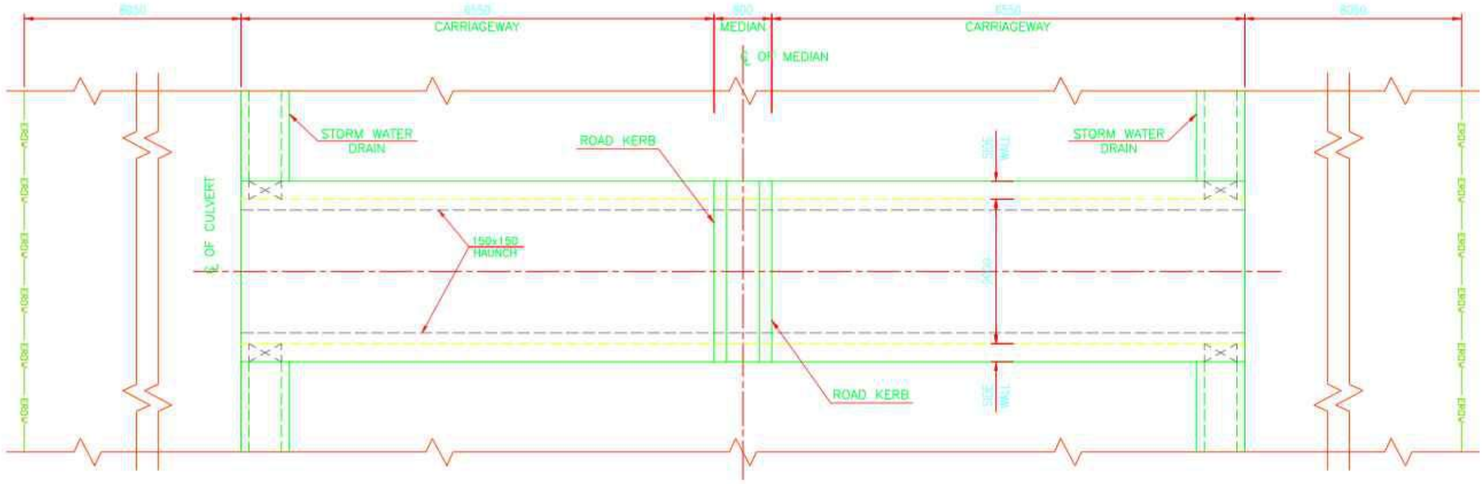
SCALE-1:50



CROSS SECTION OF CULVERT

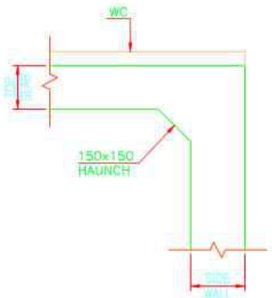
SCALE-1:40

Sn	Road no	No of Vent	Span	Height	Bottom Slab Thickness	Outer Wall Thickness	Top Slab Thickness	Width	Remarks
1	R-30-01	1	2	2	0.250	0.250	0.250	13.90	New Construction
2		1	2	2	0.250	0.250	0.250	13.90	New Construction
3		1	2	2	0.250	0.250	0.250	13.90	New Construction



PLAN OF CULVERT

SCALE-1:60



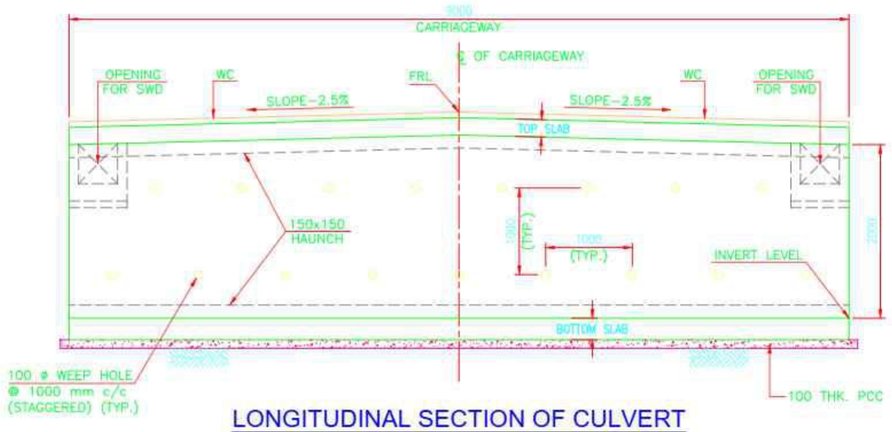
DETAIL - 'X'

SCALE-1:20

NOTES :-

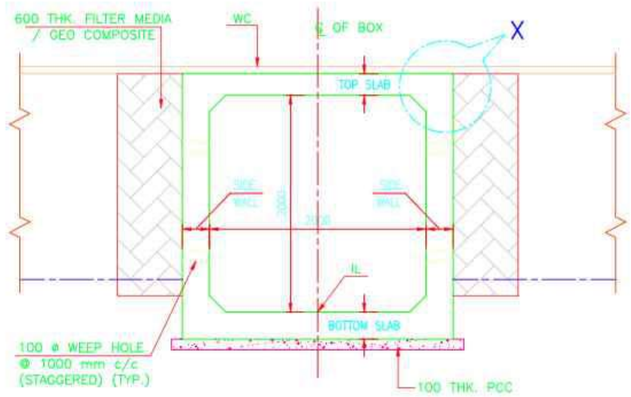
1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN M UNLESS MENTIONED OTHERWISE.
2. DIMENSIONS ARE NOT TO BE SCALED, ONLY WRITTEN DIMENSIONS ARE TO BE FOLLOWED.
3. ALL CONCRETE SHALL BE DESIGN MIX & MINIMUM GRADE OF WHICH IN VARIOUS COMPONENTS SHALL BE AS FOLLOWS:-
   RCC BOX M30
   PCC LEVELING COURSE M15
4. HIGH STRENGTH DEFORMED BARS SHALL BE OF GRADE Fe500D CONFORMING TO IS:1786-1985.
5. LAYING, COMPACTION & EXTENT OF BACKFILL BEHIND THE BOX WALLS SHALL CONSIST OF SELECTED EARTH CONFORMING TO THE APPENDIX-6 OF IRC:78-2014 HAVING PROPERTIES C=0, Φ≥30° & DENSITY=20KN/m.

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency					Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		**PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.**		
4												
3												
2							CONSULTANT :		DRAWING TITLE :	GENERAL ARRANGEMENT DRAWING OF BOX CULVERT (SPAN 1 x 2.0m x 2.0m)	ISSUE RECORD	APPROVED FOR ISSUE
1											Concept	
0								Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.	DRAWING NO :	VSPL/2324-066/TRB/DPR/STR/BC-03	DFR/DPR	
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY			SCALE :		Tender Drawing	✓
											SHEET SIZE A2	Revision R0
												Date Feb. 2025



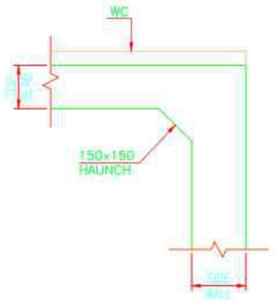
LONGITUDINAL SECTION OF CULVERT

SCALE–1:50



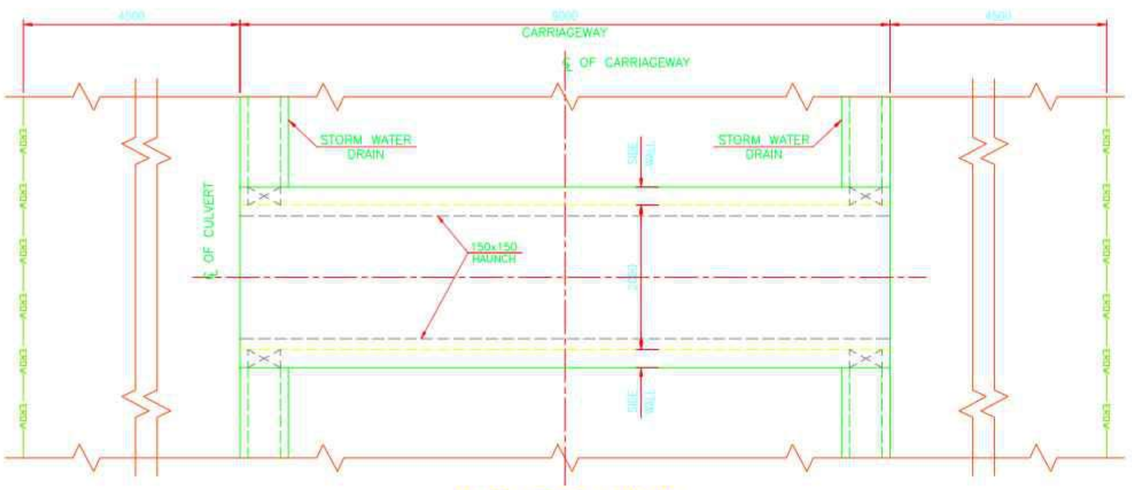
CROSS SECTION OF CULVERT

SCALE–1:40



DETAIL - 'X'

SCALE–1:20



PLAN OF CULVERT

SCALE–1:60

Sn	Road no	No of Vent	Span	Height	Bottom Slab Thickness	Outer Wall Thickness	Top Slab Thickness	Width	Remarks
1	R-18-02	1	2	2	0.250	0.250	0.250	7.50	New Construction
2	R-18-04	1	2	2	0.250	0.250	0.250	7.50	New Construction
3	R-18-05	1	2	2	0.250	0.250	0.250	7.50	New Construction
4	R-18-07	1	2	2	0.250	0.250	0.250	7.50	New Construction
5		1	2	2	0.250	0.250	0.250	7.50	New Construction
6		1	2	2	0.250	0.250	0.250	7.50	New Construction
7	R-18-07A	1	2	2	0.250	0.250	0.250	7.50	New Construction
8	R-18-09	1	2	2	0.250	0.250	0.250	7.50	New Construction
9	R-18-11	1	2	2	0.250	0.250	0.250	7.50	New Construction
10	R-18-12	1	2	2	0.250	0.250	0.250	7.50	New Construction
11	R-18-13	1	2	2	0.250	0.250	0.250	7.50	New Construction
12	R-18-14	1	2	2	0.250	0.250	0.250	7.50	New Construction
13	R-18-15	1	2	2	0.250	0.250	0.250	7.50	New Construction
14		1	2	2	0.250	0.250	0.250	7.50	New Construction
15	R-18-16	1	2	2	0.250	0.250	0.250	7.50	New Construction
16	R-18-17	1	2	2	0.250	0.250	0.250	7.50	New Construction
17		1	2	2	0.250	0.250	0.250	7.50	New Construction
18	R-18-18	1	2	2	0.250	0.250	0.250	7.50	New Construction
19		1	2	2	0.250	0.250	0.250	7.50	New Construction
20	R-18-21	1	2	2	0.250	0.250	0.250	7.50	New Construction
21		1	2	2	0.250	0.250	0.250	7.50	New Construction

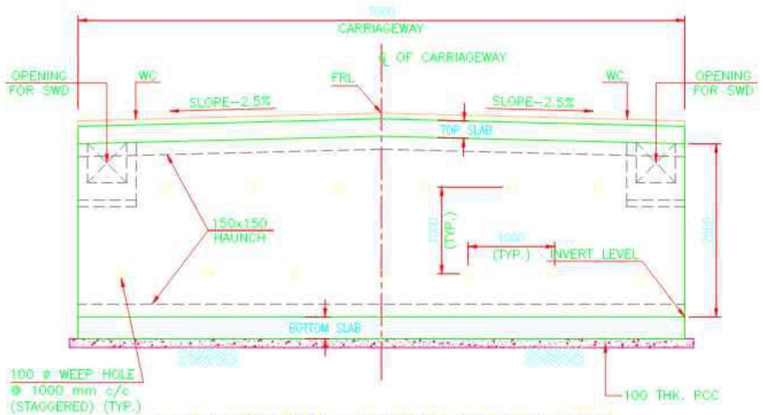
NOTES: -

1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN M UNLESS MENTIONED OTHERWISE.
2. DIMENSIONS ARE NOT TO BE SCALED, ONLY WRITTEN DIMENSIONS ARE TO BE FOLLOWED.
3. ALL CONCRETE SHALL BE DESIGN MIX & MINIMUM GRADE OF WHICH IN VARIOUS COMPONENTS SHALL BE AS FOLLOWS:–
   RCC BOX M30
   PCC LEVELING COURSE M15
4. HIGH STRENGTH DEFORMED BARS SHALL BE OF GRADE Fe500D CONFORMING TO IS:1786–1985.
5. LAYING, COMPACTION & EXTENT OF BACKFILL BEHIND THE BOX WALLS SHALL CONSIST OF SELECTED EARTH CONFORMING TO THE APPENDIX–6 OF IRC:78–2014 HAVING PROPERTIES C=0, ϕ≥30° & DENSITY=20KN/m.

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.		N W E S	ISSUE RECORD / APPROVED FOR ISSUE
4												Concept
3												DFR/DPR
2							CONSULTANT :		DRAWING TITLE :	GENERAL ARRANGEMENT DRAWING OF BOX CULVERT (SPAN 1 x 2.0m x 2.0m)		Tender Drawing ✓
1							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.		DRAWING NO :	VSPL/2324-066/TRB/DPR/STR/BC-04	SHEET SIZE	Revision R0
0									SCALE :		A2	Date Feb. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY						

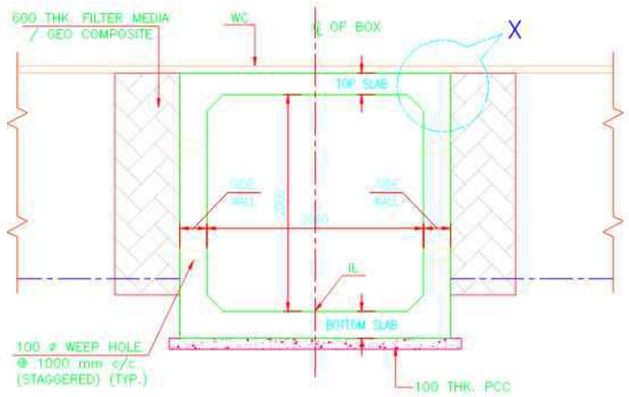
WET UTILITIES

(Storm Drain, Potable Water, Treated Waste Water, Sewerage and Rainwater Harvesting)



LONGITUDINAL SECTION OF CULVERT

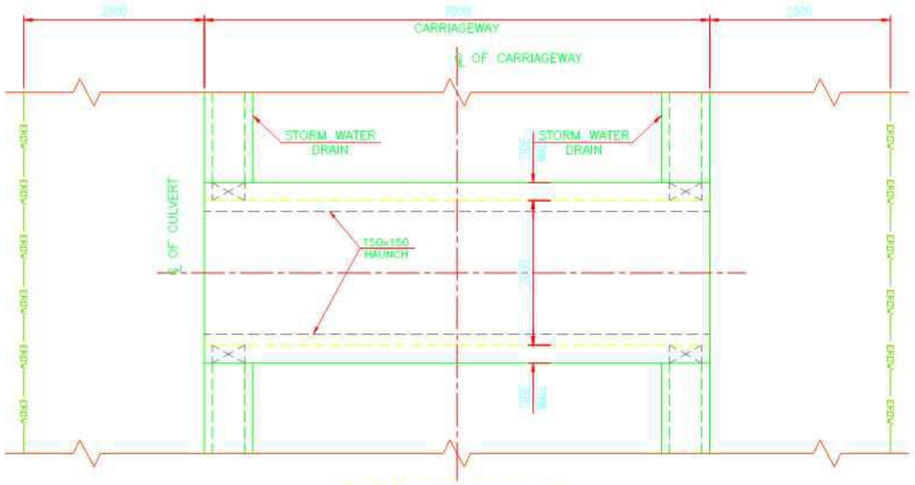
SCALE–1:50



CROSS SECTION OF CULVERT

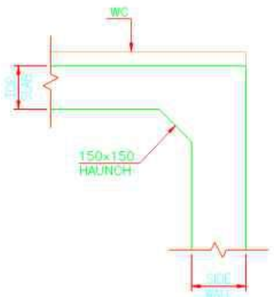
SCALE–1:40

Sn	Road no	No of Vent	Span	Height	Bottom Slab Thickness	Outer Wall Thickness	Top Slab Thickness	Width	Remarks
1	R-12-01	1	2	2	0.250	0.250	0.250	7.00	New Construction
2	R-12-02	1	2	2	0.250	0.250	0.250	7.00	New Construction
3	R-12-03	1	2	2	0.250	0.250	0.250	7.00	New Construction
4	R-12-04	1	2	2	0.250	0.250	0.250	7.00	New Construction
5		1	2	2	0.250	0.250	0.250	7.00	New Construction
6	R-12-06	1	2	2	0.250	0.250	0.250	7.00	New Construction
7		1	2	2	0.250	0.250	0.250	7.00	New Construction
8	R-12-09	1	2	2	0.250	0.250	0.250	7.00	New Construction
9	R-12-12	1	2	2	0.250	0.250	0.250	7.00	New Construction
10		1	2	2	0.250	0.250	0.250	7.00	New Construction



PLAN OF CULVERT

SCALE–1:60



DETAIL - 'X'

SCALE–1:20

NOTES: -

1. ALL DIMENSIONS ARE IN MM AND LEVELS ARE IN M UNLESS MENTIONED OTHERWISE.
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3. ALL CONCRETE SHALL BE DESIGN MIX & MINIMUM GRADE OF WHICH IN VARIOUS COMPONENTS SHALL BE AS FOLLOWS:–
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   PCC LEVELING COURSE M15
4. HIGH STRENGTH DEFORMED BARS SHALL BE OF GRADE Fe500D CONFORMING TO IS:1786–1985.
5. LAYING, COMPACTION & EXTENT OF BACKFILL BEHIND THE BOX WALLS SHALL CONSIST OF SELECTED EARTH CONFORMING TO THE APPENDIX–6 OF IRC:78–2014 HAVING PROPERTIES C=0, ϕ>30° & DENSITY=20KN/m.

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.		ISSUE RECORD	APPROVED FOR ISSUE
4											Concept	
3											DFR/DPR	
2							CONSULTANT :		DRAWING TITLE :	GENERAL ARRANGEMENT DRAWING OF BOX CULVERT (SPAN 1 x 2.0m x 2.0m)	Tender Drawing	✓
1							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.		DRAWING NO :	VSPL/2324-066/TRB/DPR/STR/BC-05	Revision	R0
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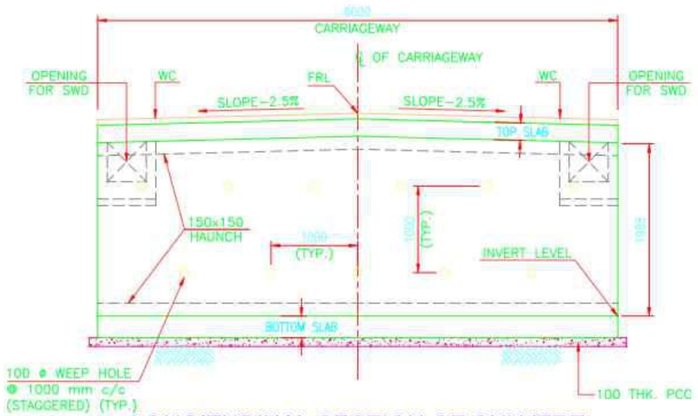
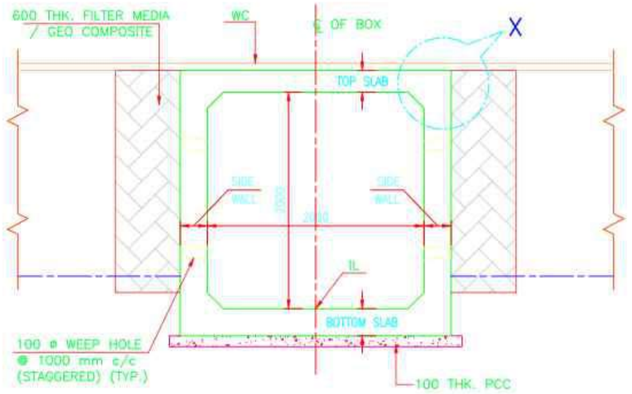
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY						



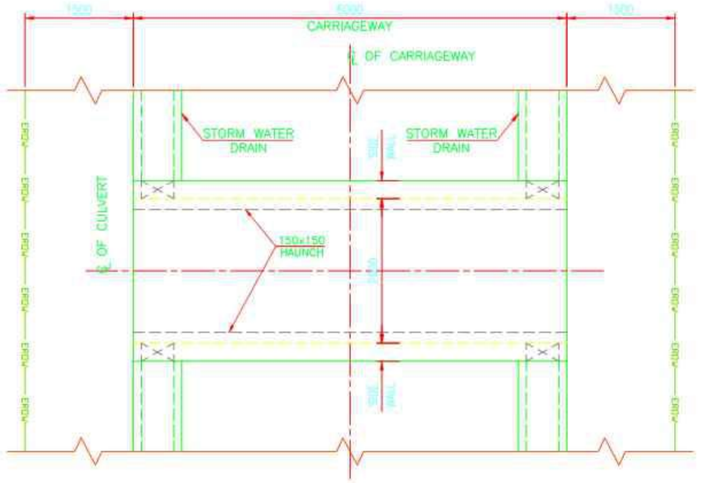
LONGITUDINAL SECTION OF CULVERT

SCALE-1:50



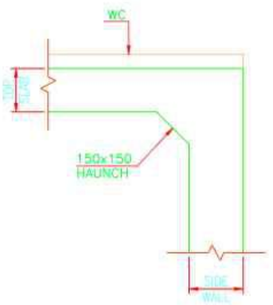
CROSS SECTION OF CULVERT

SCALE-1:40



PLAN OF CULVERT

SCALE-1:60



DETAIL - 'X'

SCALE-1:20

Sn	Road no	No of Vent	Span	Height	Bottom Slab Thickness	Outer Wall Thickness	Top Slab Thickness	Width	Remarks
1	R-09-3	1	2	2	0.250	0.250	0.250	6.00	New Construction
2	R-09-30	1	2	2	0.250	0.250	0.250	6.00	New Construction
3	R-09-39	1	2	2	0.250	0.250	0.250	6.00	New Construction
4	R-09-43	1	2	2	0.250	0.250	0.250	6.00	New Construction
5		1	2	2	0.250	0.250	0.250	6.00	New Construction

NOTES :-

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3. ALL CONCRETE SHALL BE DESIGN MIX & MINIMUM GRADE OF WHICH IN VARIOUS COMPONENTS SHALL BE AS FOLLOWS:-
   RCC BOX M30
   PCC LEVELING COURSE M15
4. HIGH STRENGTH DEFORMED BARS SHALL BE OF GRADE Fe500D CONFORMING TO IS:1786-1985.
5. LAYING, COMPACTION & EXTENT OF BACKFILL BEHIND THE BOX WALLS SHALL CONSIST OF SELECTED EARTH CONFORMING TO THE APPENDIX-6 OF IRC:78-2014 HAVING PROPERTIES C=0, ϕ>30° & DENSITY=20KN/m.

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency					Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.		ISSUE RECORD / APPROVED FOR ISSUE
4												Concept
3												DFR/DPR
2							CONSULTANT :		DRAWING TITLE :	GENERAL ARRANGEMENT DRAWING OF BOX CULVERT (SPAN 1 x 2.0m x 2.0m)		Tender Drawing ✓
1								Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.	DRAWING NO :	VSPL/2324-066/TRB/DPR/STR/BC-06	SHEET SIZE	Revision R0
0									SCALE :		A2	Date Feb. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY						

LEGEND

Storm Water Network (Width in Meters)

Storm Node

Flow Direction

Outfall

Outfall

TOWARDS AGRA

PROPOSED MP RD. 45M ROW

RAILWAY LINE

PROPOSED MP RD. 45M ROW

PROPOSED 30M ROW

ENTRY /EXIT

MASTER PLAN ROAD 75.0M WIDE

TOWARDS AGRA

BHANDAI

KAKUA VILLAGE

PROPOSED MP RD. 45M ROW

G CANAL

EXISTING CANAL

TOWARDS YAMUNA EXPRESSWAY

INNER RING ROAD

PROPOSED 60M ROW

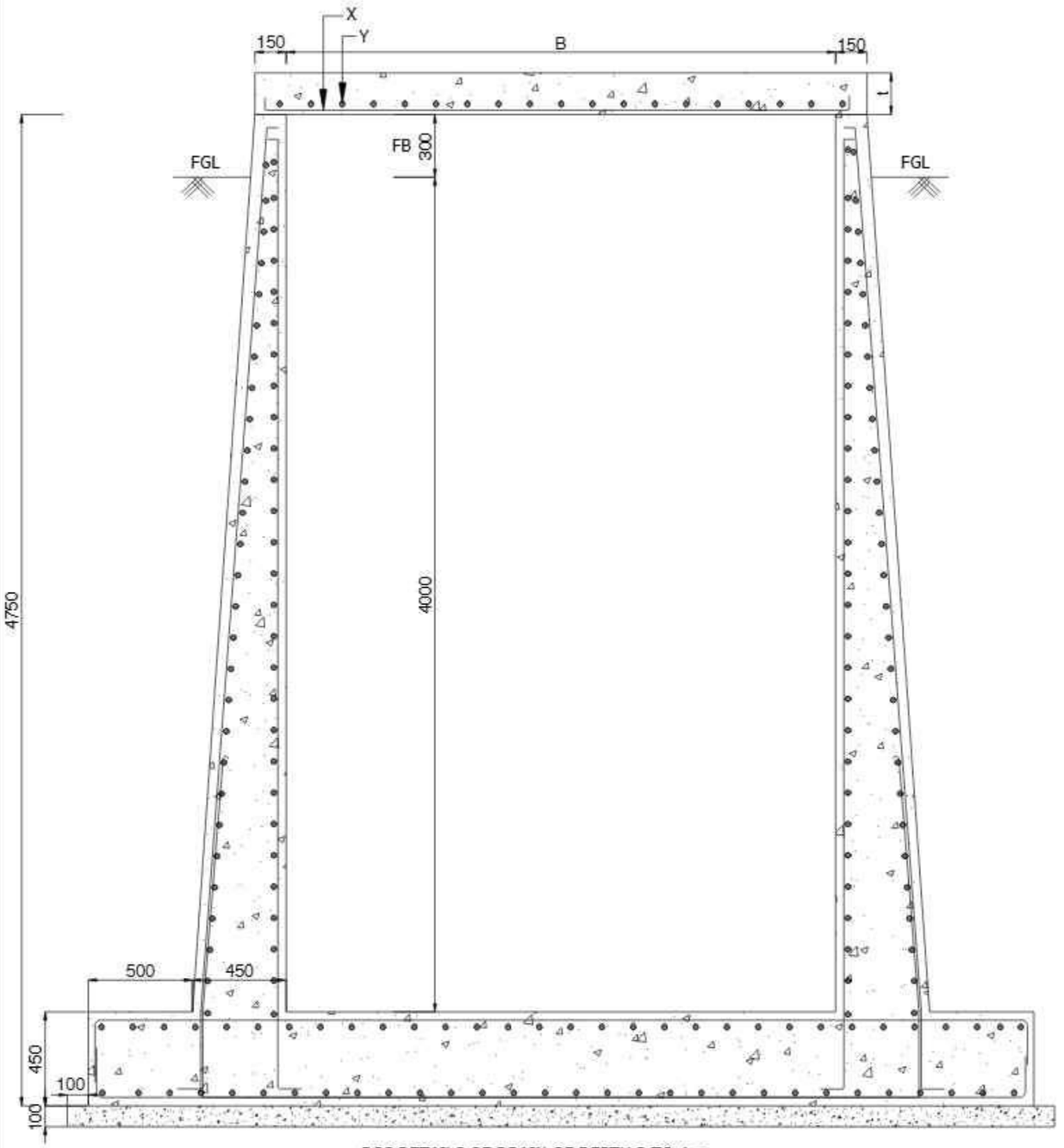
EXIT

TOWARDS MATHURA, DELHI

NH - 44

TOWARDS GWALIOR

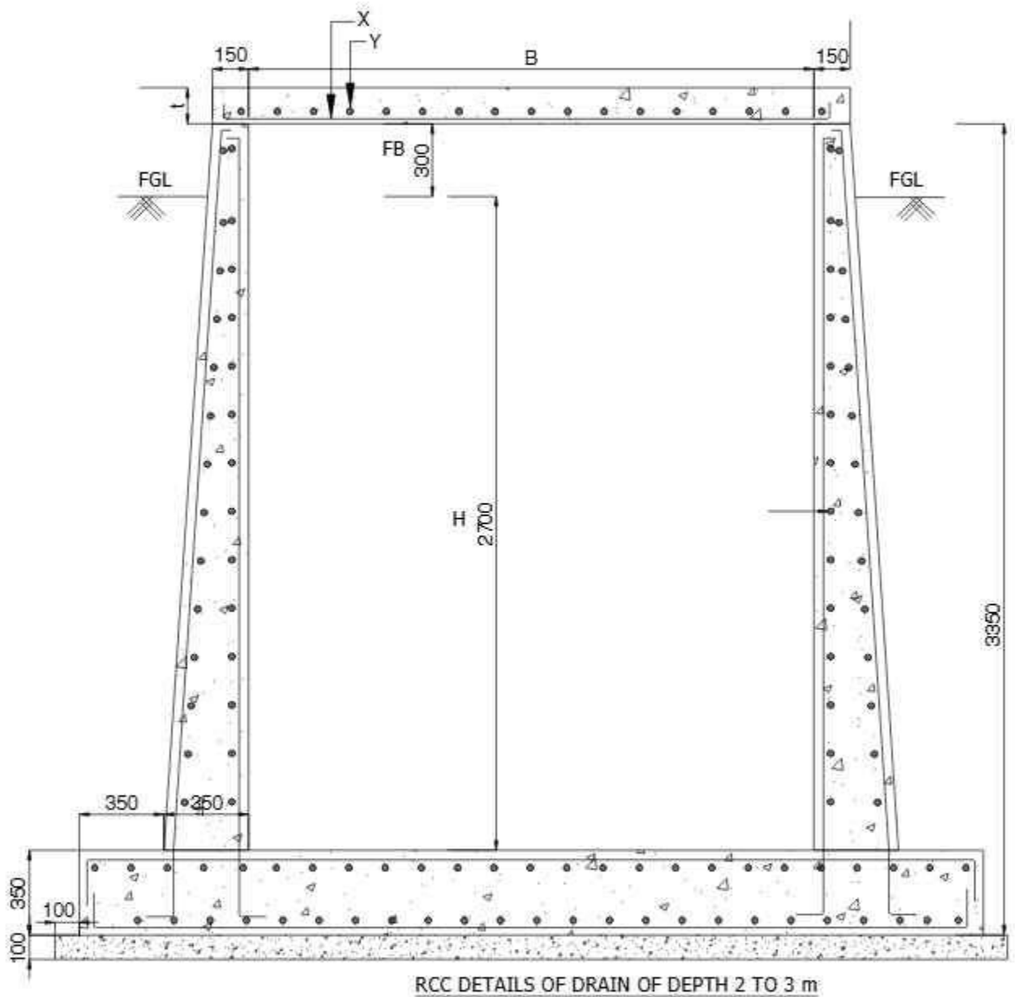
REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :	PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP, AGRA.	NOTE : ALL THE DIMENSIONS ARE IN METERS (M)		
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				.\ADA Logo.jpg	Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010			N / W E / S	ISSUE RECORD	APPROVED FOR ISSUE
4												Concept	
3												DFR/DPR	
2							CONSULTANT :		DRAWING TITLE :	PROPOSED STORM WATER DRAIN NETWORK		Tender Drawing	✓
1							VOYANTS	Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.	DRAWING NO :	VSPL/IPD/2324-066/DPR/SWD/01	SHEET SIZE	Revision	R0
0			B.B.D	S.D	P.B	S.B.R			GRAPHIC SCALE :	0 25 125 250	A0	Date	FEB. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY							



RCC DETAILS OF DRAIN OF DEPTH 3 TO 4 m

DETAILS OF COVER SLAB		
WIDTH OF DRAIN (B)	THICKNESS OF SLAB (t)	SLAB MATERIAL
UP TO 1.00M	0.2M	RCC CAST IN SITU
FROM 1.00M to 2.00M	0.2M	RCC CAST IN SITU
FROM 2.00M to 3.00M	0.25M	RCC CAST IN SITU
Above 3.00M	0.25M	RCC CAST IN SITU

Note:
1) 'Y' Indicates high yield strength deformed bars of gradeTMT Fe500 as per S:1786 (with latest amendments)
2) Plain cement concrete (PCC) - 1:3:6 Reinforcement Cement Concrete (RCC) - M25
3) Clear cover to Reinforcement.
   a) Base Slab : 50mm
   b) Cover slab : 25mm
   b) RCC Wall : 30 mm
4) All laps shall be 50 times dia of bar and shall be staggered
5) All concrete work shall be as per IS:456 (with latest amendments)



RCC DETAILS OF DRAIN OF DEPTH 2 TO 3 m

REVISION BLOCK			QUALITY ASSURANCE			
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency			
4						
3						
2						
1						
0			S.S.D	S.D	P.S	S.S.R
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

CLIENT : Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT : Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE : PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.

DRAWING TITLE : RCC Drain Details - C

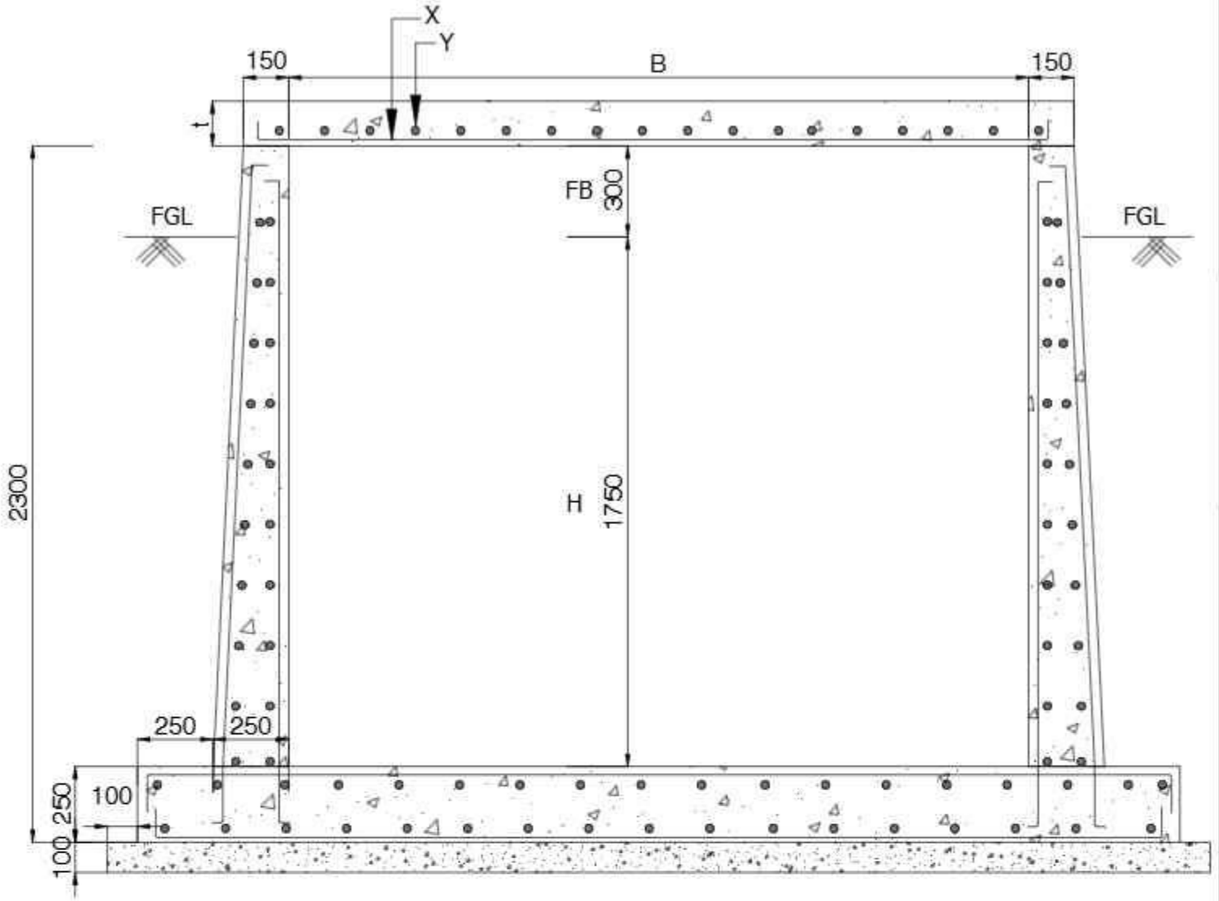
DRAWING NO : VSPL/IPD/2324-066/DPR/RCC/04

GRAPHIC SCALE :

NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)

ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DPR/DPR	
Tender Drawing	✓
Revision	R0
Date	FEB: 2025

SHEET SIZE : A3



RCC DETAILS OF DRAIN OF DEPTH 1 TO 2 m

DETAILS OF COVER SLAB		
WIDTH OF DRAIN (B)	THICKNESS OF SLAB (t)	SLAB MATERIAL
UP TO 1.00M	0.20M	RCC CAST IN SITU
FROM 1.00M to 2.00M	0.20M	RCC CAST IN SITU
FROM 2.00M to 3.00M	0.25M	RCC CAST IN SITU
Above 3.00M	0.25M	RCC CAST IN SITU

Note:
1) 'Y' Indicates high yield strength deformed bars of gradeTMT Fe500 as per S:1786 (with latest amendments)
2) Plain cement concrete (PCC) - 1:3:6 Reinforcement Cement Concrete (RCC) - M25
3) Clear cover to Reinforcement.
   a) Base Slab : 50mm
   b) Cover slab : 25mm
   b) RCC Wall : 30 mm
4) All laps shall be 50 times dia of bar and shall be staggered
5) All concrete work shall be as per IS:456 (with latest amendments)

RCC DETAILS OF DRAIN OF DEPTH UP TO 1 m

REVISION BLOCK						
5						
4						
3						
2						
1						
0			S.S.D	S.D	P.S	S.S.R
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

QUALITY ASSURANCE
The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency

CLIENT :
Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT :
Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE : PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.

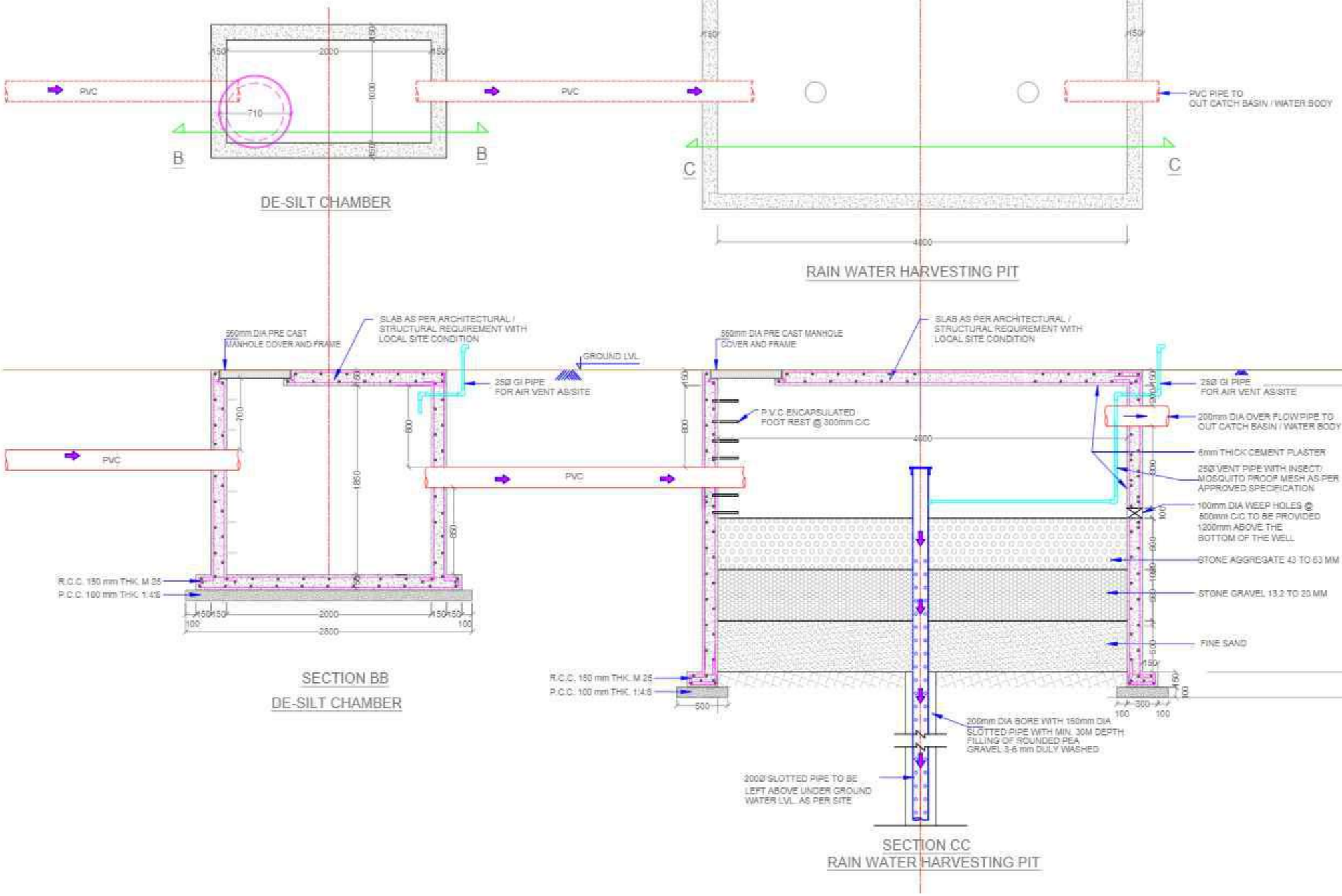
DRAWING TITLE : RCC Drain Details - D

DRAWING NO : VSPL/IPD/2324-066/DPR/RCC/05

GRAPHIC SCALE :

NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)

	ISSUE RECORD	APPROVED FOR ISSUE
	Concept	
	DPR/DPR	
SHEET SIZE	Tender Drawing	✓
	Revision	R0
A3	Date	FEB.2025



REVISION BLOCK			QUALITY ASSURANCE			
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency			
4						
3						
2						
1						
0			B.B.D	S.D	P.B	S.B.R
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

CLIENT :
Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT :
Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE : PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.

DRAWING TITLE : RAIN WATER HARVESTING PIT FROM PLOTS

DRAWING NO : VSPL/IPD/2324-066/DPR/RWHP/11

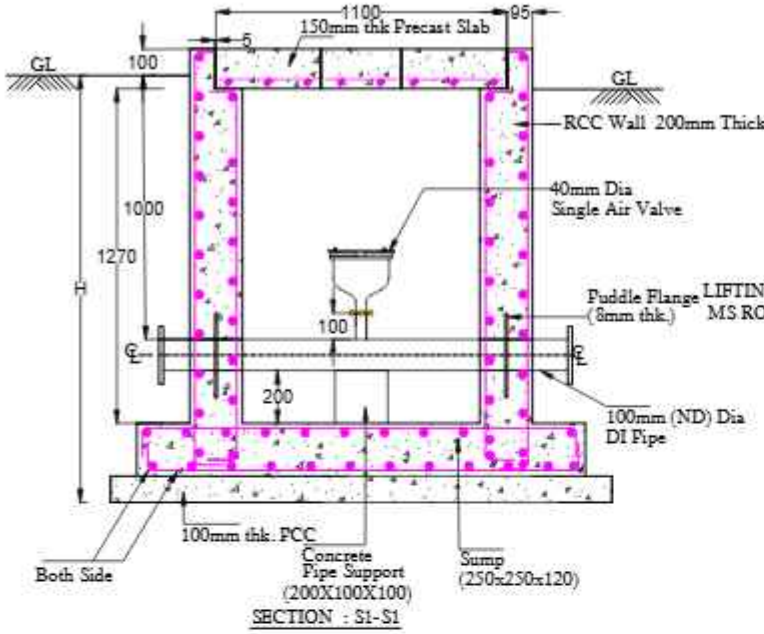
GRAPHIC SCALE :

NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)

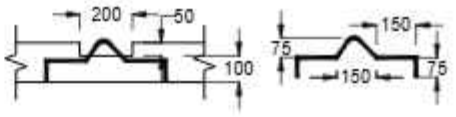
ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DPR/DPR	
Tender Drawing	✓
Revision	R0
Date	Feb, 2025

SHEET SIZE A3

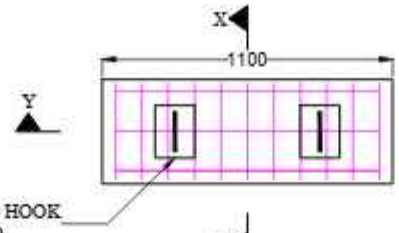
REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (M)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP, AGRA.		N W E S	ISSUE RECORD / APPROVED FOR ISSUE
4												Concept
3												DFR/DPR
2							CONSULTANT :		DRAWING TITLE :	PROPOSED POTABLE WATER SUPPLY NETWORK		Tender Drawing ✓
1							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.		DRAWING NO :	VSPL/IPD/2324-066/DPR/PWS/01	SHEET SIZE	Revision R0
0			B.B.D	S.D	P.B	S.B.R			GRAPHIC SCALE :	0 10 20 25 50	A1	Date FEB. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY						



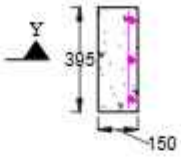
SECTION : S1-S1



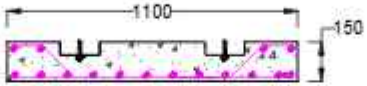
DETAIL FOR LIFTING HOOK



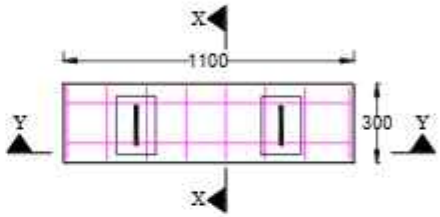
DETAILS OF SLAB-1



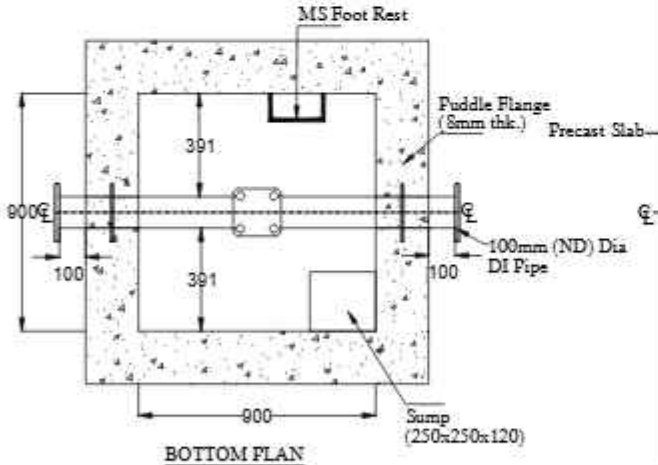
SECTION X-X



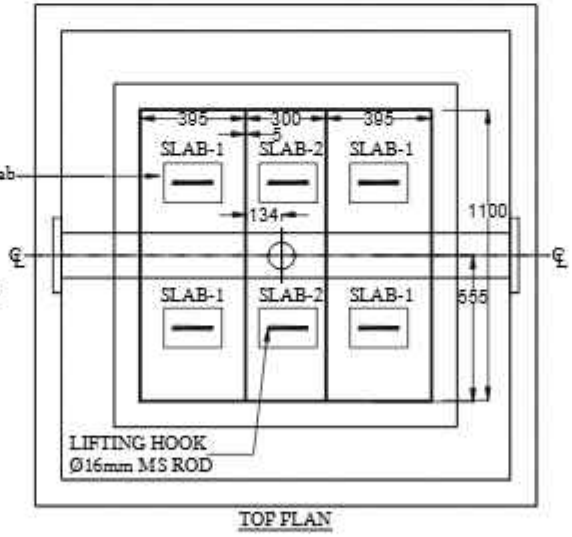
SECTION Y-Y



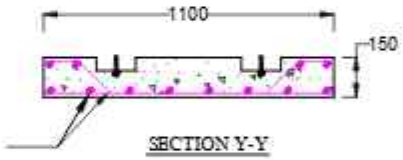
DETAILS OF SLAB-2



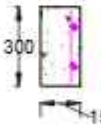
BOTTOM PLAN



TOP PLAN



SECTION Y-Y

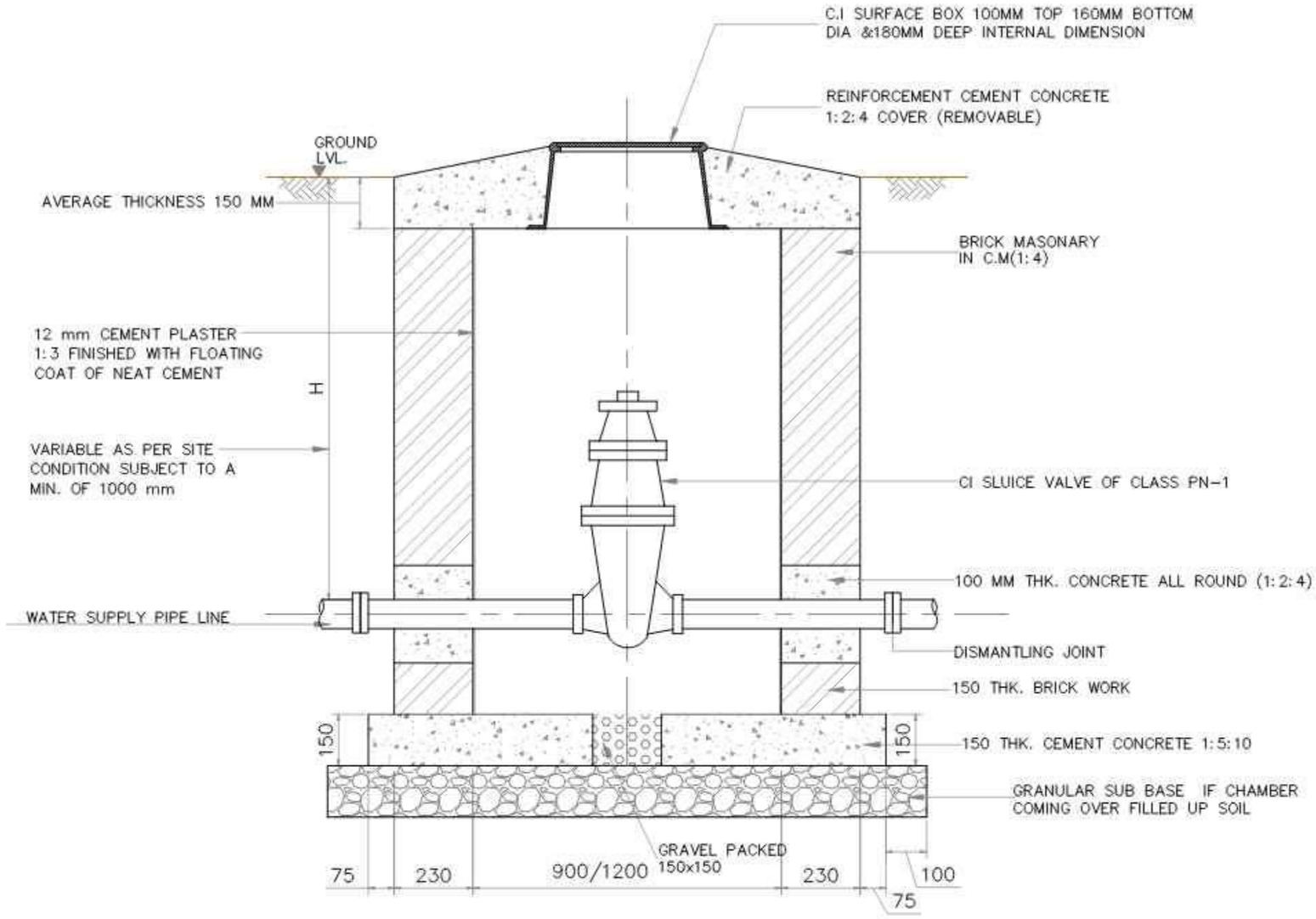


SECTION X-X

NOTES:

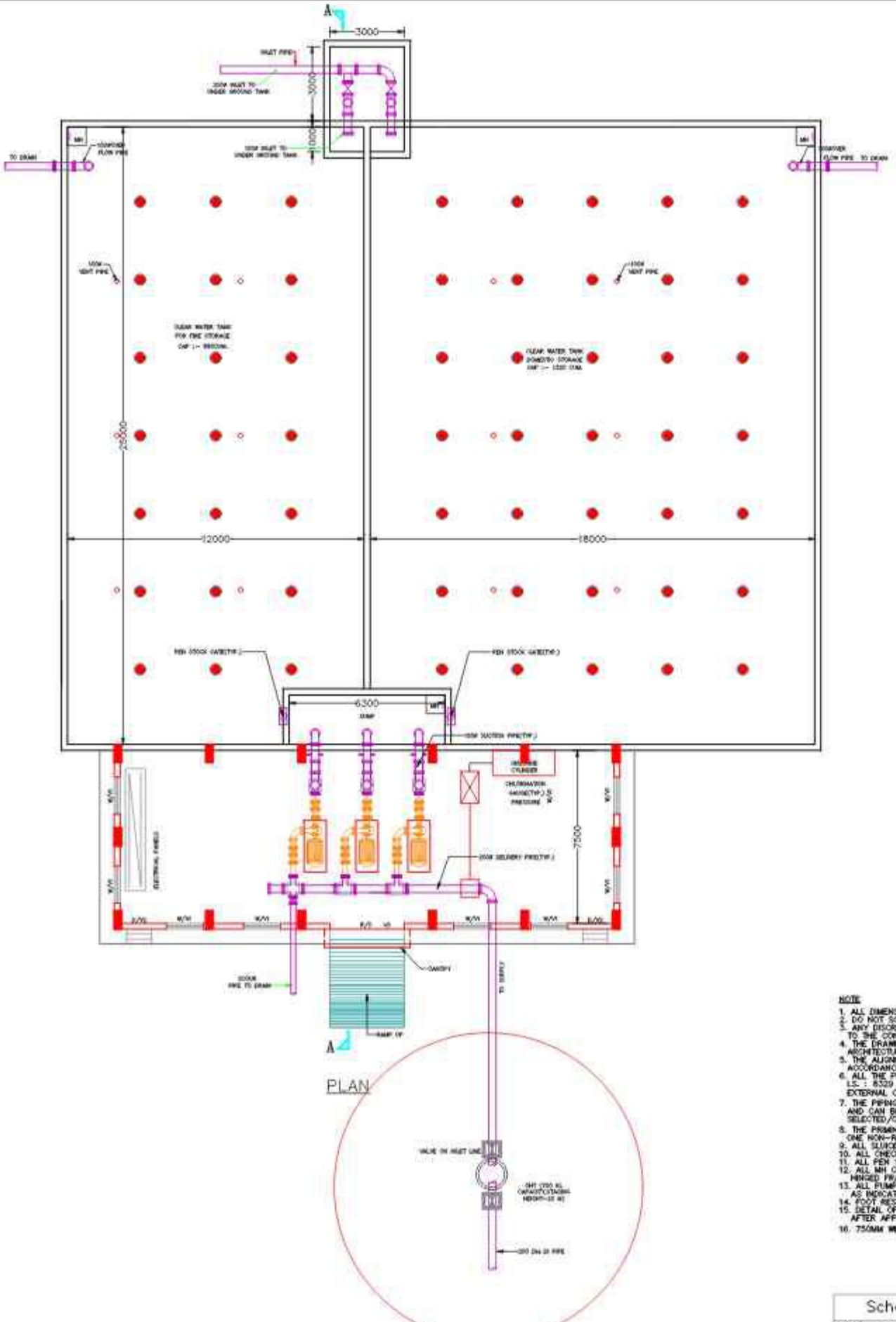
1. All Dimensions are in mm unless otherwise specified.
2. Grade of Concrete - M25 for Reinforced Cement Concrete (RCC).
3. Y TMT Bar of Grade Fe 500 as per IS-1786.
4. All concrete work shall be as per IS:456, with latest amendments.
5. Sluice valve dimensions shall be conforming to IS-14846 (with latest amendments)
6. The mechanical fixtures / specials shown in drawing are indicative purpose only. Separate quality assurance plan for these are to be got approved by contractor separately.
7. All flanges dimensions shall be conforming to IS:1538 (with latest amendments)
8. H will be variable as per site condition.
9. The MS rungs shall be provided from top slab to pipe barrel top & then pipe barrel top to chamber bottom.

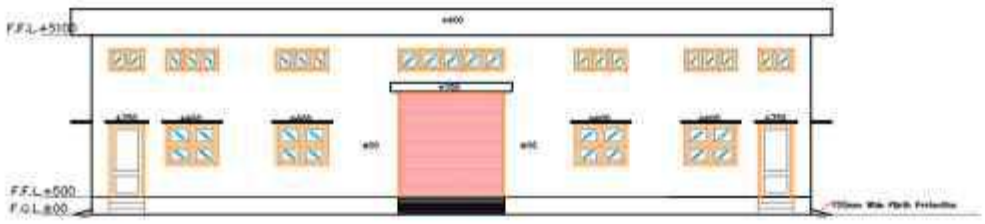
REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.		ISSUE RECORD	APPROVED FOR ISSUE
4											Contract	
3											DPR/DPR	
2											Tender Drawing	✓
1											Revision	R0
0			S.S.D.	S.D.	P.R.	S.S.R.	CONSULTANT : Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.		DRAWING TITLE : DETAIL OF TYPICAL AIR VALVE CHAMBER		Date	Feb 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY			DRAWING NO : VBPL/IPD/2324-066/DPR/AVC/01			
									GRAPHIC SCALE :		SHEET SIZE A3	



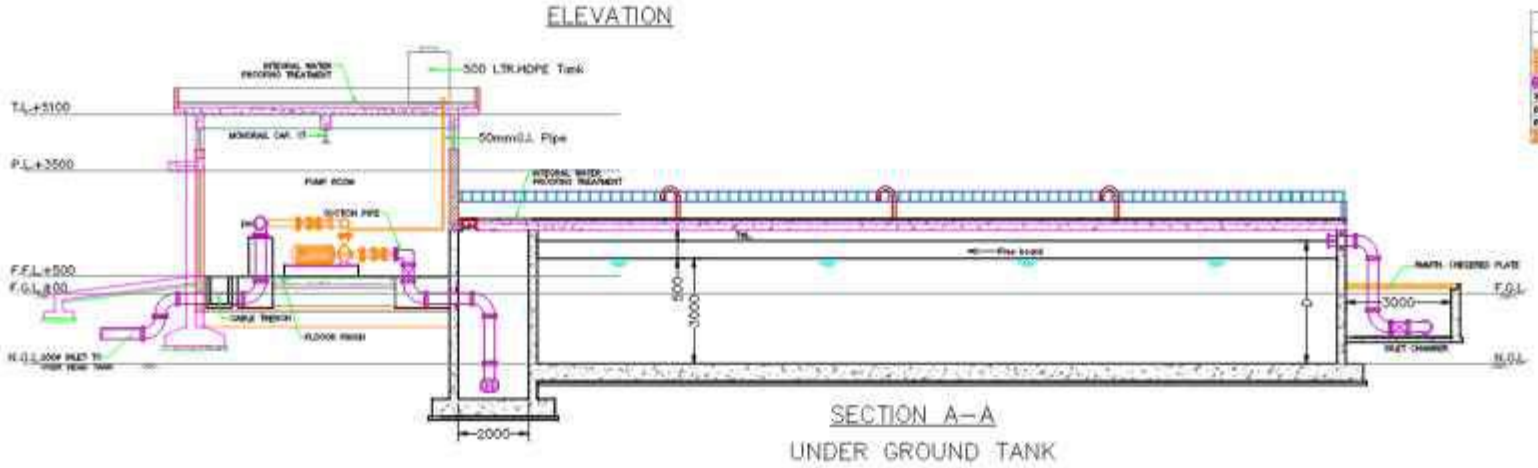
DIA. OF PIPE (IN MM)	INTERNAL SIZE OF VALVE CHAMBER (IN MM)		
	L	B	H
UPTO 150MM	900	900	VARIABLE SUBJECT TO A MINIMUM OF 1000MM.
ABOVE 150MM	1200	1200	
NOTE: The value of 'H' is from the top of the pipe.			

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.		N W E S	ISSUE RECORD / APPROVED FOR ISSUE
4												Concept
3												DPR/DPR
2							CONSULTANT :		DRAWING TITLE :	Sluice Valve Details	SHEET SIZE	Tender Drawing ✓
1							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.		DRAWING NO :	VSPL/IPD/2324-066/DPR/SLV/06		Revision R0
0			S.S.D	S.D	P.S	S.S.R			GRAPHIC SCALE :	0 5 10 20 40	A3	Date FEB. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY						





ELEVATION



SECTION A–A

UNDER GROUND TANK

NOTE

1. ALL DIMENSIONS ARE IN MM AND LEVEL ALSO IN MM. w.r.t. FGL±000
2. DO NOT SCALE THE DRAWING, WORK TO WRITTEN DIMENSIONS ONLY.
3. ANY DISCREPANCY IN THE DRAWING SHALL BE COMMUNICATED TO THE CONSTRUCTION MANAGER FOR RECTIFICATIONS.
4. THE DRAWING SHALL BE READ IN CONJUNCTION WITH THE RELEVANT ARCHITECTURAL, STRUCTURAL AND ELECTRICAL DRAWINGS.
5. THE ALIGNMENT OF THE INLET PIPING FOR TANKS SHALL BE IN ACCORDANCE WITH THE SITE PLAN.
6. ALL THE PIPES SHALL BE OF D.I. (GLASS K9.) CONFORMING TO I.S. : 8329 AND SPECIALS TO I.S. : 9523 WITHIN WATERWORKS UPTO EXTERNAL CHAMBER.
7. THE PIPING ARRANGEMENT AND LOCATION INSIDE THE PUMP HOUSE MAY VARY AND CAN BE ADJUSTED DEPENDING UPON MAKE/MODEL OF PUMPS SELECTED/ORDERED FOR INSTALLATION BY THE CONTRACTOR.
8. THE PRIMING PIPE SHALL HAVE ONE BUTTERFLY VALVE AND ONE NON-RETURN VALVE.
9. ALL SLUICE VALVE PROVIDED SHALL BE CONFIRMING TO IS: 14846:2000.
10. ALL CHECK VALVE SHALL BE CONFIRMING TO IS:5312.
11. ALL PEN STOCK GATE SHALL BE CI CONFIRMING TO IS:3042.
12. ALL MH COVER SHALL BE FABRICATED FROM 6MM THICK MS PLATE HINGED FRAME AND FLANGED ANGLE PROVIDED WITH LOCKING DEVICE.
13. ALL PUMP SHALL BE CENTRIFUGAL, END SUCTION TYPE OF THE CAPACITY AS INDICATED THE SCHEDULED AND DRIVEN BY ELECTRIC MOTOR.
14. FOOT REST SHALL BE PROVIDED AT M.H. OPENNING AS PER IS 10810 @ 300 C/C.
15. DETAIL OF PIPING ARRANGEMENT INSIDE THE PUMP HOUSE TO BE PERMITTED LATER AFTER APPROVAL OF PUMPPS SUBMITTED BY THE CONTRACTOR.
16. 750MM WIDE PLINTH PROTECTION SHALL BE PROVIDED ALROUND UGR & PH

Schedule of Doors and Windows

S.NO.	Symbool		Size
1	Window W	MS Glazed Window	1500 x 1200
2	Ventilator V1	MS Glazed Ventilator	1500 x 600
3	Ventilator V2	MS Glazed Ventilator	1000 x 600
4	Ventilator V3	MS Glazed Ventilator	3000 x 600
5	Door D	MS Sheet Door	1000 x 2100
6	Rolling Shutter R/S	MS Rolling Shutter	3000 x 3000

LEGEND

Sym. (Double line)	
	SLUICE VALVE
	NON – RETURN VALVE
	STRAINER WITH FOOT VALVE
S.H.	SUCTION HEADER
D.H.	DELIVERY HEADER
P.G.	PRESSURE GAUGE
	DISMANTLING JOINT

REVISION BLOCK

No.	DATE	DESCRIPTION
A		
B		
C		
D		
E		
F		

QUALITY ASSURANCE
The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency

DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY
S.S.C	S.C	P.S.	S.S.T.

CLIENT : Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT : Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centre, Sec -30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE : PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.

DRAWING TITLE : UGR & PH

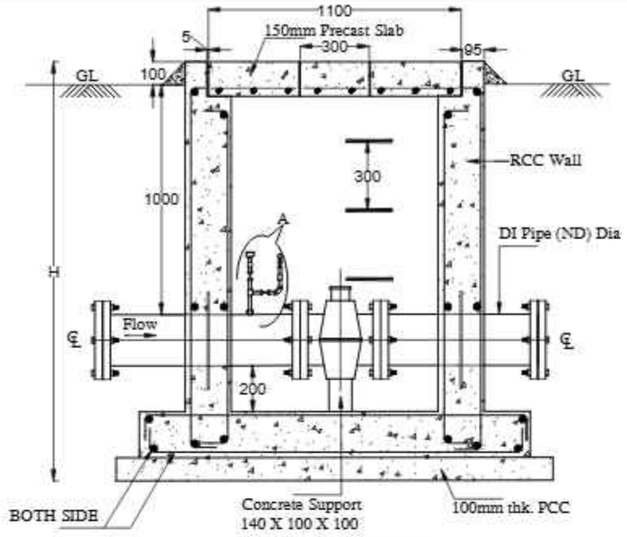
DRAWING NO : VSPL/ADA/224-00/DRG/GEN/0100

GRAPHIC SCALE :

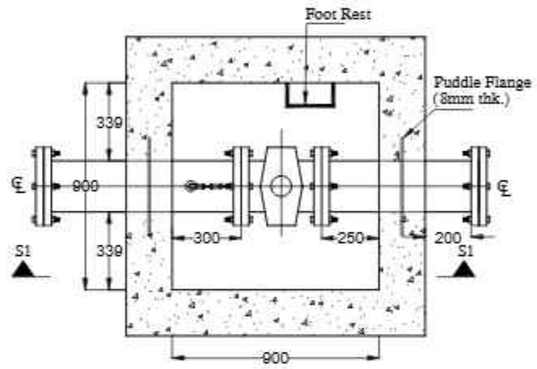
NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)

ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DRAWING	
Tender Drawing	✓
Approved	S.S.
Date	FEB. 2018

SHEET SIZE : A3

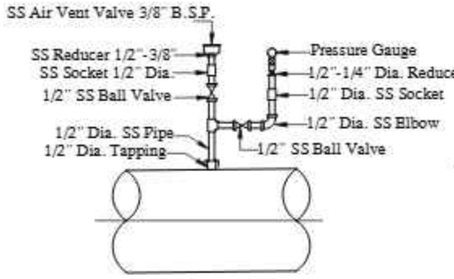


SECTION : S1-S1



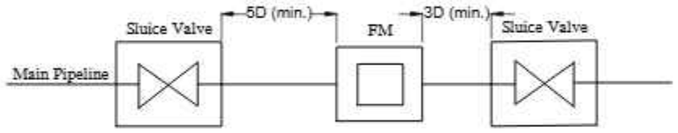
BOTTOM PLAN

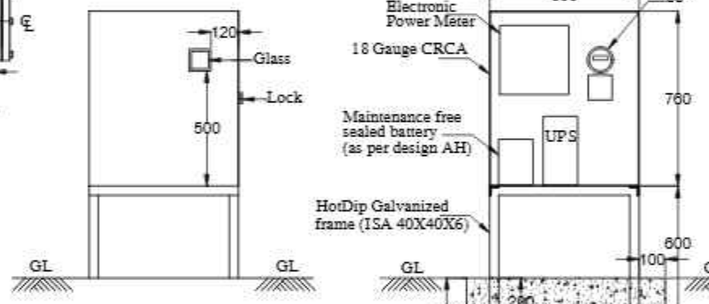
S.NO.	PIPE DIA	FLOW METER DIA
1.	350	350
2.	400	400
3.	450	450



DETAIL-A

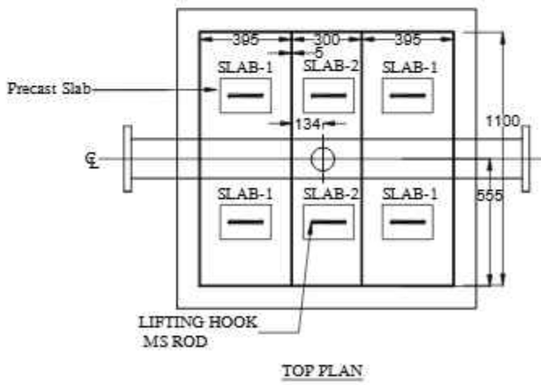
(All Tubings & Fittings are SS and AISI316/TI)



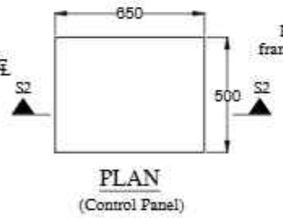


ELEVATION
(Control Panel)

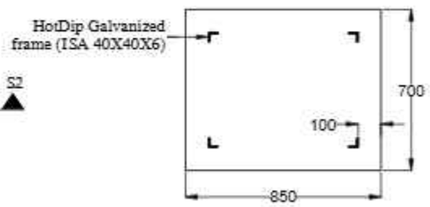
SECTION S2-S2
(Control Panel)



TOP PLAN



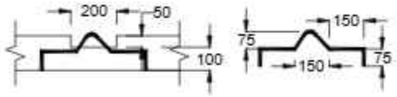
PLAN
(Control Panel)



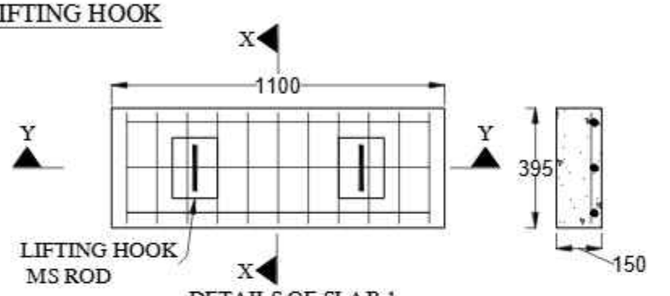
BOTTOM PLAN
(Control Panel)

DETAILS OF DIMENSIONS FOR FLOW METER CHAMBER

S.NO.	PIPE DIA	INTERNAL DIMENSIONS		
		L	B	WALL THK(t)
1.	100	1500	1000	200
2.	125	1500	1000	200
3.	150	1500	1000	200
4.	200	2000	1250	200
5.	250	2000	1250	200
6.	300	2000	1500	200

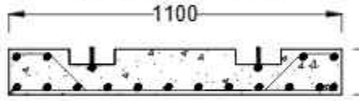


DETAIL FOR LIFTING HOOK

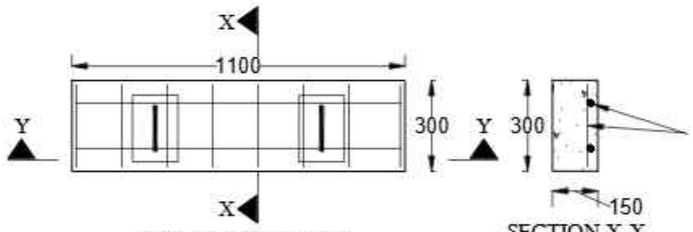


DETAILS OF SLAB-1

SECTION X-X

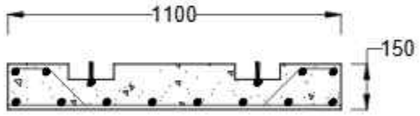


SECTION Y-Y



DETAILS OF SLAB-2

SECTION X-X



SECTION Y-Y

NOTES:

1. All Dimensions are in mm unless otherwise specified.
2. Grade of Concrete - M25 for Reinforced Cement Concrete (RCC).
3. Y TMT Bar of Grade Fe 500 as per IS-1786.
4. All concrete work shall be as per IS:456, with latest amendments.
5. Flow meter dimensions shall be conforming to IS-779 (with latest amendments)
6. The mechanical fixtures / specials shown in drawing are indicative purpose only. Separate quality assurance plan for these are to be got approved by contractor separately.
7. All flanges dimensions shall be confirming to IS:1538 (with latest amendments)
8. H will be variable as per site condition.
9. The MS rungs shall be provided from top slab to pipe barrel top & then pipe barrel top to chamber bottom.

ABBREVIATION:

TYP	- TYPICAL
DIA	- DIAMETER
DI	- DUCTILE IRON
THK	- THICK
C	- CENTRE LINE
PCC	- PLAIN CEMENT CONCRETE
RCC	- REINFORCED CEMENT CONCRETE
FGL	- FINISHED GROUND LEVEL

REVISION BLOCK						
5						
4						
3						
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1						
0			S.S.D	S.D	P.S	S.S.R
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

QUALITY ASSURANCE
The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency

CLIENT :
Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT :
Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE : PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.

DRAWING TITLE : Typical Details of Flow Meter Chamber and Control Panel

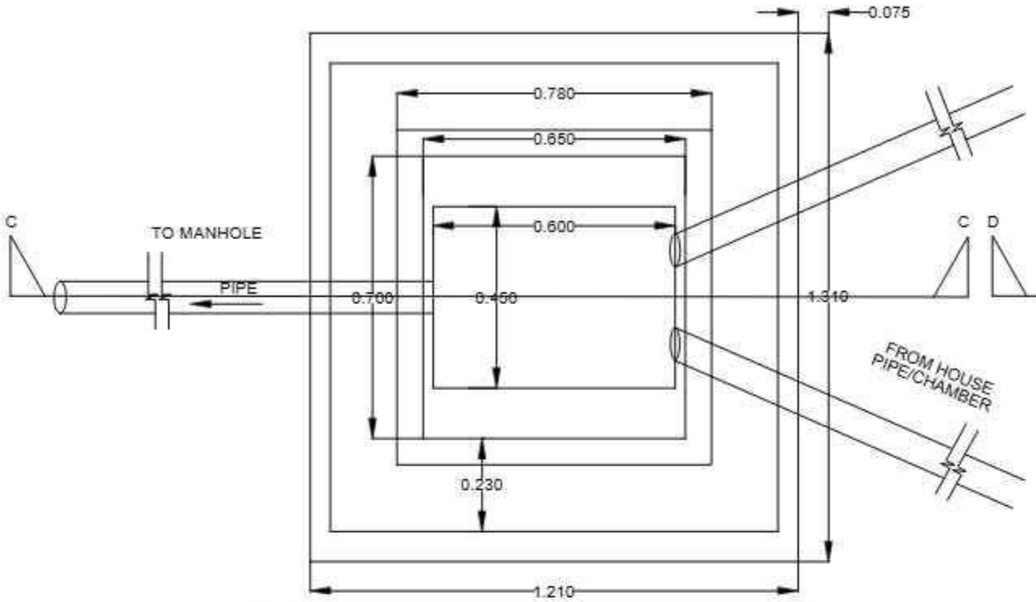
DRAWING NO : VSPL/IPD/2324-066/DPR/FMC/02

GRAPHIC SCALE :

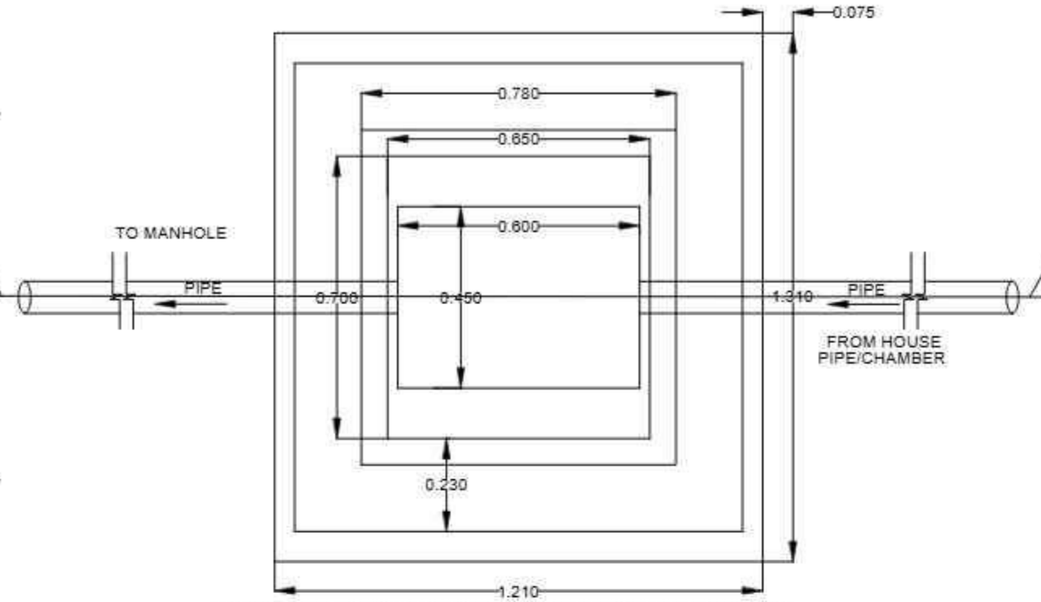
NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)

	ISSUE RECORD	APPROVED FOR ISSUE
SHEET SIZE A2	Concept	
	DPR/DPR	
	Tender Drawing	✓
	Revision	R0
	Date	FEB. 2025

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (M)		
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency					Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		**PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP, AGRA.**		ISSUE RECORD	APPROVED FOR ISSUE
4											N W E S	Concept	
3												DFR/DPR	
2							CONSULTANT :		DRAWING TITLE :	PROPOSED SEWERAGE NETWORK		Tender Drawing	✓
1									DRAWING NO :	VSPL/IPD/2324-066/DPR/SEW/01	SHEET SIZE	Revision	R0
0			R.K	S.D	P.B	S.B.R		Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.	GRAPHIC SCALE :	0 25 125 250	A0	Date	FEB. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY							



PLAN OF RCC CHAMBER 0.60X0.45X0.60M



PLAN OF RCC CHAMBER 0.60X0.45X0.60M

Note:

1) Clear cover to reinforcement shall be:

a) Footing / base slab - 40mm

b) RCC Wall - 25mm

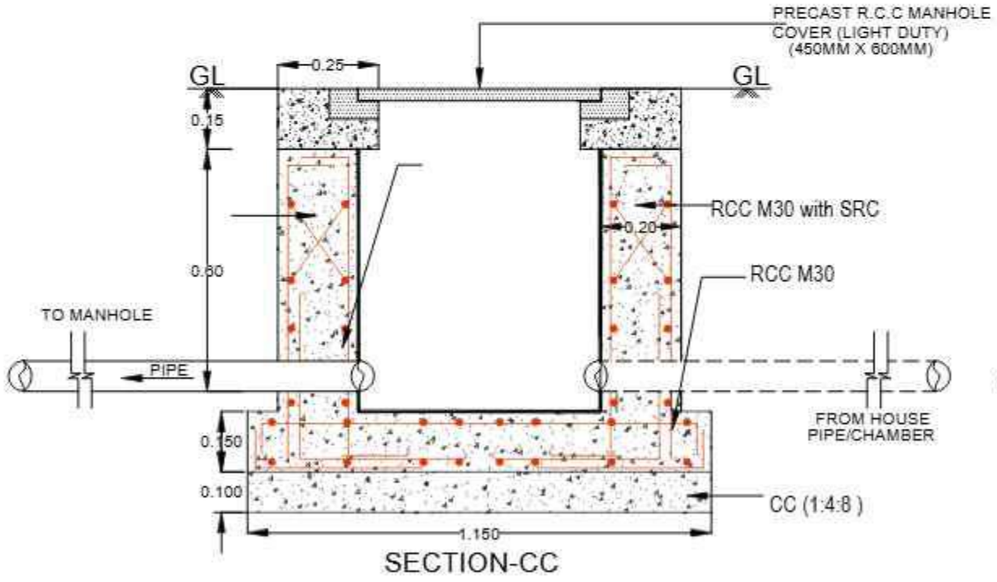
2) Minimum lap length shall be 60 times Dia of bar and shall be staggered.

3) All concrete work shall be as per IS:456 with latest amendments.

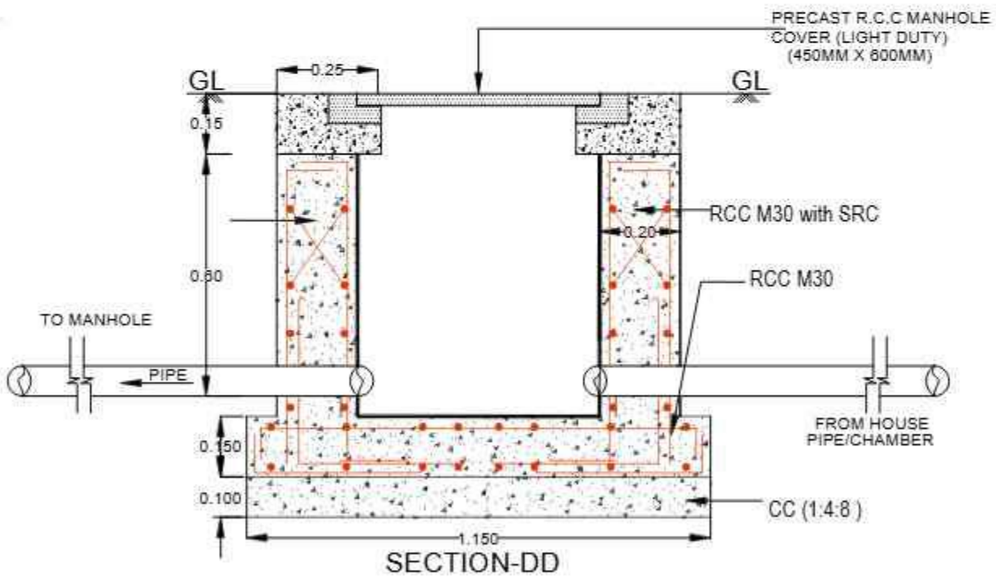
4) Y TMT Bar of grade fe 415 as per IS:1786 with latest amendments.

5) Foot Rest to be made from 12mm Dia steel bar with 6mm thick plastic encapsulation confirming to IS:1786 with latest amendments.

6) For Steel Fibre Reinforcement Concrete (SFRC) manhole cover, the manhole cover and steel fibre reinforcement shall be conforming to IS:12592 with latest amendmends.



SECTION-CC

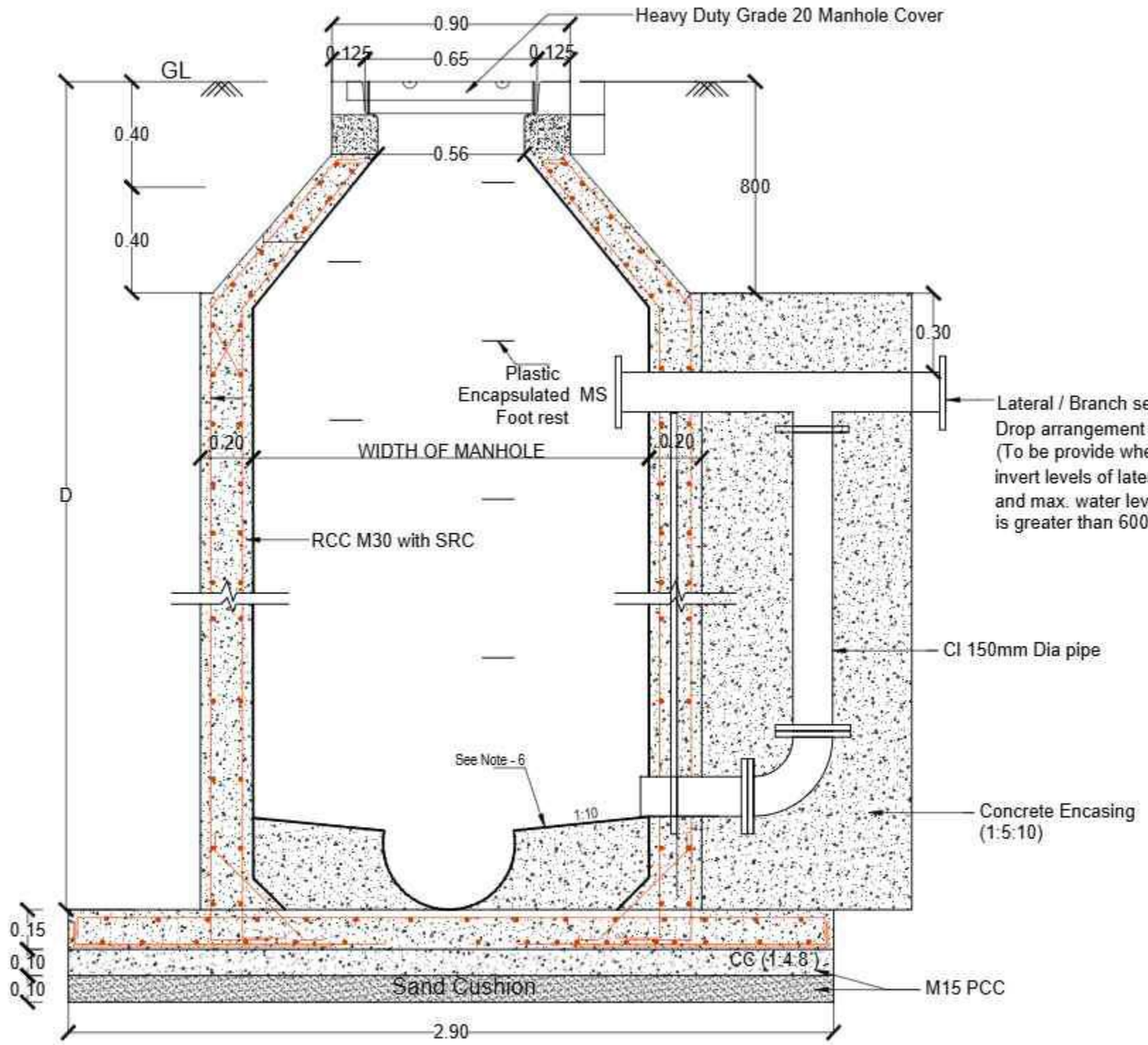


SECTION-DD

LEGEND:

TYP	TYPICAL
DIA	DIAMETER
UN	UNITLESS NOTED
THK	THICK
PCC	PLAIN CEMENT CONCRETE
EQ	EQUAL
MWL	MAXIMUM WATER LEVEL
CM	CEMENT MORTAR
RCC	REINFORCED CEMENT CONCRETE

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.		N W E S	ISSUE RECORD / APPROVED FOR ISSUE
4												Concept /
3												DPR/DPR /
2							CONSULTANT :		DRAWING TITLE :	Plot Sewer Connecting Chamber	SHEET SIZE	Tender Drawing / ✓
1							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.		DRAWING NO :	VSPL/JPD/2324-066/DPR/PSCC/03	A3	Revision / R0
0			S.S.D	S.D	P.S	S.S.R			GRAPHIC SCALE :	0 100 300 1000		Date / Feb. 2024
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY						



SECTION OF DROP MANHOLE WITH
RCC (TYPE - 3)

NOTES

1. VATA IN C.M.(1:1) SHALL BE PROVIDED ALL AROUND THE PIPE ENTERING AND LEAVING THE MANHOLE.
2. MANHOLE LOCATED ON ROAD SHALL HAVE MANHOLE COVER FLUSH WITH FINISHED ROAD SURFACE.
3. CHANNELS FOR MANHOLE ARE TO BE CONSTRUCTED DULY CONSIDERING THE DIRECTION OF FLOW AS
4. WELL AS ALIGNMENT AND INVERT LEVEL OF PIPES ENTERING/ LEAVING THE MANHOLE AND AS DIRECTED BY ENGINEER-IN-CHARGE.
   D IS THE DEPTH FROM GROUND LEVEL TO LOWEST SEWER INVERT LEVEL IN MANHOLE
   MS STEPS WITH PLASTIC ENCAPSULATED.
   PCC THICKNESS (d):
5. UPTO 5M DEPTH – 200MM
   5M TO 7M DEPTH – 250MM
   7M TO 9M DEPTH – 300MM
   Heavy Duty Grade M20 Manhole Cover
6. THE BENCHING AT THE SIDE OF THE CHANNEL SHALL BE AT LEAST 50mm ABOVE THE CROWN
7. OF THE PIPE AND THEN RISE WITH A SLOPE OF 1 IN 10 TOWARDS THE SIDE OF THE MANHOLE. SEMICIRCULAR PORTION WILL BE ACHIEVED IN CEMENT CONCRETE FINISHING ITSELF.
   210 THICKNESS OF CONCRETE CAP CAN BE VARIED TO FLUSH MANHOLE COVER AND FRAME WITH ROAD SURFACE.

LEGEND

TYP	TYPICAL
DIA	DIAMETER
UN	UNLESS NOTED
THK	THICK
PCC	PLAIN CEMENT CONCRETE
EQ	EQUAL
MWL	MAXIMUM WATER LEVEL
CM	CEMENT MORTAR
GL	GROUND LEVEL
SRC	SULPHATE RESISTANT CEMENT

REVISION BLOCK						
5						
4						
3						
2						
1						
0			S.S.D	S.D	P.S	S.S.R
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

QUALITY ASSURANCE
The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency

CLIENT :
Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony,
Agra, Uttar Pradesh - 282010

CONSULTANT :
Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE : PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.

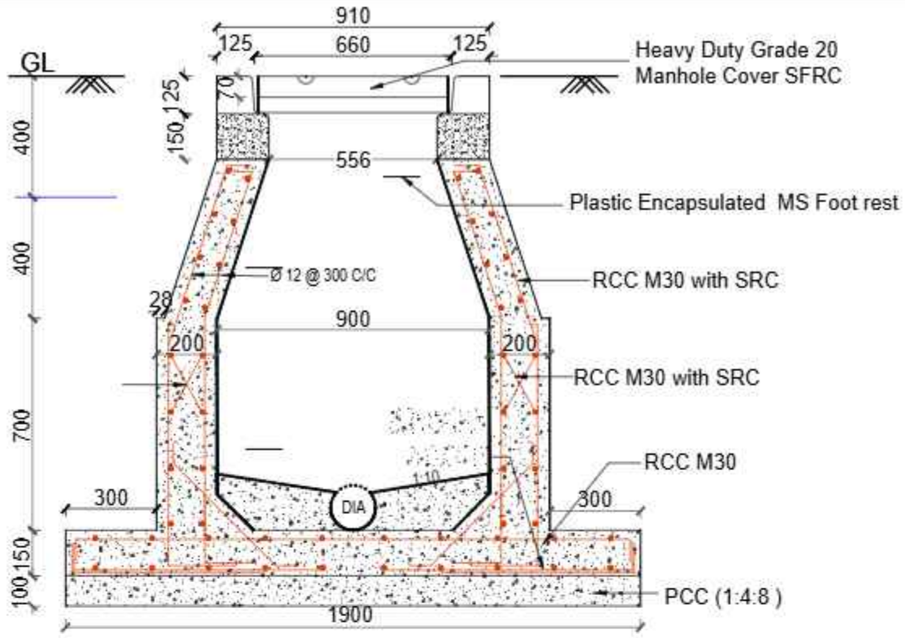
DRAWING TITLE : Drop Manhole

DRAWING NO : VSPL/IPD/2324-066/DPR/DMH/07

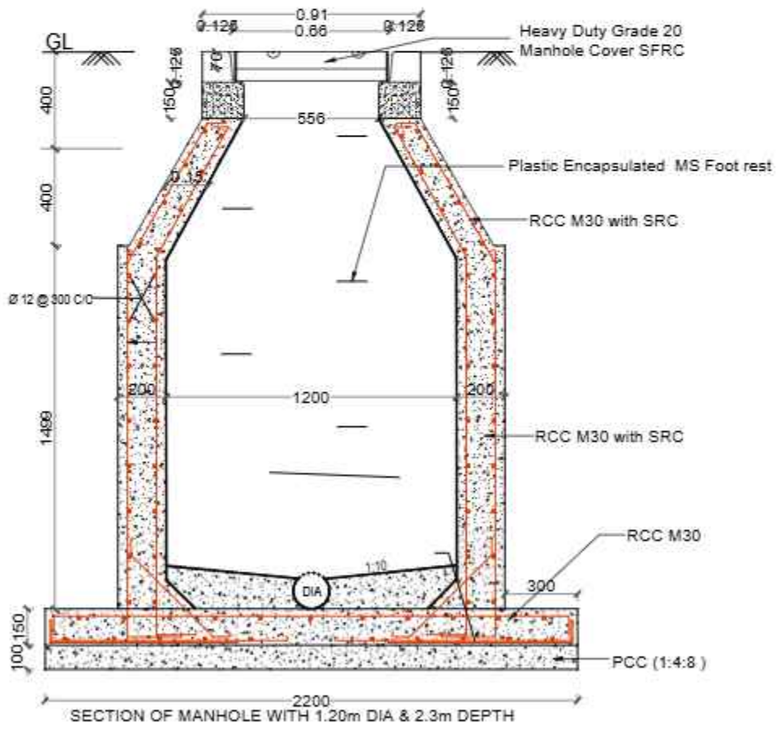
GRAPHIC SCALE :

NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)

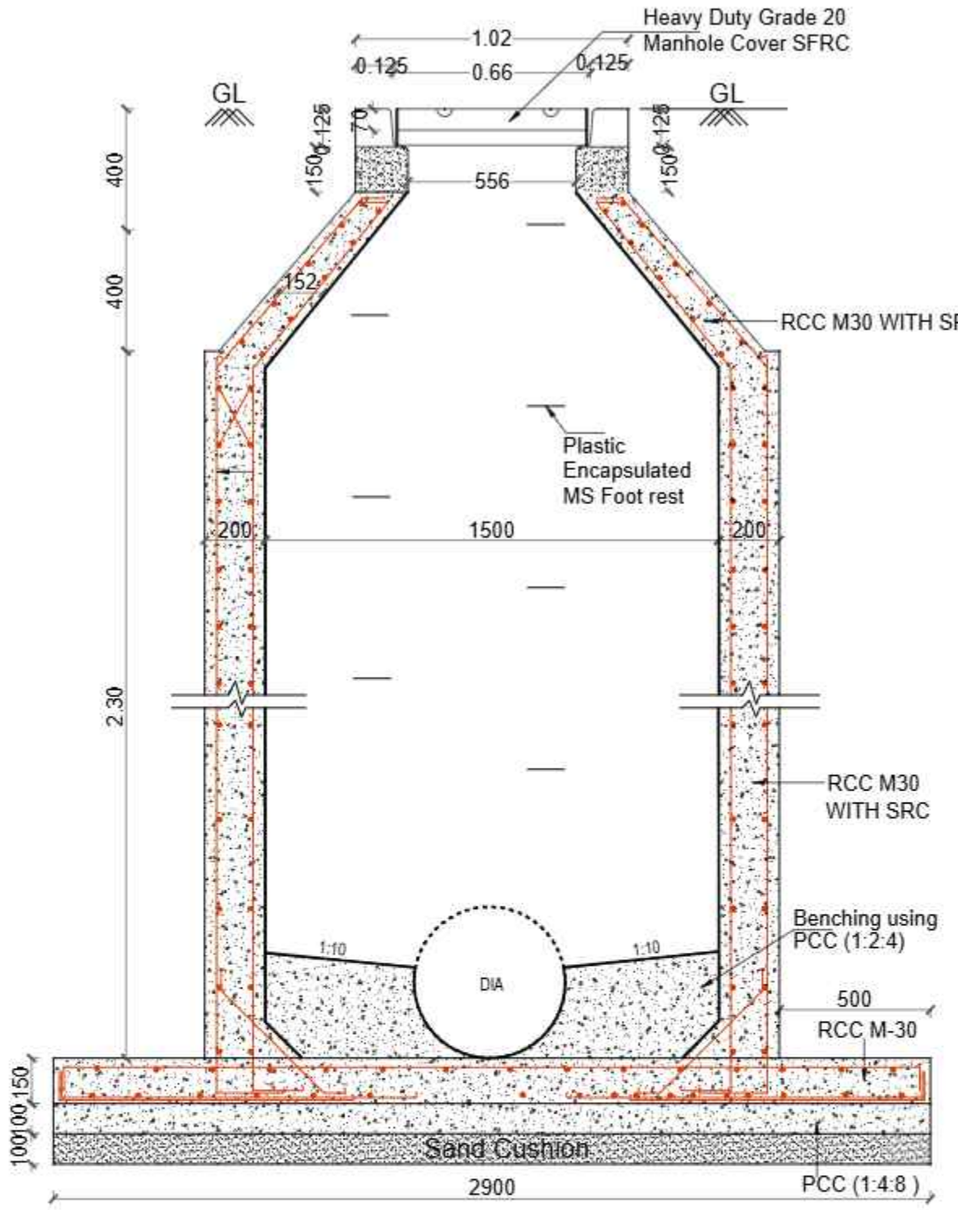
	ISSUE RECORD	APPROVED FOR ISSUE
	Concept	
	DPR/DPR	
SHEET SIZE	Tender Drawing	✓
	Revision	R0
A3	Date	FEB. 2025



SECTION OF MANHOLE WITH 0.90m DIA & 1.5m DEPTH



SECTION OF MANHOLE WITH 1.20m DIA & 2.3m DEPTH



SECTION OF MANHOLE WITH
RCC (TYPE - 3)
(1.50m Dia & above 2.30m and upto 9.00m depth)

Note:

1) Clear cover to reinforcement shall be:

a) Footing / base slab - 40mm

b) RCC Wall - 25mm

2) Minimum lap length shall be 60 times Dia of bar and shall be staggered.

3) All concrete work shall be as per IS:456 with latest amendments.

4) Y TMT Bar of grade fe 500 as per IS:1786 with latest amendments.

5) Foot Rest to be made from 12mm Dia steel bar with 6mm thick plastic encapsulation confirming to IS:1786 with latest amendments.

6) For Steel Fibre Reinforcement Concrete (SFRC) manhole cover, the manhole cover and steel fibre reinforcement shall be conforming to IS:12592 with latest amendmends.

LEGEND:

TYP	TYPICAL
DIA	DIAMETER
UN	UNITLESS NOTED
THK	THICK
PCC	PLAIN CEMENT CONCRETE
EQ	EQUAL
MWL	MAXIMUM WATER LEVEL
CM	CEMENT MORTAR
RCC	REINFORCED CEMENT CONCRETE
SRC	SULPHATE RESISTANT

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)		
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency					Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.	N W E S	ISSUE RECORD	APPROVED FOR ISSUE
4												Concept	
3												DPR/DPR	
2							CONSULTANT :		DRAWING TITLE :	Typical Details of Manholes	SHEET SIZE	Tender Drawing	✓
1								Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.	DRAWING NO :	VSPL/IPD/2324-066/DPR/DMH/08		Revision	R0
0			S.S.D	S.D	P.S	S.S.R			GRAPHIC SCALE :	0 500 1000 2000	A3	Date	FEB. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY							

KEY PLEN

LEGEND

R.C.W. Network

R.W.S. Node

TOWARDS AGRA

PROPOSED MP RD. 45M ROW

RAILWAY LINE

TOWARDS GWALIOR

PROPOSED MP RD. 45M ROW

PROPOSED 30M ROW

MASTER PLAN ROAD 75.0M WIDE

TOWARDS AGRA

BHANDAI

KAKUA VILLAGE

PROPOSED MP RD. 45M ROW

EXISTING CANAL

TOWARDS YAMUNA EXPRESSWAY

INNER RING ROAD

TOWARDS MATHURA, DELHI

NH - 44

TOWARDS GWALIOR

REVISION BLOCK			QUALITY ASSURANCE			
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency			
4						
3						
2						
1						
0			R.K	S.D	P.B	S.B.R
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

CLIENT :

Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony,
Agra, Uttar Pradesh - 282010

CONSULTANT :

Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE : **PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.**

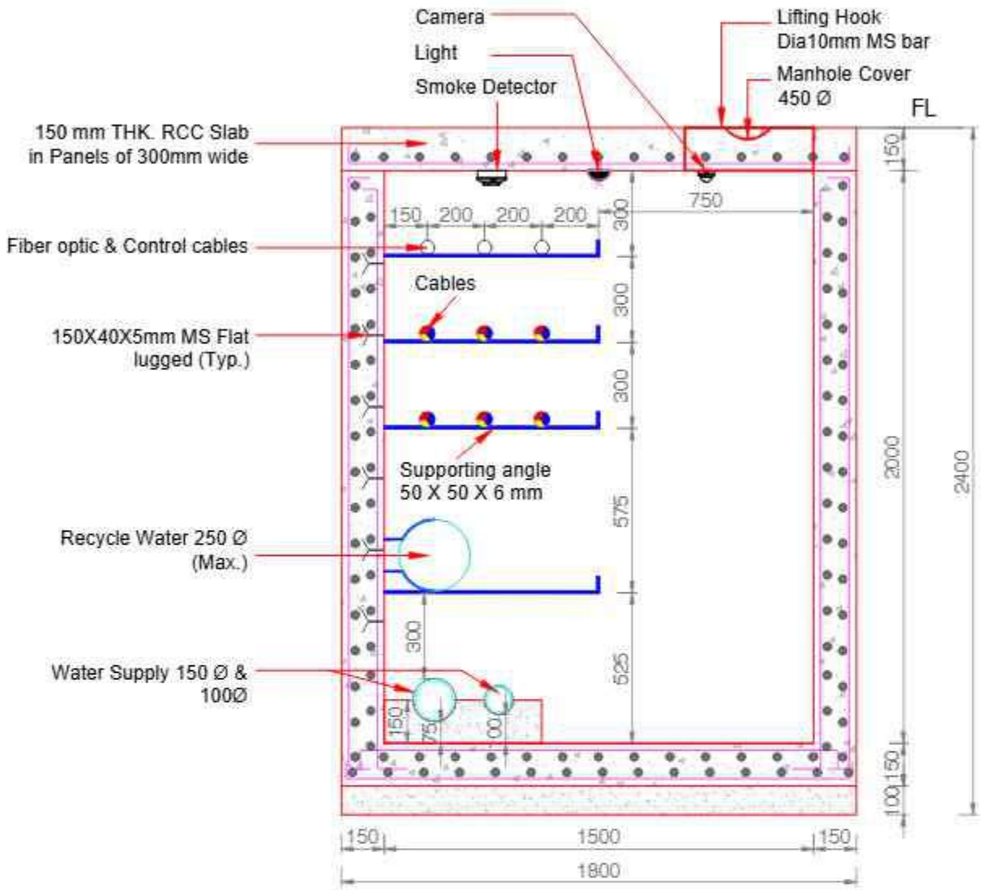
DRAWING TITLE : TREATED WASTE WATER NETWORK

DRAWING NO : VSPL/IPD/2324-066/DPR/RCW/01

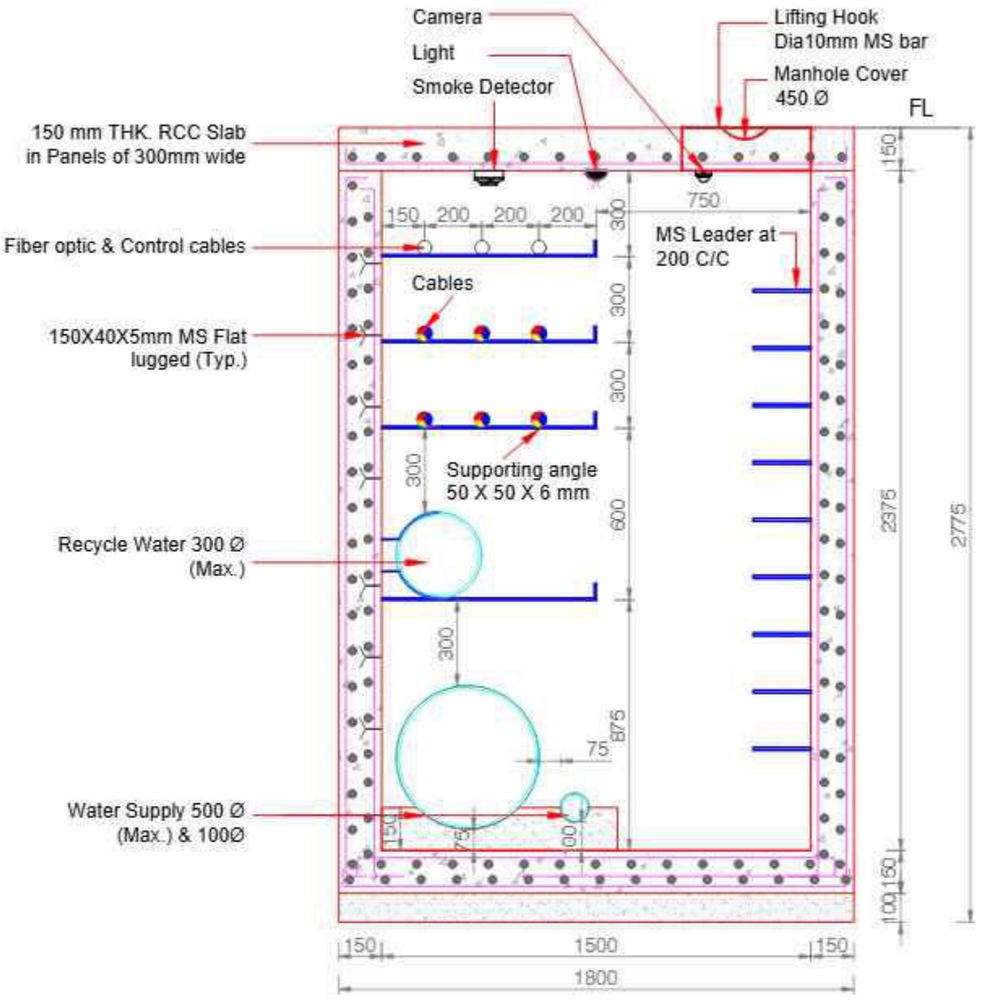
GRAPHIC SCALE :

NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

	ISSUE RECORD	APPROVED FOR ISSUE
SHEET SIZE A1	Concept	
	DFR/DPR	
	Tender Drawing	✓
	Revision	R0
	Date	FEB. 2025



UTILITY DUCT (12M ROW)



UTILITY DUCT (18M ROW & ABOVE)

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (MM)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM, AGRA.		N W E S	ISSUE RECORD / APPROVED FOR ISSUE
4												Concept
3												DPR/DPR
2							CONSULTANT :		DRAWING TITLE :	DETAIL OF UTILITY DUCT	SHEET SIZE	Tender Drawing ✓
1							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.		DRAWING NO :	VSPL/IPD/2324-066/DPR/UD/10		Revision RD
0			S.S.D	S.D	F.S	S.S.R			GRAPHIC SCALE :	0 100 500 1000 M	A3	Date FEB. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY						

POWER INFRASTRUCTURE

SINGLE LINE DIAGRAM

LEGEND	DESCRIPTION
	ISOLATOR
	ISOLATOR EARTH SWITCH / LBS
	CABLE OR BUS CONNECTION POINT
	AUXILIARY TRANSFORMER
	LIGHTNING ARRESTOR
	MINIATURE CIRCUIT BREAKER
	MOULDED CASE CIRCUIT BREAKER (MCCB)
52	DRAWOUT POWER CIRCUIT BREAKER, MEDIUM VOLTAGE
	33kV GIS BREAKER
	DISCONNECTING FUSE - SOLID MATERIAL, MEDIUM VOLTAGE
	TERMINAL BLOCK LUG
	DELTA CONNECTION
	WYE GROUNDED CONNECTION, SOLID GROUND
PROT.	PROTECTION RELAY
	CABLE GLAND
	CURRENT TRANSFORMER
	CONNECTION POINT TO EQUIPMENT SPECIFIED IN OTHER DIVISIONS. RACEWAY, CONDUCTOR AND CONNECTION IN THIS DIVISION
PT	POTENTIAL TRANSFORMER
PT	COMPACT SUBSTATION
	RING MAIN UNIT
	OUTDOOR DG SET
E/M	ELECTRICAL / MECHANICAL INTERLOCK
	SERIES REACTOR
S	SWITCH FUSE UNIT (SFU)
	CONTACTOR
	CAPACITOR BANK
	CONTROL TRANSFORMER
	NON-SEGREGATED PHASE BUS DUCT
	FUSE
M	AIR CIRCUIT BREAKER
	FAULT PASSAGE INDICATOR (FPI)
M	VACCUM CIRCUIT BREAKER WITH MOTORIZED
	POWER TRANSFORMER

LAYOUT

LEGEND	DESCRIPTION
	220kV / 33kV MRSS (MAIN RECEIVING SUBSTATION)
	33kV/11kV ELECTRICAL SUBSTATION (ESS)
	11kV/0.415kV COMPACT SUBSTATION (CSS)
	33kV, 3 - WAY RMU
	11kV, 3 - WAY RMU
	33kV, 4 - WAY RMU
	11kV, 4 - WAY RMU
	33kV, 5 - WAY RMU
	11kV, 5 - WAY RMU

ABBREVIATION

ACB	AIR CIRCUIT BREAKER
VCB	VACUUM CIRCUIT BREAKER
MCCB	MOULDED CASE CIRCUIT BREAKER
MCB	MINIATURE CIRCUIT BREAKER
DB	DISTRIBUTION BOARD
GIS	GAS INSULATED SWITCHGEAR
CSS	COMPACT SUBSTATION
LBS	LOAD BREAK SWITCH
FPI	FAULT PASSAGE INDICATOR
O/G	OUTGOING
I/C	INCOMER
B/C	BUS COUPLER
RMU	RING MAIN UNIT
ESS	ELECTRICAL SUBSTATION

PANEL TAGGING

X - ESS# - XkV - R# - F# - #W - RMU-#

- RMU NUBMER
- NUMBER OF OF WAYS (3W, 4W, 5W)
- FEEDER SEQUENCE NUMBER
- RING SEQUENCE NUMBER
- VOLTAGE RATING
- ELECTRICAL SUBSTATION NUMBER
- ZONE NUMBER (P1 OR P2 OR P3 OR S)

X - ESS# - XkV - R# - F# - CSS-#

- CSS NUBMER
- FEEDER SEQUENCE NUMBER
- RING SEQUENCE NUMBER
- VOLTAGE RATING
- ELECTRICAL SUBSTATION NUMBER
- ZONE NUMBER (P1 OR P2 OR P3 OR S)

LINE TYPE

	33kV INCOMING SUPPLY FROM NEAREST MRSS TO ESS
	33kV OUTGOING FEEDER OR RMU TO RMU LINK LINE
	11kV OUTGOING FEEDER OR RMU TO RMU LINK LINE
	33kV RMU LOOPING
	11kV RMU LOOPING

METERING DEVICE

ASS	AMMETER SELECTOR SWITCH		
VSS	VOLTMETER SELECTOR SWITCH	MFM	MULTI FUNCTION METER
V	VOLTMETER (DIGITAL)	AMF	AUTO MAINS FAILURE
A	AMMETER (DIGITAL)	F	FREQUENCY METER

INDICATING LAMPS (LED TYPE)

LEGEND		DESCRIPTION
	R	RED-R PHASE
	Y	YELLOW-Y PHASE
	B	BLUE-B PHASE
	R	ON
	G	OFF

NOTES

A) 220kV GIS/ 33KV GIS HT PANEL/ 33kV RMU/ 11kV RMU/ 11kV INDOOR GIS PANEL:-

220KV GIS PANEL:

1. DESIGN PARAMETERS:
   - A) APPLICATION : INDOOR
   - B) SYSTEM VOLTAGE : 220kV +6%, -9%
   - C) HIGHEST SYSTEM VOLTAGE : 245kV
   - D) SYSTEM FREQUENCY : 50HZ +3%, -3%
   - E) FAULT LEVEL : CB 40kA/1Sec AND ES 40kA/1Sec
   - F) AMBIENT TEMPERATURE : 50° C

11kV INDOOR GIS PANEL:

4. DESIGN PARAMETERS:
   - A) APPLICATION : INDOOR
   - B) SYSTEM VOLTAGE :11kV +6%,-9%
   - C) HIGHEST SYSTEM VOLTAGE : 12kV
   - D) SYSTEM FREQUENCY : 50HZ +3%,-3%
   - E) FAULT LEVEL : CB 25kA/1Sec : AND ES 25kA/1Sec
   - F) AMBIENT TEMPERATURE : 50° C
   - G) PROTECTION LEVEL : IP4X

33KV GIS HT PANEL:

2. DESIGN PARAMETERS:
   - A) APPLICATION : INDOOR
   - B) SYSTEM VOLTAGE : 33kV +6%, -9%
   - C) HIGHEST SYSTEM VOLTAGE : 36kV
   - D) SYSTEM FREQUENCY : 50HZ +3%, -3%
   - E) FAULT LEVEL : CB 25kA/1Sec AND ES 25kA/1Sec
   - F) AMBIENT TEMPERATURE : 50° C
   - G) PROTECTION LEVEL : IP4X

11kV RMU:

5. DESIGN PARAMETERS:
   - A) APPLICATION : OUTDOOR
   - B) SYSTEM VOLTAGE : 11kV +6%,-9%
   - C) HIGHEST SYSTEM VOLTAGE : 12kV
   - D) SYSTEM FREQUENCY : 50HZ +3%,-3%
   - E) FAULT LEVEL FOR 11kV : CB/LBS 25kA /1Sec OR 20kA/3Sec.
   - F) AMBIENT TEMPERATURE : 50° C

33kV RMU:

3. DESIGN PARAMETERS:
   - A) APPLICATION : OUTDOOR
   - B) SYSTEM VOLTAGE : 33kV +6%,-9%
   - C) HIGHEST SYSTEM VOLTAGE : 36kV
   - D) SYSTEM FREQUENCY : 50HZ +3%,-3%
   - E) FAULT LEVEL : CB/LBS 20kA/3Sec
   - F) AMBIENT TEMPERATURE : 50° C

6. THE INDOOR GIS PANEL SHALL HAVE VCB BREAKER, THREE POSITION DISCONNECTING SWITCH AND COPPER BUS BAR SHALL BE ENCLOSED IN SF6 GAS. CIRCUIT-BREAKER AND THREE-POSITION SWITCH DRIVES ARE TO BE DESIGNED WITH MECHANICAL INTERROGATION INTERLOCKS. THREE-POSITION DISCONNECTOR (ON-OFF-EARTH) IS TO BE DESIGNED WITH SEPARATE MANUAL AND/OR MOTORIZED DRIVES FOR THE DISCONNECTOR AND EARTH SWITCH FUNCTIONS.
7. THE HT SWITCHBOARD WILL BE SINGLE BUS BAR TYPE. THE BREAKERS WILL BE FIXED TYPE ON THE FLOOR AND EQUIPPED WITH THREE POSITION DISCONNECTOR EARTH SWITCH. THE SWITCHBOARD SHALL BE PROVIDED FOR EXTENSION IN EITHER DIRECTION.
8. ALL PROTECTIVE RELAYS WILL BE NUMERICAL TYPE WITH COMMUNICATION COMPATIBILITY AS PER IEC 61850. THE NUMERICAL RELAYS SHALL BE WITH PROGRAMMABLE LOGIC AND CAPABLE OF COMMUNICATING WITH SUB STATION RTU VIA FIBRE OPTIC SERIAL BUS THROUGH IEC STANDARD 61850.
9. MULTIFUNCTION METER WILL BE MICROPROCESSOR BASED GIVING DETAILS OF VOLTS, AMPS, FREQUENCY, KW, KWH, PF, KVA, KVARH AND MAXIMUM DEMAND. IT SHALL BE COMMUNICABLE TYPE THROUGH RS 485 PORT. ACCURACY WILL BE CLASS 0.5S.
10. THE INTERLOCK SHALL BE PROVIDED BETWEEN BUSBAR ISOLATOR & OUTGOING EARTHING SWITCH AND INTERLOCK BETWEEN BUSBAR ISOLATOR AND CIRCUIT-BREAKER.
11. MECHANICAL INTERLOCK BETWEEN THE SWITCH DISCONNECTOR AND THE OUTGOING EARTHING SWITCH WILL BE PROVIDED.
12. CIRCUIT BREAKER DRIVE MECHANISM SHALL BE DESIGNED FOR BOTH MANUAL AND MOTOR OPERATION AND SHALL ALLOW AUTO RECLOSING.
13. ALL CUBICLES WILL BE PROVIDED WITH ADEQUATE CAPACITY SPACE HEATER SUITABLE FOR OPERATING VOLTAGE OF 240V AC.
14. MINIMUM 20% SPARE TERMINAL BLOCKS WILL BE PROVIDED AT SWITCHGEAR.
14. SF6 GAS SHALL BE THE ONLY INSULATING MEDIUM FOR THE SWITCHGEAR & INTERRUPTING MEDIUM VACUUM.
16. THE TWO INCOMING FEEDERS ON THE BOARDS SHALL NOT RUN IN PARALLEL AND SHALL BE FEEDING THE LOADS ON THE RESPECTIVE BUS SECTIONS.
17. INDOOR SWITCHBOARD SUITABLE WITH CONVENTIONAL LOCAL OPERATION FROM THE BOARD AND SUBSTATION SCADA SYSTEMAS WELL AS REMOTE CONTROLLED THROUGH SCADA ON IEC 61850 PROTOCOL.
18. THE SUB-STATION CAN BE AN UNMANNED ONE AND REMOTE CONTROLLED FROM SCADA SYSTEM.
19. THE OUTDOOR TYPE RMU SHALL BE EXTENDABLE TYPE AND STAND ALONE. RMU SHALL HAVE TWO NUMBERS INCOMING FEEDER OF FAULT MAKING / LOAD BREAKING, MOTOR OPERATED, LINE SIDE SWITCHES AND REQUIRED NUMBER OF OUTGOING FEEDERS OF TEE-OFF, SPRING OPERATED, CIRCUIT BREAKER WITH SEALED FOR LIFE VACUUM INTERRUPTER.
20. LOOPING CABLE B/W RMU`S/CSS`S SHALL BE OF SAME SIZE AS INDICATED IN THE OUTGOING FEEDERS.
21. RMU WILL BE EQUIPPED WITH NECESSARY FIELD REMOTE TERMINAL UNIT, FAULT CIRCUIT INDICATOR AND VOLTAGE PASSAGE INDICATOR /CAPACITIVE VOLTAGE INDICATOR, MECHANICAL MIMIC, RMU FRTU WILL HAVE DISPLAY UNIT AND PROVISION FOR SCADA REMOTE CONTROL.
22. EACH BREAKER OF 33kV GIS AND 11kV GIS SHALL HAVE TWO BREAKER TRIPPING COILS.
23. 33kV GIS AND 11kV GIS SHALL BE PROVIDED WITH MECHANICAL MIMIC AT THE PANEL FRONT DOOR DIRECTLY LINKED TO MECHANISM.
24. THE OUTDOOR CSS SHALL HAVE MOTORIZED LOAD BREAK SWITCH, VCB BREAKER ALONG THREE POSITION DISCONNECTING SWITCH AND COPPER BUSBAR.
25. ALL PROTECTIVE RELAY WILL BE NUMERICAL TYPE WITH RS 485 COMMUNICATION.
26. CSS WILL HAVE INBUILT POWER PACK UNIT WITH BATTERY BACKUP TO CATER THE DC LOAD.
27. MULTIFUNCTION METER WILL BE MICROPROCESSOR BASED AND COMMUNICABLE THROUGH RS 485 PORT.
28. ALL INDICATING LAMPS WILL BE LED TYPE.
29. THE DRAWING DEPICTS THE KEY POWER DISTRIBUTION SCHEME DETAILED ENGINEERING CONTRACTOR SHALL VERIFY AND DEVELOP THE DRAWING BASED ON THE BASIS OF CONFIRMED LOAD/VENDOR.
30. EQUIPMENT RATING AND FEEDER QUANTITY OF SWITCHBOARDS ARE TENTAVIVE WHICH SHALL BE CONFIRMED BY CONTRACTOR DURING DETAILED ENGINEERING.
31. SWITCHGEAR CONTROL SUPPLY FOR PROTECTIVE RELAYS, AUXILIARY RELAYS, BREAKER CLOSING COIL, TRIPPING COIL & INDICATION LAMPS WILL BE OPERATED 110V DC. SPRING CHARGING MOTOR, LAMP & SPACE HEATER WILL BE 240V AC SUPPLY. FOR SCADA/PLC EACH ESS WILL HAVE DEDICATED 240V UPS SYSTEM WITH SMPS. FOR 24V DC REQUIREMENT OF RMU & CSS WILL HAVE INBUILT POWER PACK UNIT 24V DC WITH BATTERY BACKUP TO CATER THE DC LOAD OF FRTU & CONTROL SUPPLY FOR RMU.

32. TO MAINTAIN THE REDUNDANCY AND RELIABILITY IN THE POWER SUPPLY DISTRIBUTION NETWORK, 11 KV RING MAIN UNITS SHALL BE CONNECTED IN A RING. THE HV SUPPLY DISTRIBUTION SYSTEM SHALL BE PLANNED IN RING FORMATION WITH AN OPEN POINT, SO AS TO OPERATE THE SYSTEM AS RADIAL FEEDER. EACH RING START & END SHALL BE CONNECTED TO SEPARATE SOURCES THROUGH THE FEEDERS ON THE DIFFERENT BUSES.
33. TRANSFORMER LOADING SHALL BE DESIGNED SUCH THAT EACH TRANSFORMER IS NOT LOADED BEYOND APPROXIMATELY 80%. HOWEVER IN CASE OF EMERGENCY 100% CONTINUOUS LOADING SHALL BE PERMITTED.
34. 11 kV INCOMING POWER SUPPLY TO WTP, STP, CETP SWM ETC. SHALL BE TAPPED FROM NEAREST 11kV RMU AT TWO DIFFERENT PONTS.
35. DEDICATED ELECTRICAL ROOM SHALL BE CONSIDERED FOR STP, CETP, WTP AND SWM PLANT.
36. RATING OF DG SET AND LT AUX. SWITCHBOARD ARE TENTATIVE AND SHALL BE AS PER FINAL LOAD REQUIREMENT.
37. STREET LIGHTING SHALL BE FED FROM RESPECTIVE SUBSTATIONS THROUGH CSS/LIGHTING FEEDER PILLAR ARRANGEMENT.
38. STREET LIGHTING POLES SHALL BE CONTROLLED AS GROUP THROUGH GATE WAY CONTROLLER MOUNTED INSIDE LIGHTING FEEDER PILLAR.
39. FOR STREET LIGHTING, DEDICATED LIGHTING SCADA SYSTEM SHALL BE PROVIDED. POWER SCADA AT RESPECTIVE MRSS/ESS AND LIGHTING SCADA SHALL BE INTERFACED WITH SCADA AT COMMON COMMAND CENTER.
40. MFM OF EACH HIGH MAST FEEDER PILLAR SHALL BE INTERFACED WITH RESPECTIVE SUBSTATION SCADA.

B) 33KV & 11KV CABLE / RCC CABLE TRENCH CONFIGURATION :

1. ALL DIMENSIONS ARE IN METERS UNLESS STATED OTHERWISE.
2. ALL 33 KV, 11KV, 415V POWER CABLE AND FIBER OPTIC CABLE FOR COMMUNICATION SHALL BE LAID IN RCC CABLE TRENCHES.
3. IN CABLE TRENCHES, CABLES SHALL BE ARRANGED IN SUCH A MANNER THAT HIGHER VOLTAGE CABLES SHALL BE AT THE BOTTOM AND THE LOWER VOLTAGE CABLES SHALL BE AT THE TOP.
4. THE 33KV AND 11KV CABLES ARE SPACED BY ONE CABLE DIAMETER AND 1.1KV CABLE WILL BE TOUCHING EACH OTHER.
5. IN CABLE TRENCHES, DEDICATED CABLE TRAY WILL BE PROVIDED FOR HV, LV AND OFC.
6. CABLING FROM RCC CABLE TRENCH TO RESPECTIVE PLOT SHALL BE LAID THROUGH FLEXIBLE ADAPTER & EXTENSION PIPE.

REVISION BLOCK		
5		
4		
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1		
0		
REV.	DATE	DESCRIPTION

QUALITY ASSURANCE

The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency

DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY
		P.B	S.B.R

CLIENT :

Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT :

Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

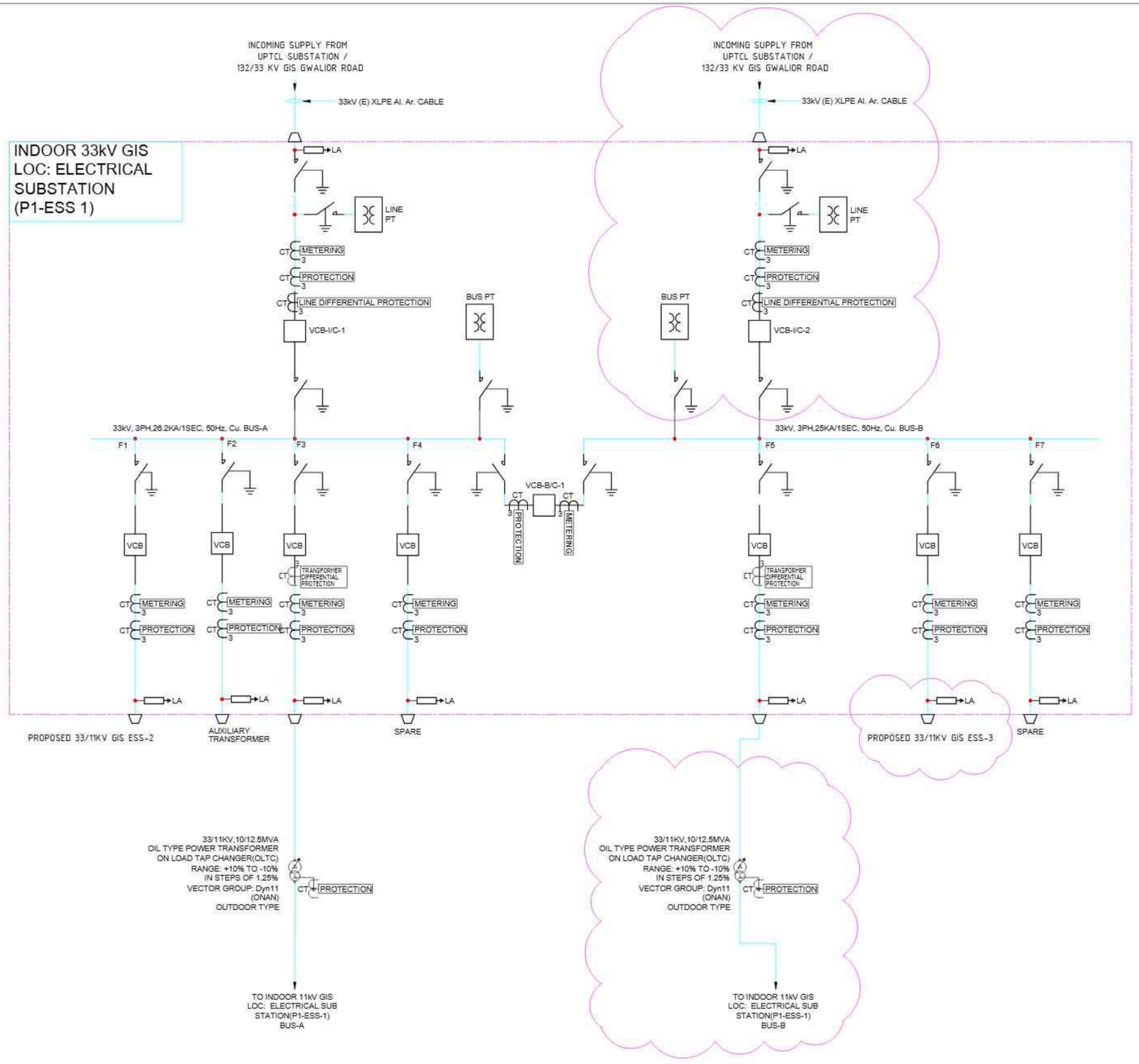
PROJECT TITLE :	**PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.**
DRAWING TITLE :	**ELECTRICAL LEGENDS & ABBREVIATIONS**
DRAWING NO :	**VSPL/IPD/2324-066/DPR/EL/00**
GRAPHIC SCALE :	

NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

N / W / E / S

ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DFR/DPR	
Tender Drawing	✓
Revision	R1
Date	FEB. 2025

SHEET SIZE A2



NOTE:-

1.Cloud Repsentation will be excluded from the EPC scope.

REVISION BLOCK			QUALITY ASSURANCE			
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency			
4						
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0					P.B	S.B.R
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

CLIENT :
Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT :
Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE : **PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.**

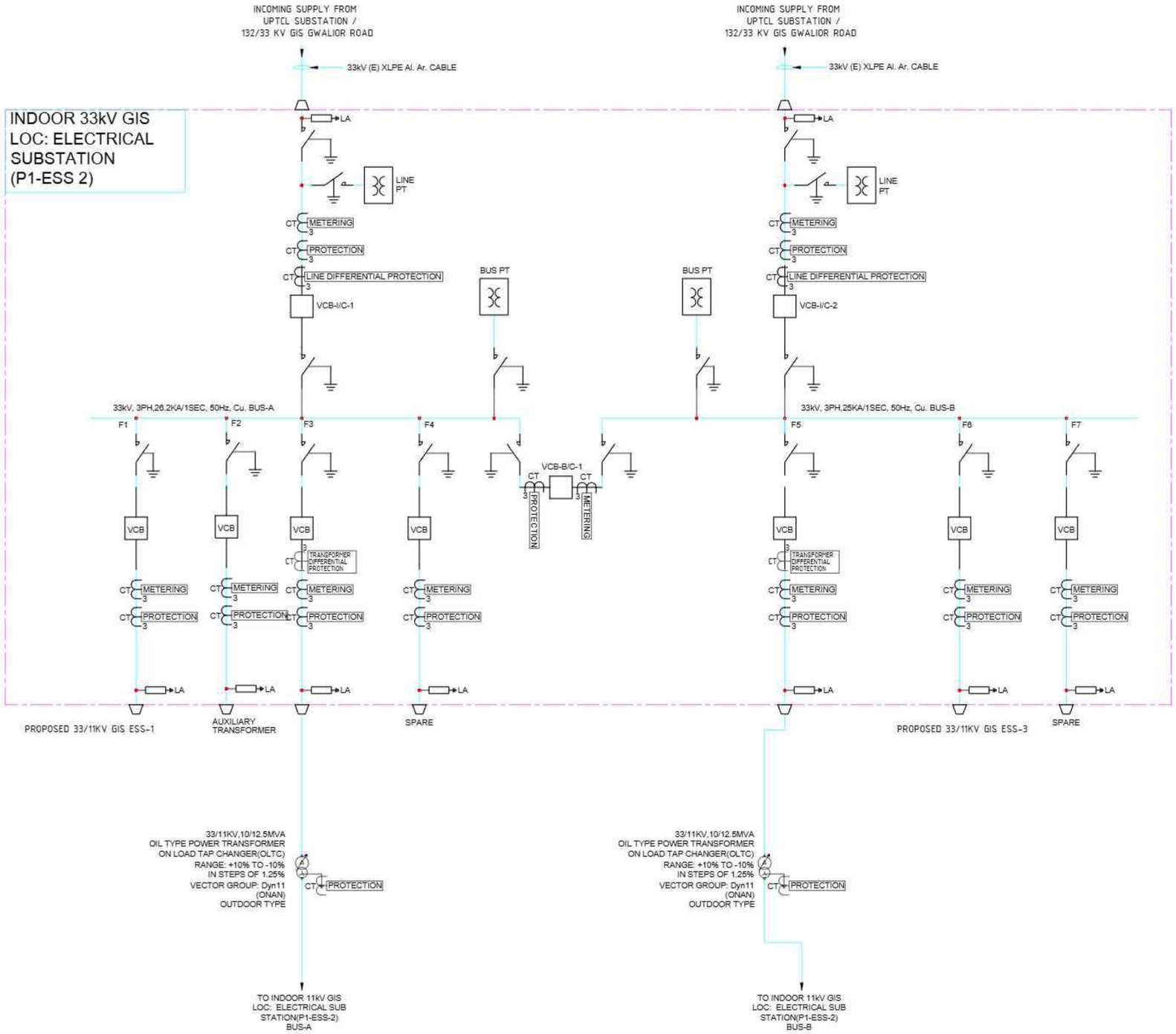
DRAWING TITLE : **33 KV ELECTRICAL SUBSTATION-1 SLD FOR ATAL PURAM TOWNSHIP-AGRA (SHEET 1 OF 3)**

DRAWING NO : **VSPL/IPD/2324-066/DPR/EL/01**

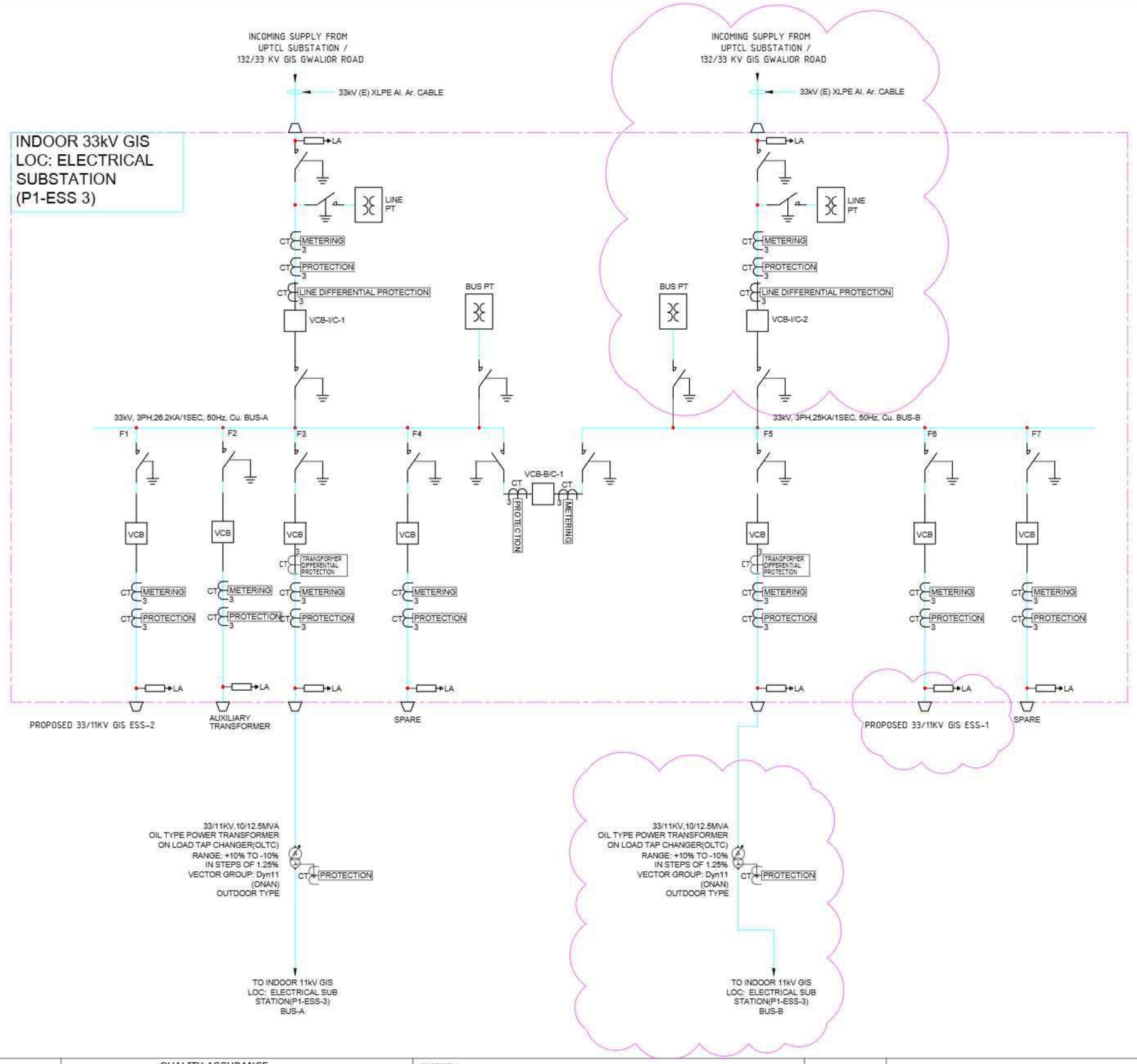
GRAPHIC SCALE :

NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

	ISSUE RECORD	APPROVED FOR ISSUE
	Concept	
	DFR/DPR	
SHEET SIZE A2	Tender Drawing	✓
	Revision	R1
	Date	FEB. 2025



REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (M)		
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.		N W E S	ISSUE RECORD	APPROVED FOR ISSUE
4												Concept	
3												DFR/DPR	
2							CONSULTANT :		DRAWING TITLE :	33 KV ELECTRICAL SUBSTATION-2 SLD FOR ATAL PURAM TOWNSHIP-AGRA (SHEET 2 OF 3)		Tender Drawing	✓
1							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.		DRAWING NO :	VSPL/IPD/2324-066/DPR/EL/01		Revision	R1
0					P.B	S.B.R			GRAPHIC SCALE :		SHEET SIZE A2	Date	FEB. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY							



NOTE:-

1.Cloud Repsentation will be excluded from the EPC scope.

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :	PROJECT TITLE :	NOTE : ALL THE DIMENSIONS ARE IN METERS (M)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010	PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.	N W E S	ISSUE RECORD / APPROVED FOR ISSUE
4										Concept
3										DFR/DPR
2							CONSULTANT :	DRAWING TITLE : 33 KV ELECTRICAL SUBSTATION-3 SLD FOR ATAL PURAM TOWNSHIP-AGRA (SHEET 3 OF 3)		Tender Drawing ✓
1							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.	DRAWING NO : VSPL/IPD/2324-066/DPR/EL/01	SHEET SIZE	Revision R1
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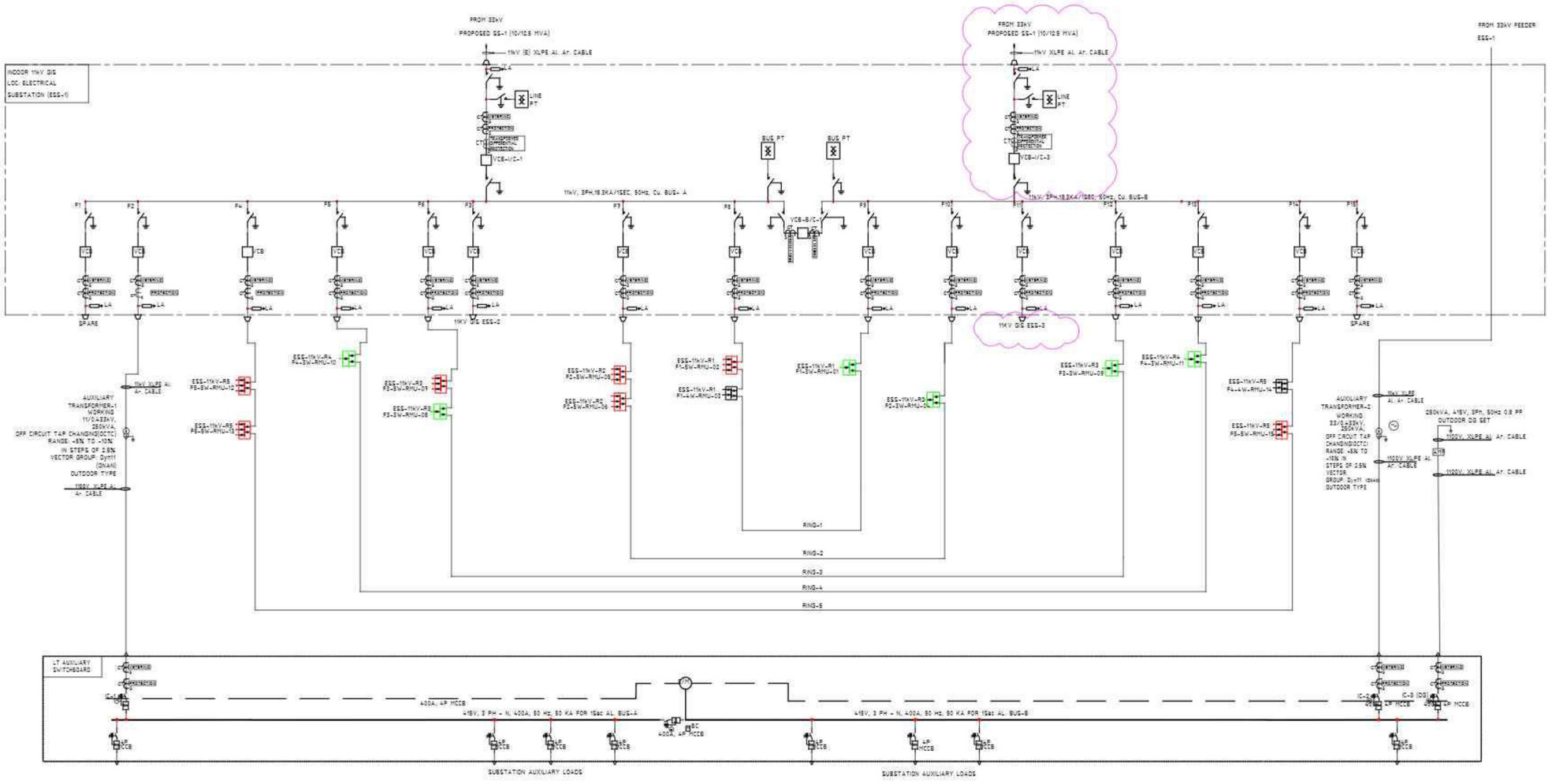
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY				



NOTE:-

1.Cloud Repsentation will be excluded from the EPC scope.

REVISION BLOCK			QUALITY ASSURANCE			
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency			
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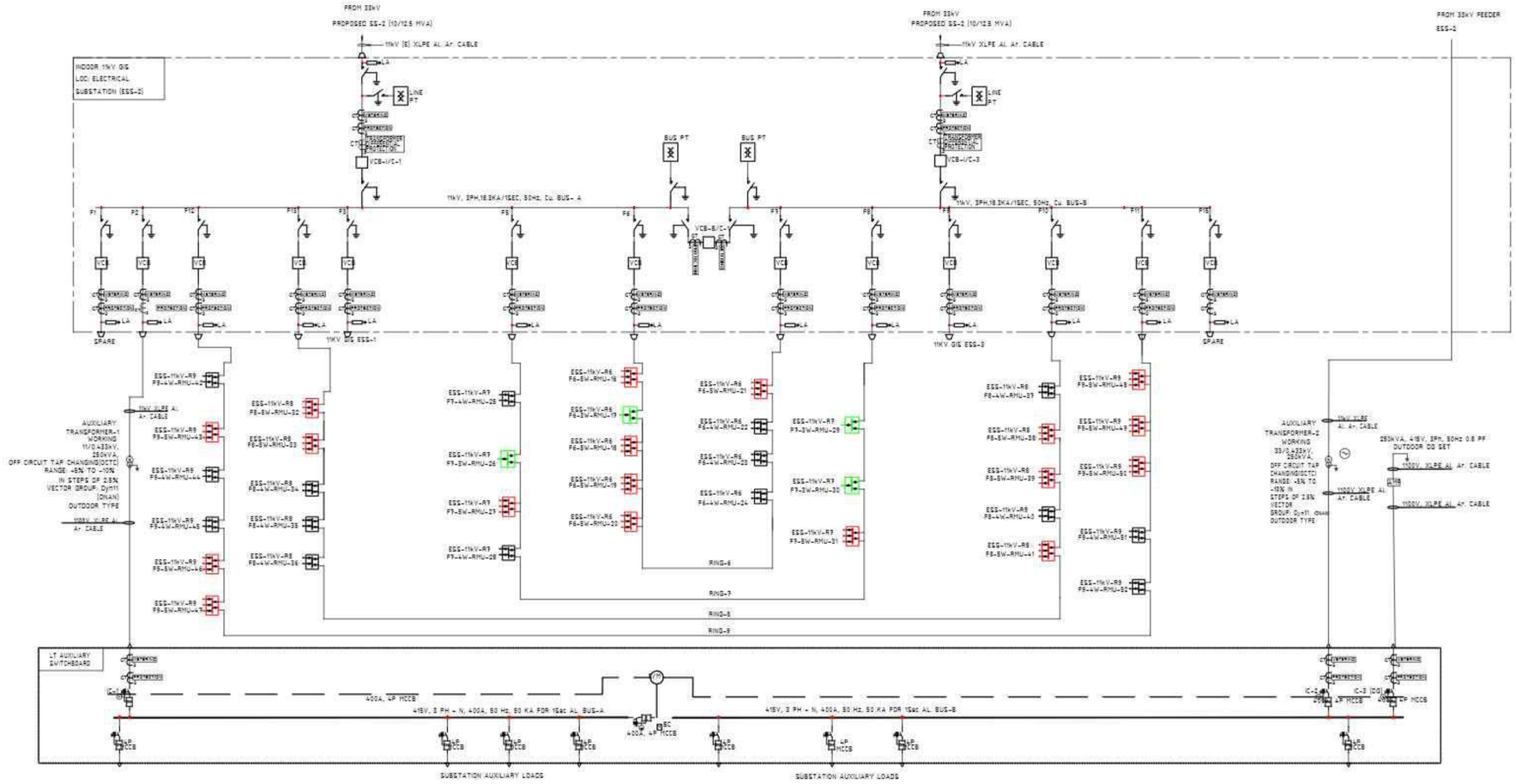
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

CLIENT :	Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010
CONSULTANT :	Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.
PROJECT TITLE :	**PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.**
DRAWING TITLE :	**11KV ELECTRICAL SUBSTATION -1 SLD FOR ATAL PURAM TOWNSHIP-AGRA (SHEET 1 OF 3)**
DRAWING NO :	**VSPL/IPD/2324-066/DPR/EL/02**
GRAPHIC SCALE :	

NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DFR/DPR	
Tender Drawing	✓
Revision	R1
Date	FEB. 2025

SHEET SIZE: A2



REVISION BLOCK			QUALITY ASSURANCE			
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REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

CLIENT :
Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT :
Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE : **PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.**

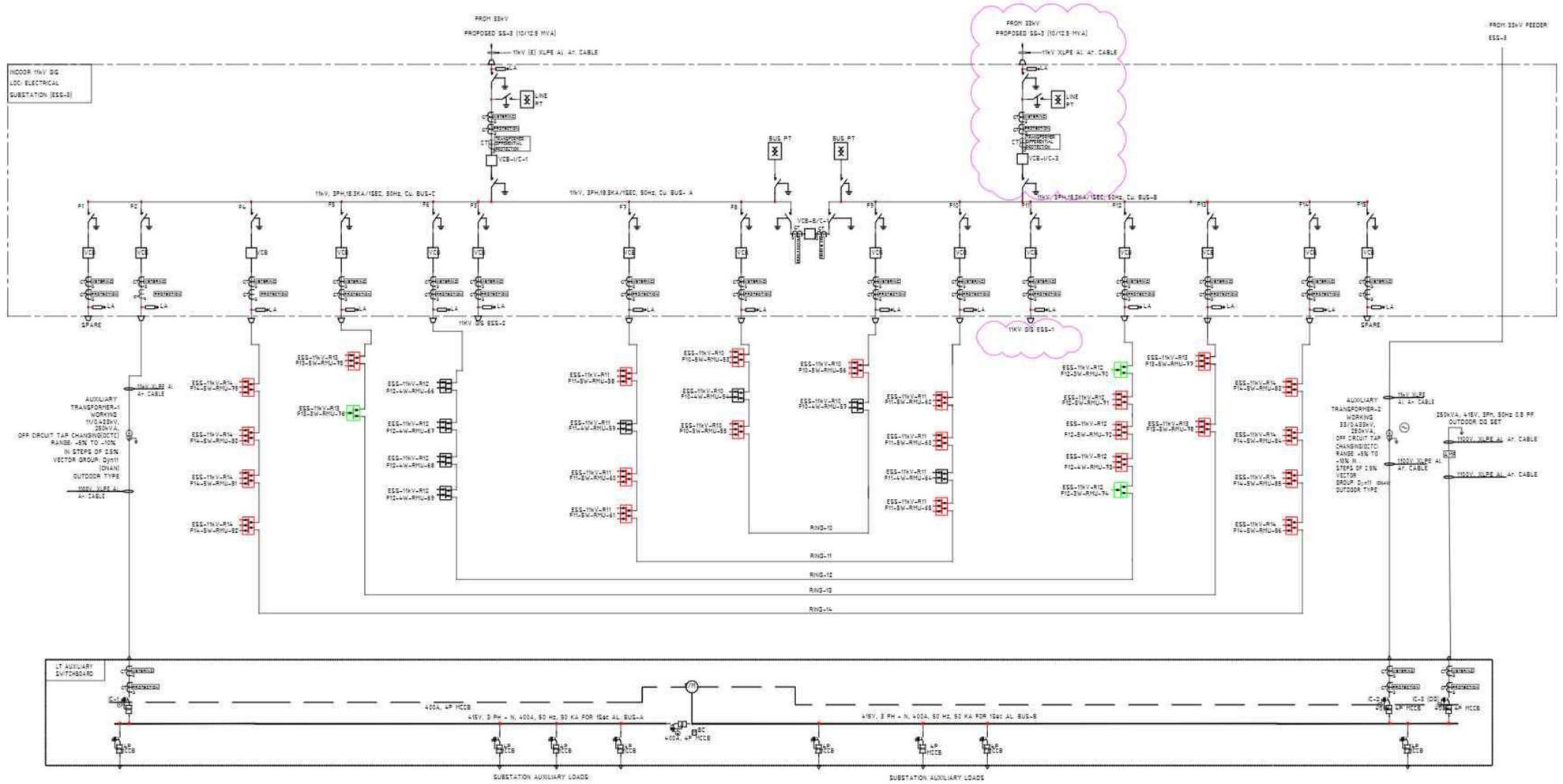
DRAWING TITLE : **11KV ELECTRICAL SUBSTATION-2 SLD FOR ATAL PURAM TOWNSHIP-AGRA (SHEET 2 OF 3)**

DRAWING NO : **VSPL/IPD/2324-066/DPR/EL/02**

GRAPHIC SCALE :

NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

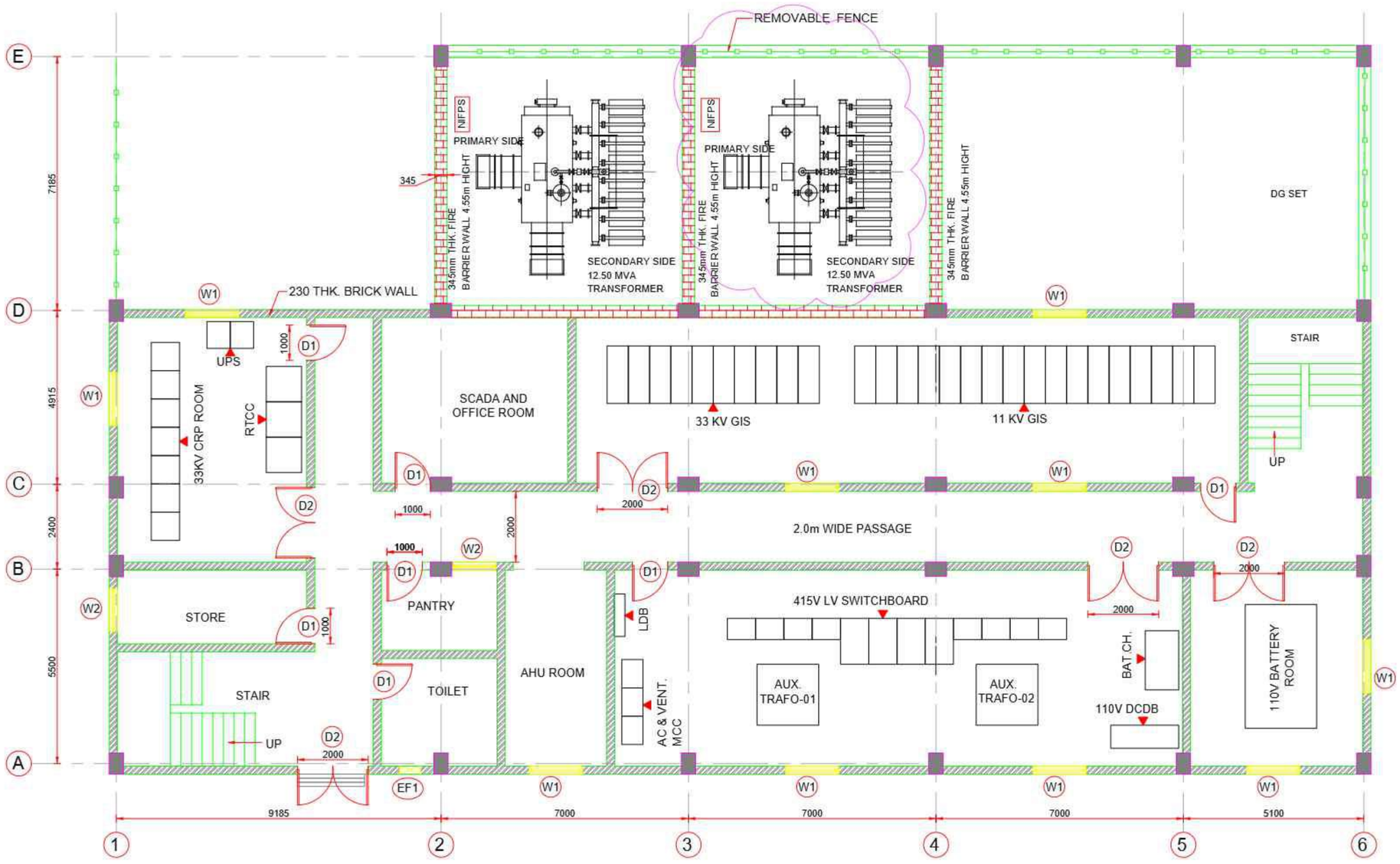
	ISSUE RECORD	APPROVED FOR ISSUE
	Concept	
	DFR/DPR	
SHEET SIZE A2	Tender Drawing	✓
	Revision	R1
	Date	FEB. 2025



NOTE:-

1.Cloud Repsentation will be excluded from the EPC scope.

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (M)		
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency					Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.		ISSUE RECORD	APPROVED FOR ISSUE
4											N W E S	Concept	
3												DFR/DPR	
2							CONSULTANT :	Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.	DRAWING TITLE :	11KV ELECTRICAL SUBSTATION-3 SLD FOR ATAL PURAM TOWNSHIP-AGRA (SHEET 3 OF 3)		Tender Drawing	✓
1									DRAWING NO :	VSPL/IPD/2324-066/DPR/EL/02	SHEET SIZE	Revision	R1
0					P.B	S.B.R			GRAPHIC SCALE :		A2	Date	FEB. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY							



TYPICAL 33/11KV SUBSTATION (ESS-1&3) LAYOUT

(CLEAR HEIGHT OF SUBSTATION BUILDING 4.5M)

(SCALE 1:75)

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS NOTED OTHERWISE.
2. ONLY WRITTEN DIMENSIONS ARE TO BE FOLLOWED, DRAWING SHOULD NOT BE SCALED UNDER ANY CIRCUMSTANCES.
3. ELECTRICAL EQUIPMENT RATING SIZE, EQUIPMENT LAYOUT, BUILDING DIMENSIONS INDICATED HERE IS TENTATIVE ONLY.
4. CONTRACTOR TO FINALIZE ELECTRICAL EQUIPMENT LAYOUT/BUILDING DIMENSIONS ACCORDING TO VENDOR DATA DURING DETAIL ENGINEERING STAGE.
5. NECESSARY PATHWAY SHALL BE PROVIDED ALONG THE SUBSTATION BUILDING PERIPHERY FOR PROPER ACCESSIBILITY OF THE BUILDING.
6. CABLE TRENCH DEPTH AND WIDTH WILL BE SELECTED DURING DETAIL DESIGN BY EPC CONTRACTOR.

REVISION BLOCK			QUALITY ASSURANCE			
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency			
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REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

CLIENT : Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT : Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE : **PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.**

DRAWING TITLE : GA LAYOUT FOR 33/11KV SUBSTATION-1&3FOR ATAL PURAM TOWNSHIP-AGRA

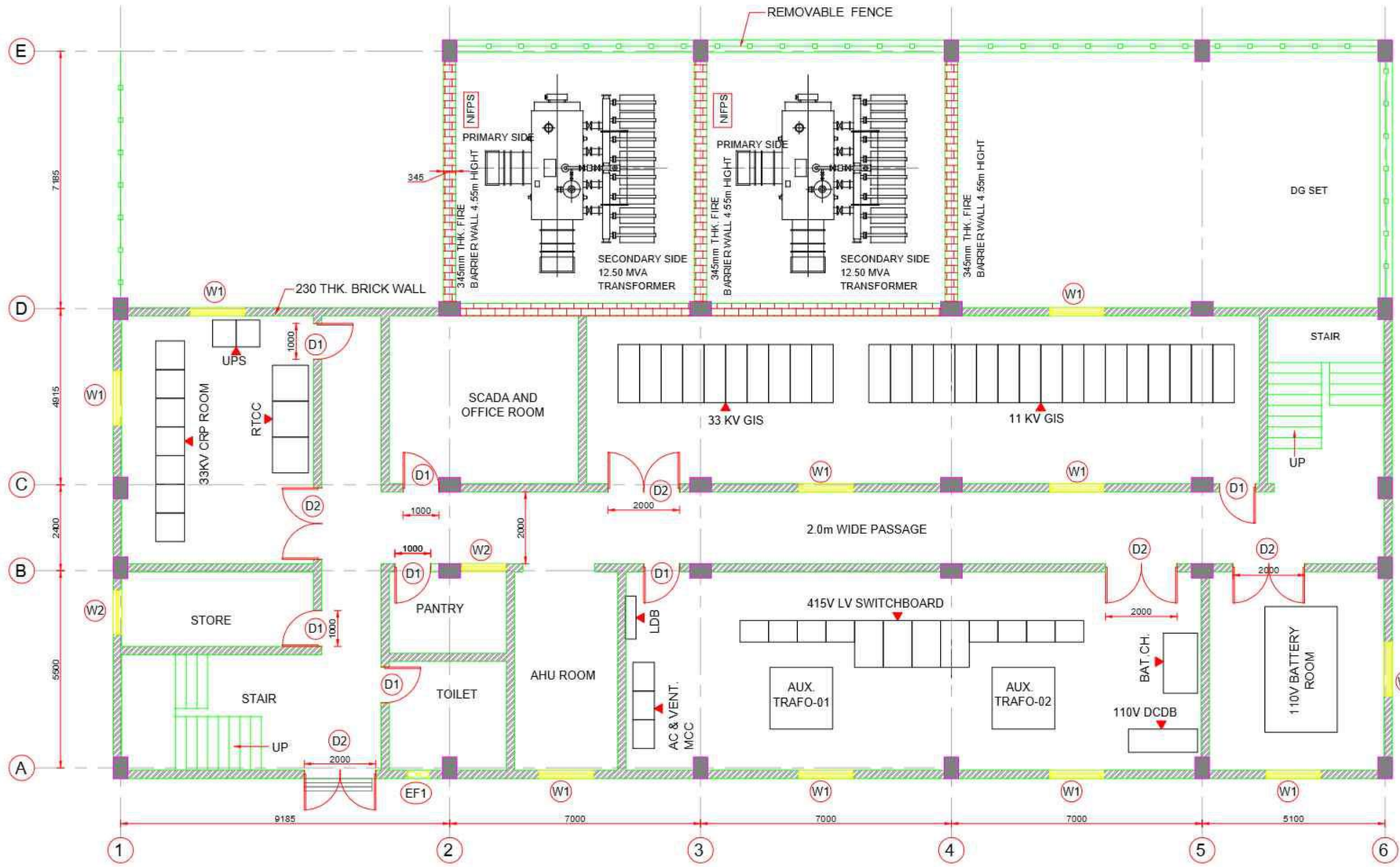
DRAWING NO : VSPL/IPD/2324-066/DPR/EL/04

GRAPHIC SCALE :

NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

SHEET SIZE : A2

ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DFR/DPR	
Tender Drawing	✓
Revision	R1
Date	FEB. 2025



TYPICAL 33/11KV SUBSTATION (ESS-2) LAYOUT

(CLEAR HEIGHT OF SUBSTATION BUILDING 4.5M)

(SCALE 1:75)

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS NOTED OTHERWISE.
2. ONLY WRITTEN DIMENSIONS ARE TO BE FOLLOWED, DRAWING SHOULD NOT BE SCALED UNDER ANY CIRCUMSTANCES.
3. ELECTRICAL EQUIPMENT RATING SIZE, EQUIPMENT LAYOUT, BUILDING DIMENSIONS INDICATED HERE IS TENTATIVE ONLY.
4. CONTRACTOR TO FINALIZE ELECTRICAL EQUIPMENT LAYOUT/BUILDING DIMENSIONS ACCORDING TO VENDOR DATA DURING DETAIL ENGINEERING STAGE.
5. NECESSARY PATHWAY SHALL BE PROVIDED ALONG THE SUBSTATION BUILDING PERIPHERY FOR PROPER ACCESSIBILITY OF THE BUILDING.
6. CABLE TRENCH DEPTH AND WIDTH WILL BE SELECTED DURING DETAIL DESIGN BY EPC CONTRACTOR.

REVISION BLOCK			QUALITY ASSURANCE			
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency			
4						
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REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

CLIENT : Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT : Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE : **PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.**

DRAWING TITLE : GA LAYOUT FOR 33/11KV SUBSTATION-2FOR ATAL PURAM TOWNSHIP-AGRA

DRAWING NO : **VSPL/IPD/2324-066/DPR/EL/04**

GRAPHIC SCALE :

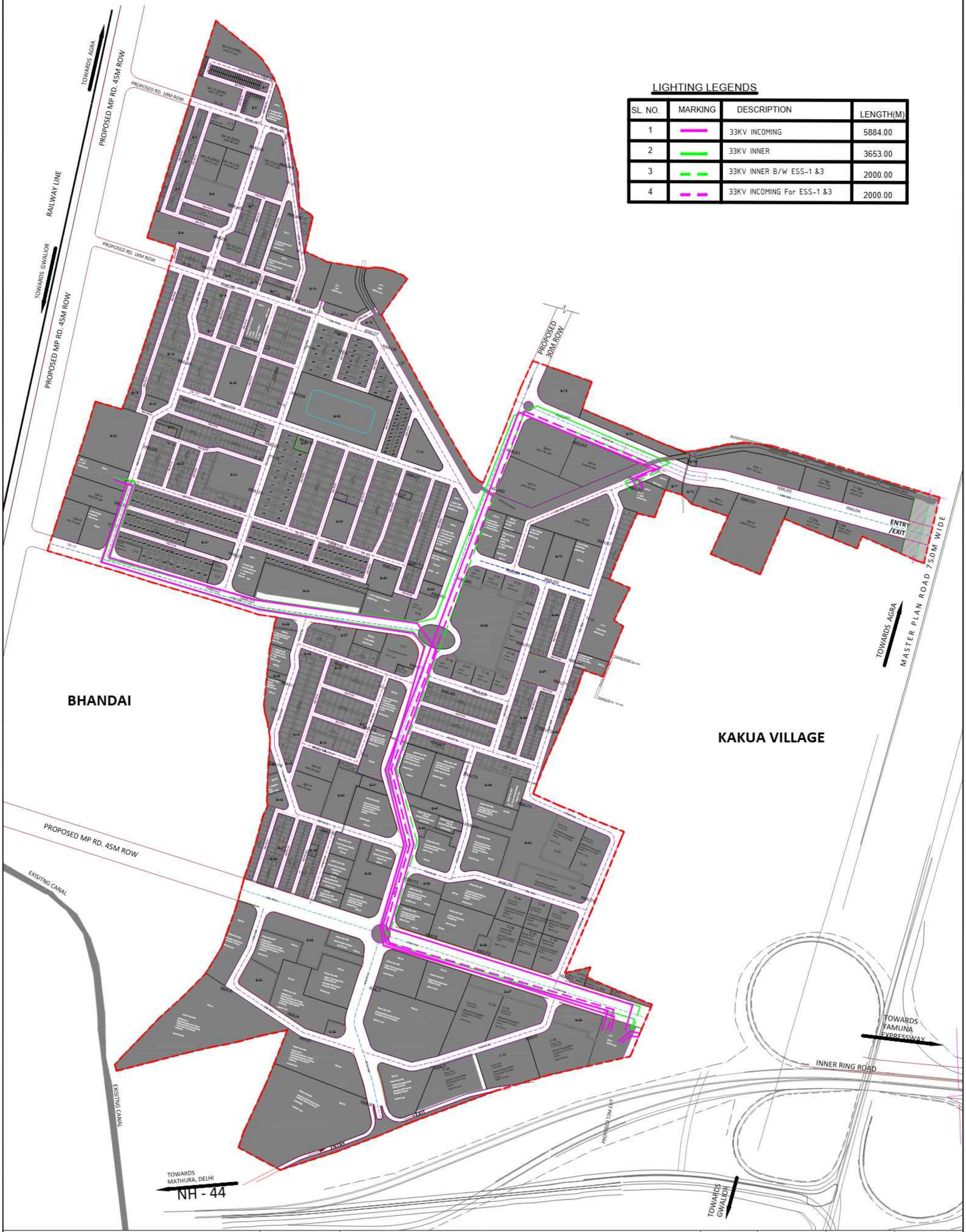
NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

SHEET SIZE : A2

	ISSUE RECORD	APPROVED FOR ISSUE
	Concept	
	DFR/DPR	
	Tender Drawing	✓
	Revision	R1
	Date	FEB. 2025

LIGHTING LEGENDS

SL. NO.	MARKING	DESCRIPTION	LENGTH(M)
1		33KV INCOMING	5884.00
2		33KV INNER	3653.00
3		33KV INNER B/W ESS-1 &3	2000.00
4		33KV INCOMING For ESS-1 &3	2000.00



CLIENT
AGRA DEVELOPMENT AUTHORITY ADA
RATAN MUNI RD, JAIPUR HOUSE, JAIPUR HOUSE COLONY, AGRA, UTTAR PRADESH 282010

CONSULTANT
VOYANTS SOLUTIONS PVT. LTD.
403, 4TH FLOOR, PARK CENTRA, SEC-30, NH-8, GURGAON - 122001, HR.

PROJECT TITLE:	**PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.**		
DRAWING TITLE:	**33KV CABLING NETWORK LAYOUT FOR ATAL PURAM TOWNSHIP-AGRA**		
DRG. No. :	VSPL/IPD/2324-066/DPR/EL/005/R1	DATE :	
DRAWN BY :	VOYANTS TEAM	SCALE :	0 25 125 250

N W E S

DRAFTSMAN	J. E.	A. E.
E. E.	T. P.	I/C L. A.
C. E.	SECRETARY	VICE CHAIRMAN

LIGHTING LEGENDS

SL. NO.	MARKING	DESCRIPTION	NOS./ LENGTH(M)
1		11 KV RMU (3Way)	14
2		11 KV RMU (4Way)	24
3		11 KV RMU (5Way)	51
4		TRANSFORMER	66
5		3Cx300Sqm RMU TO TRANSFORMER	7468.00
6		11KV RING -1	817.00
7		11KV RING -2	1966.00
8		11KV RING -3	1958.00
9		11KV RING -4	1352.00
10		11KV RING -5	920.00
11		11KV RING -6	1195.00
12		11KV RING -7	1640.00
13		11KV RING -8	3068.00
14		11KV RING -9	2396.00
15		11KV RING -10	1492.00
16		11KV RING -11	2202.00
17		11KV RING -12	2236.00
18		11KV RING -13	2209.00
19		11KV RING -14	3215.00
20		11KV INTER CONNECTION (300Sqmm)	3781.00
21		11KV INTER CONNECTION (300Sqmm)	1993.00

CLIENT
AGRA DEVELOPMENT AUTHORITY ADA
RATAN MUNI RD, JAIPUR HOUSE, JAIPUR HOUSE COLONY, AGRA, UTTAR PRADESH 282010

CONSULTANT
VOYANTS SOLUTIONS PVT. LTD.
403, 4TH FLOOR, PARK CENTRA, SEC-30, NH-8, GURGAON - 122001, HR.

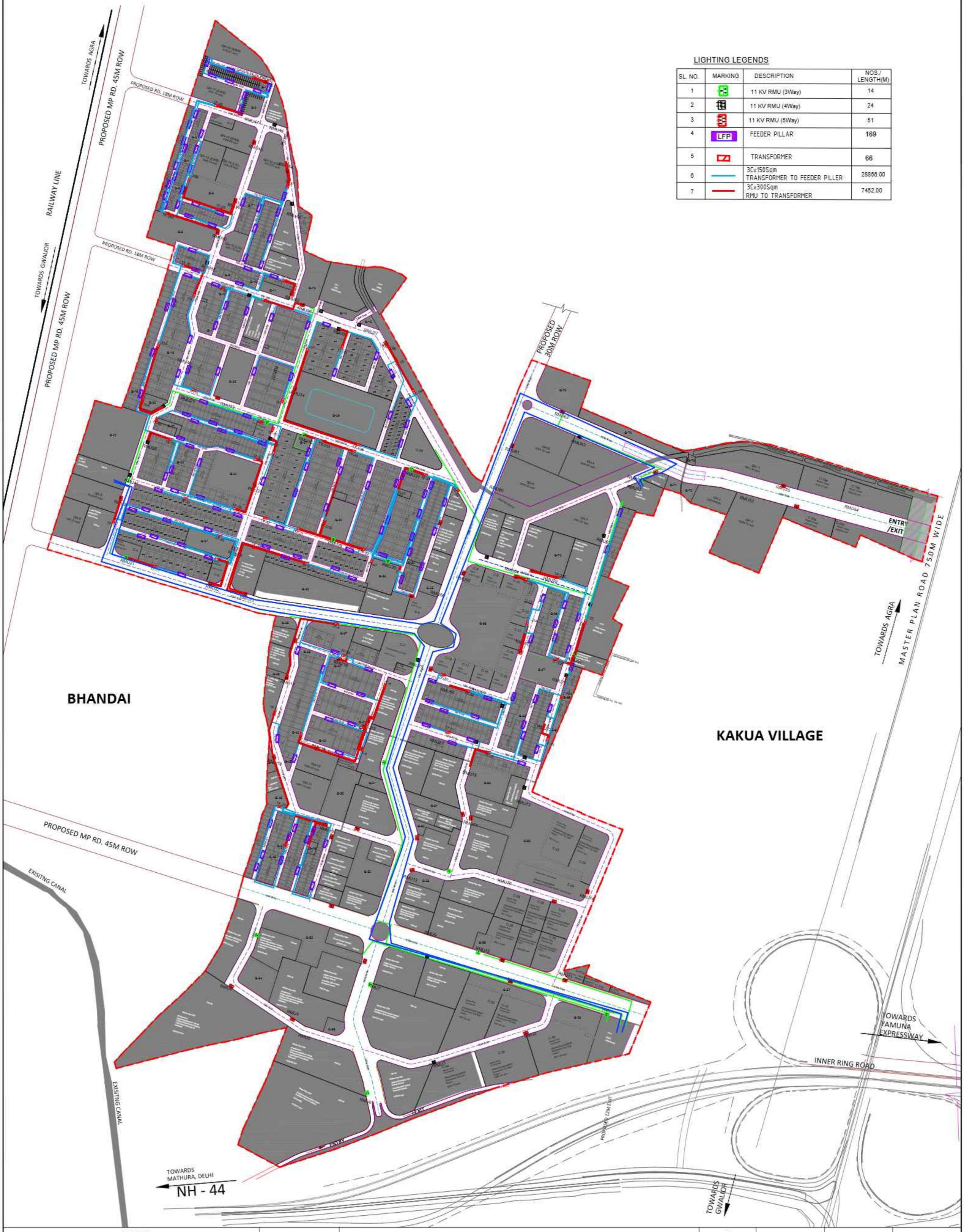
PROJECT TITLE:	PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.		
DRAWING TITLE:	11KV CABLE NETWORK LAYOUT FOR ATAL PURAM TOWNSHIP-AGRA		
DRG. No. :	VSPL/IPD/2324-066/DPR/EL/06/R1	DATE :	
DRAWN BY :	VOYANTS TEAM	SCALE :	0 25 125 250

N W E S

DRAFTSMAN	J. E.	A. E.
E. E.	T. P.	I/C L. A.
C. E.	SECRETARY	VICE CHAIRMAN

LIGHTING LEGENDS

SL. NO.	MARKING	DESCRIPTION	NOS./ LENGTH(M)
1		11 KV RMU (3Way)	14
2		11 KV RMU (4Way)	24
3		11 KV RMU (5Way)	51
4	LFP	FEEDER PILLAR	169
5		TRANSFORMER	66
6		3Cx150Sqm TRANSFORMER TO FEEDER PILLER	28856.00
7		3Cx300Sqm RMU TO TRANSFORMER	7452.00



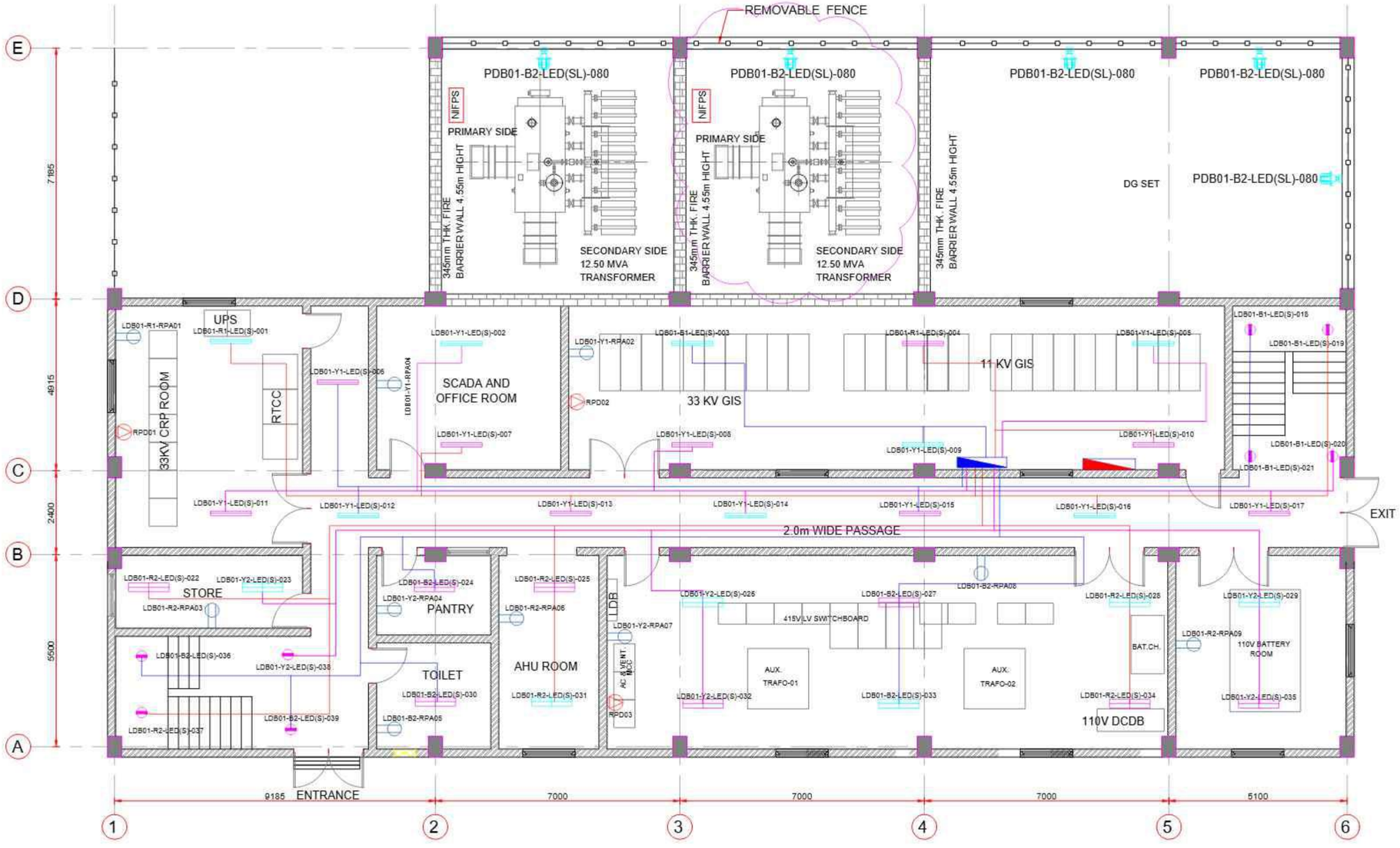
CLIENT
AGRA DEVELOPMENT AUTHORITY ADA
RATAN MUNI RD, JAIPUR HOUSE, JAIPUR HOUSE COLONY, AGRA, UTTAR PRADESH 282010

CONSULTANT
VOYANTS SOLUTIONS PVT. LTD.
403, 4TH FLOOR, PARK CENTRA, SEC-30, NH-8, GURGAON - 122001, HR.

PROJECT TITLE:	PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.		
DRAWING TITLE:	LV CABLING LAYOUT FOR FOR ATAL PURAM TOWNSHIP-AGRA		
DRG. No. :	VSPL/IPD/2324-066/DPR/EL/007/R1	DATE :	
DRAWN BY :	VOYANTS TEAM	SCALE :	0 25 125 250

N W E S

DRAFTSMAN	J. E.	A. E.
E. E.	T. P.	I/C L. A.
C. E.	SECRETARY	VICE CHAIRMAN



TYPICAL 33/11KV SUBSTATION (ESS1&3) LAYOUT

(CLEAR HEIGHT OF SUBSTATION BUILDING 4.5M)

(SCALE 1:75)

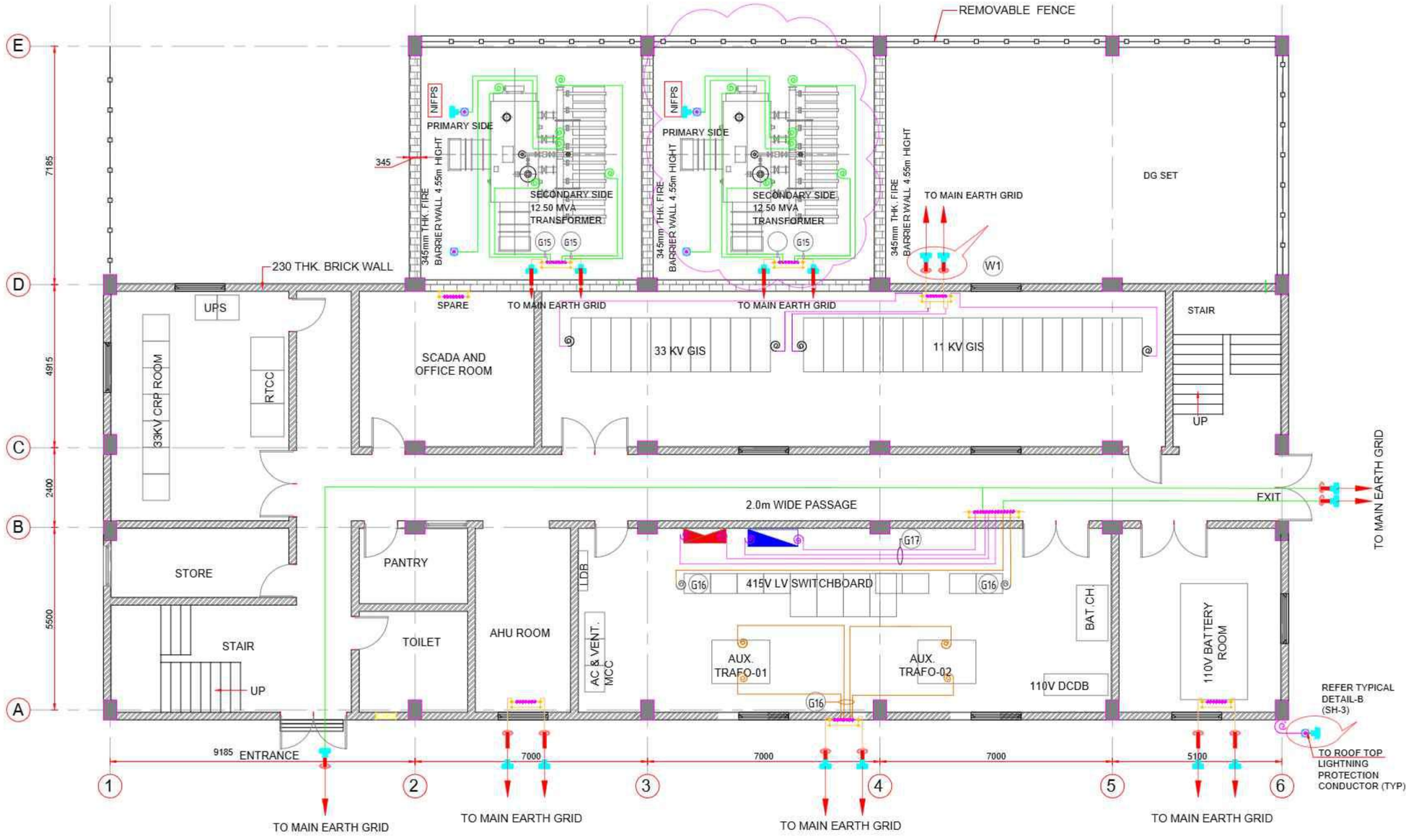
NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METER UNLESS OTHERWISE NOTED.
2. LIGHTING FIXTURE/SOCKET LOCATION SHOWN IN THIS DRAWING ARE INDICATIVE IN CASE OF ANY INTERFERENCE, LOCATION OF PARTICULAR FIXTURE/SOCKET MAY BE CHANGED DURING ERECTION STAGE IN CO-ORDINATION WITH MECHANICAL GA/ ELECTRICAL GA DRAWING (AS APPLICABLE) IN CONSULTATION WITH ENGINEER-IN-CHARGE.
3. THE LIGHTING EQUIPMENTS SHALL BE MOUNTED AS FOLLOWS :-
   SWITCH BOX : +1200 MM FROM FFL
   SOCKET OUTLET : 400MM ABOVE FFL
   EXIT/ENTRANCE : 300MM ABOVE DOOR
   LIGHTING PANEL: +1500MM FROM FFL
4. LIGHTING LUMINARIES SHALL BE MOUNTED AS PER HEIGHT MENTIONED IN THE LIGHTING CALCULATION.
5. 415V, 63A POWER OUTLET SHALL BE FED FROM 415V PDB, LOCATED AT 33/11kV BUILDING (SWITCHGEAR ROOM).
6. EACH SINGLE CIRCUIT FEEDER SHALL BE LIMITED TO MAXIMUM FOUR (4) SOCKET OUTLET.
7. LIGHTING WIRES SHALL BE ROUTED IN THE CONCRETE/BRICK WALL BUILDING VIA EMBEDDED GI PIPES IN THE FLOOR SLAB/BUILDING WALLS.
8. LIGHTING WIRE SHALL BE ROUTED THROUGH RGS PIPE IN THE STEEL COLOUMN BUILDING HAVING METAL CLAD WALLS. EXIT SIGNS ARE PROVIDED WITH RECHARGEABLE BATTERIES FOR 2Hrs BACKUP. THE BATTERY PACK SHALL HAVE ITS OWN BUILT-IN CHARGER AND THESE EXIT SIGNS SHALL BE CONNECTED TO THE NORMAL SUPPLY. UPON FAILURE OF NORMAL SUPPLY, THE BATTERY PACK SHALL CONTINUE TO PROVIDE POWER SUPPLY FOR TWO HOURS.
9. THE UNIT SHALL BE EQUIPPED WITH NICKEL CADMIUM SEALED CELLS AND AN AUTOMATIC CHARGER MAINS FAILURE RELAY AND SHALL BE MAINTENANCE FREE.
10. CLOUD REPRESENTATION WILL BE EXCLUDE FROM THE EPC SCOPE

NORMAL CIRCUIT DETAILS:

LDB 01 R1 F1001
- FIXTURE TYPE'F1', FIXTURE No. 001
- PHASE No. R, CKT No. 1
- SERIAL NO. 1
- LIGHTING DISTRIBUTION BOARD

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (M)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.		N W E S	ISSUE RECORD / APPROVED FOR ISSUE
4												Concept
3												DPR/DPR
2							CONSULTANT :		DRAWING TITLE :	LIGHTING LAYOUT FOR 33/11KV SUBSTATIONS1&3 (SH 1 OF 3)	SHEET SIZE	Tender Drawing ✓
1							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.		DRAWING NO :	VSPL/IPD/2324-066/DPR/EL/010	A2	Revision R1
0					P.B	S.B.R			GRAPHIC SCALE :			Date FEB. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY						



GROUNDING & LIGHTNING PROTECTION LAYOUT FOR 33/11kV

(SCALE 1:75)

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS NOTED OTHERWISE.
2. ONLY WRITTEN DIMENSIONS ARE TO BE FOLLOWED, DRAWING SHOULD NOT BE SCALED UNDER ANY CIRCUMSTANCES.
3. ELECTRICAL EQUIPMENT RATING SIZE, EQUIPMENT LAYOUT, BUILDING DIMENSIONS INDICATED HERE IS TENTATIVE ONLY.
4. CONTRACTOR TO FINALIZE ELECTRICAL EQUIPMENT LAYOUT/BUILDING DIMENSIONS ACCORDING TO VENDOR DATA DURING DETAIL ENGINEERING STAGE.
5. NECESSARY PATHWAY SHALL BE PROVIDED ALONG THE SUBSTATION BUILDING PERIPHERY FOR PROPER ACCESSIBILITY OF THE BUILDING.
6. CABLE TRENCH DEPTH AND WIDTH WILL BE SELECTED DURING DETAIL DESIGN BY EPC CONTRACTOR.
7. CLOUD REPRESENTATION WILL BE EXCLUDE FROM THE EPC SCOPE

LEGEND FOR EARTHING & BILL OF QUANTITY (TABLE-1)

SYMBOL	DESCRIPTION	QTY.
	32mm DIA MS ROD	5.50 Mtrs.
G1	50X10 Sq.mm G.I FLAT	132.00 Mtrs.
G2	50X6 Sq.mm G.I FLAT	36.00 Mtrs.
G3	25X6 Sq.mm G.I FLAT	68.00 Mtrs.
	THERMOWELD T-JOINT	18.00 Nos.
	7 WAY GROUND PLATE WITH DISCONNECTING LINK	7.0 Nos.
	14 WAY GROUND PLATE WITH DISCONNECTING LINK	1.0 Nos.
	LIGHTNING PROTECTION EARTH ELECTRODE 22MM DIA, 3M LONG COPPER BOND ROD	4.0 Nos.
	EARTH ELECTRODE FOR TRANSFORMER 22MM DIA, 3M LONG COPPER BOND ROD	4.0 Nos.

REVISION BLOCK			QUALITY ASSURANCE			
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4						
3						
2						
1						
0					P.B	S.B.R
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

CLIENT : Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT : Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE : **PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.**

DRAWING TITLE : EARTHING & LIGHTNING PROTECTION LAYOUT FOR 33/11KV SUB-STATIONS 1&3 (SH 1 OF 3)

DRAWING NO : **VSPL/IPD/2324-066/DPR/EL/009**

GRAPHIC SCALE :

NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

SHEET SIZE A2

ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DFR/DPR	
Tender Drawing	✓
Revision	R1
Date	FEB. 2025

LEGEND:

S.NO.	SYMBOL	TAG	DESCRIPTION	QUANTITY
1		LED (S)	SURFACE MOUNTED LUMINAIRE WITH 40 W LED	09 Nos.
2		LED (R)	RECESSED MOUNTED LUMINAIRE WITH 40 W LED	08 Nos.
3		LED (S)	SURFACE MOUNTED LUMINAIRE WITH 40 W LED (WITH UPS BACKUP)	08 Nos.
4		LED (R)	RECESSED MOUNTED LUMINAIRE WITH 40 W LED (WITH UPS BACKUP)	06 Nos.
5		LED (S)	20 W SURFACE MOUNTED LED	08 No.
6	EXIT	EX	8W EXIT SIGN FIXTURE WALL/SURFACE MOUNTED, 240V, 50HZ.,1PH. WITH 2HRS. BATTERY BACK-UP	04 Nos.
7		RPA	100V AC, 6/16A, 50Hz, SINGLE PHASE 5PIN DUPLEX POWER RECEPTACLES (SURFACE MOUNTED).	10 Nos.
8		LDB	LIGHTING DISTRIBUTION BOARD (LDB)	01 No.
9		PDB	POWER DISTRIBUTION BOARD (PDB)	01 No.
10		RPD	415V AC, 63A, 50Hz, 3Ph+N+E WITH DISCONNECTING SWITCH WELDING RECEPTACLES, IP55 (WEATHERPROOF)	03 Nos.
11		TJB	THREE WAY JUNCTION BOXES	10 Nos.
12		FJB	FOUR WAY JUNCTION BOXES	03 Nos.
13		LED (SL)	45W LED STREET LIGHTS	06 Nos.

LIGHTING DISTRIBUTION BOARD - 02

DESCRIPTION	CONNECTED LOAD (W)			TOTAL CONNECTED LOAD (W)	DIVERSITY FACTOR	DIVERSIFIED LOAD (W)
	R	Y	B			
LIGHTING	840W	780W	740W	2360W	1.0	2360W
TOTAL	840W	780W	740W	2360W	1.0	2360W

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :	PROJECT TITLE :	NOTE : ALL THE DIMENSIONS ARE IN METERS (M)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010	PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.		
4									N / W E / S	ISSUE RECORD / APPROVED FOR ISSUE
3										Concept
2							CONSULTANT :	DRAWING TITLE : LIGHTING LAYOUT FOR 33/11KV SUBSTATIONS1&3 (SH 3 OF 3)		DFR/DPR
1							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.	DRAWING NO : VSPL/IPD/2324-066/DPR/EL/010		Tender Drawing ✓
0					P.B	S.B.R		GRAPHIC SCALE :	SHEET SIZE A2	Revision R1
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY				Date FEB. 2025

NOTES

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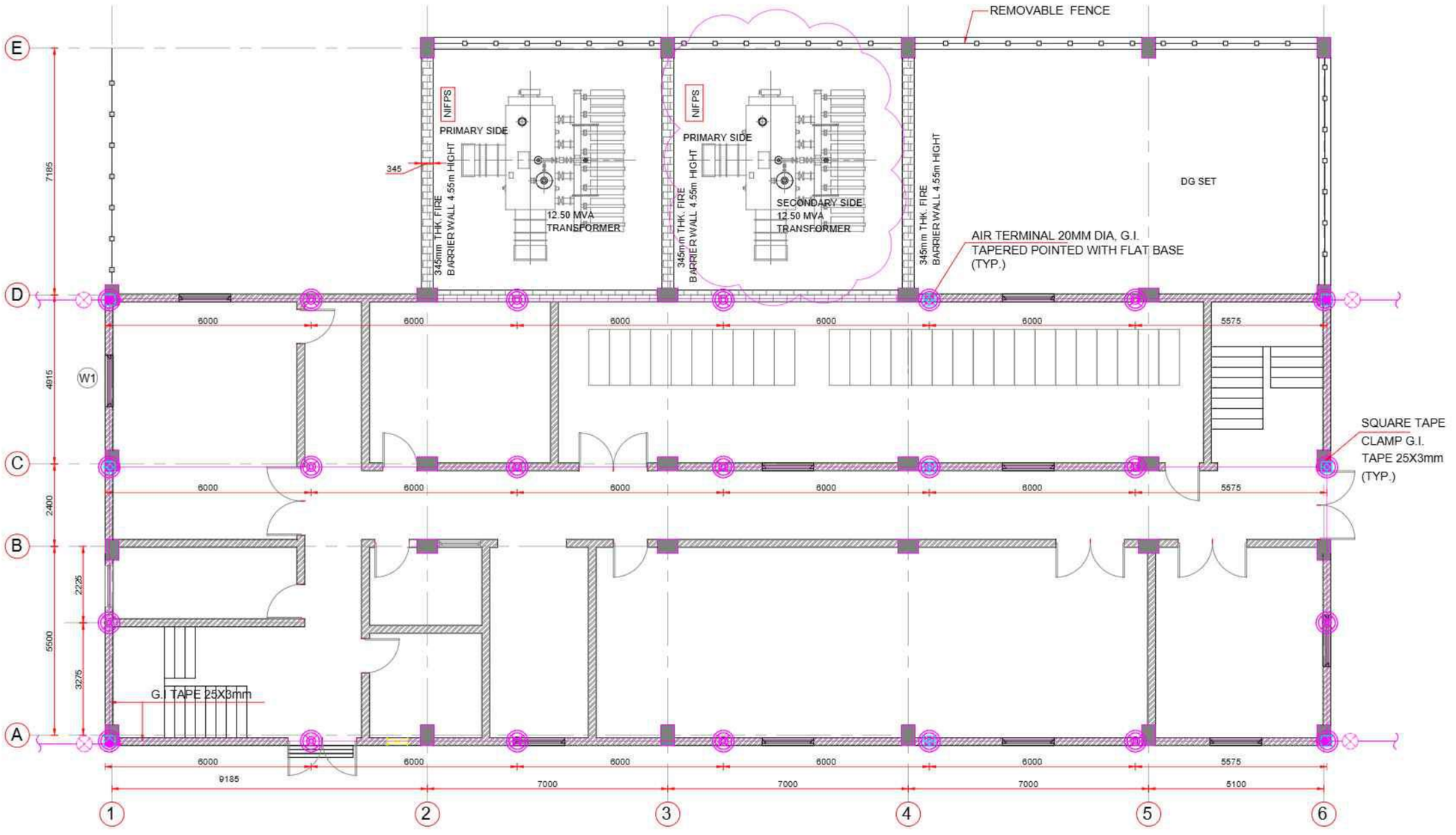

GROUNDING & LIGHTNING PROTECTION LAYOUT FOR 33/11kV

(CLEAR HEIGHT OF SUBSTATION BUILDING 4.5M)

(SCALE 1:75)

BILL OF QUANTITY & LEGEND FOR SUBSTATION:-

SYMBOL	DESCRIPTION	QTY.
	LIGHTNING PROTECTION MAIN CONDUCTOR	133 Mtrs.
	LIGHTNING PROTECTION DOWN CONDUCTOR	04 Nos.
	AIR TERMINAL 20MM DIA G.S ROD	23 Nos.
	TEST LINK	04 Nos.
	EARTH ELECTRODE FOR LIGHTNING PROTECTION	04 Nos.

REVISION BLOCK						
5						
4						
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0					P.B	S.B.R
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

QUALITY ASSURANCE
The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency

CLIENT : Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT : Voyants Solutions Pvt. Ltd.
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PROJECT TITLE : **PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.**

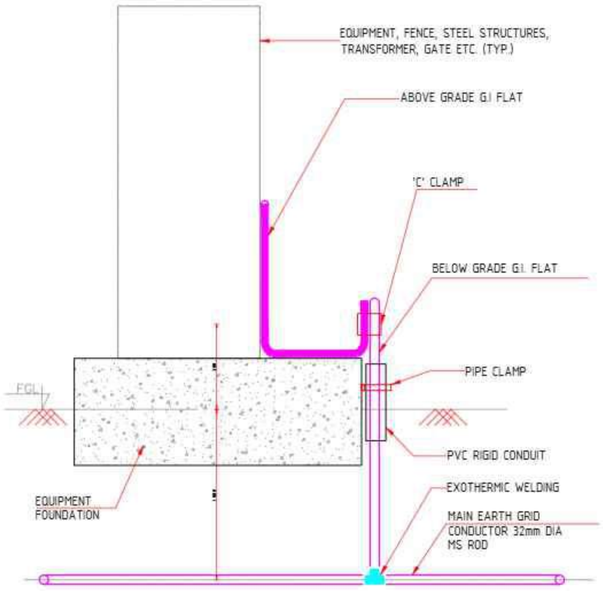
DRAWING TITLE : EARTHING & LIGHTNING PROTECTION LAYOUT FOR 33/11KV SUB-STATIONS 1&3 (SH 2 OF 3)

DRAWING NO : **VSPL/IPD/2324-066/DPR/EL/009**

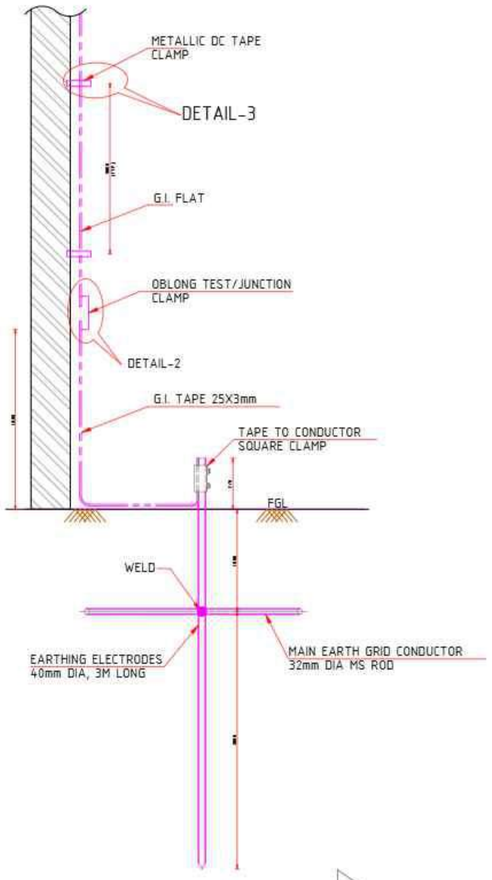
GRAPHIC SCALE :

NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

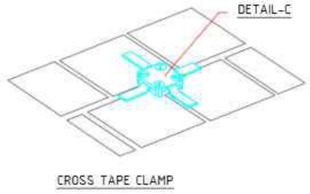
	ISSUE RECORD	APPROVED FOR ISSUE
	Concept	
	DFR/DPR	
SHEET SIZE A2	Tender Drawing	✓
	Revision	R1
	Date	FEB. 2025

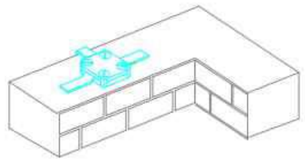


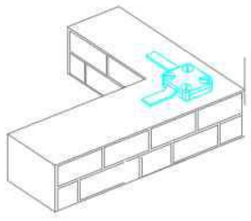
DETAIL-GD 01
CONCEPT FOR EARTHING CONNECTION



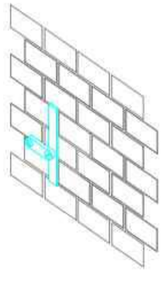
DETAIL -B

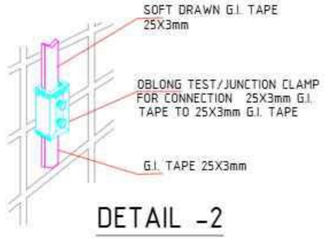




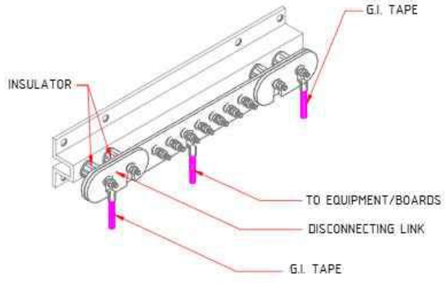


DETAIL -1
CROSS CLAMP

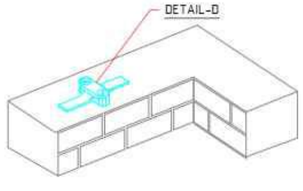




DETAIL -2



TYPICAL DETAIL OF GROUND PLATE INSTALLATION FOR INDOOR PANEL GROUNDING



DETAIL -3
BAR CABLE SADDLE

NOTES

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REVISION BLOCK			QUALITY ASSURANCE			
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4						
3						
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1						
0					P.B	S.B.R
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

CLIENT :
Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT :
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PROJECT TITLE : **PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.**

DRAWING TITLE : EARTHING & LIGHTNING PROTECTION LAYOUT FOR 33/11KV SUBSTATION 1&3 (SH 3 OF 3)

DRAWING NO : **VSPL/IPD/2324-066/DPR/EL/009**

GRAPHIC SCALE :

NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

SHEET SIZE A2

	ISSUE RECORD	APPROVED FOR ISSUE
	Concept	
	DFR/DPR	
	Tender Drawing	✓
	Revision	R1
	Date	FEB. 2025

FROM LT PANEL

4Cx16 Sq.mm
Al. XLPE CABLE

LIGHTING DISTRIBUTION BOARD – 01
LOCATION:- 33/11kV BUILDING

32A
TPN
RCBO

32A, 415V, 3ø, 4W, 50Hz, 20kA (rms) FOR 1Sec.Al, BUS BAR

R1	Y1	B1	R2	Y2	B2	B2	B2	B2
16A MCB	16A MCB	16A MCB	16A MCB	16A MCB	16A MCB	16A MCB	16A MCB	16A MCB
320W	360W	340W	520W	420W	400W			
LDB01-R1-LED-001, LDB01-R1-004, LED-007, LED-010 LED-013, LED-016, LED-020 LDB01-R1-RPA01	LDB01-Y1-LED-002,LED-005, LED-008, LED-011,LED-014, LED-017, LED-020, LDB01-Y1-RPA02	LDB01-B1-LED-003, LED-006, LED-009,LED-012, LED-015, LED-018, LED-021 LDB01-B1-RPA03	LDB01-R2-LED-022, LED-025, LED-028, LED-031, LED-034, LED-037 LDB01-R2-RPA03, RPA06, RPA09	LDB01-R2-LED-023, LED-026, LED-029, LED-032, LED-035, LED-038 LDB01-Y2-RPA04, RPA07	LDB01-R2-LED-024, LED-027, LED-030, LED-033, LED-036, LED-039 LDB01-B2-RPA05, RPA08	SPARE	SPARE	SPARE

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (M)		
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4												Concept	
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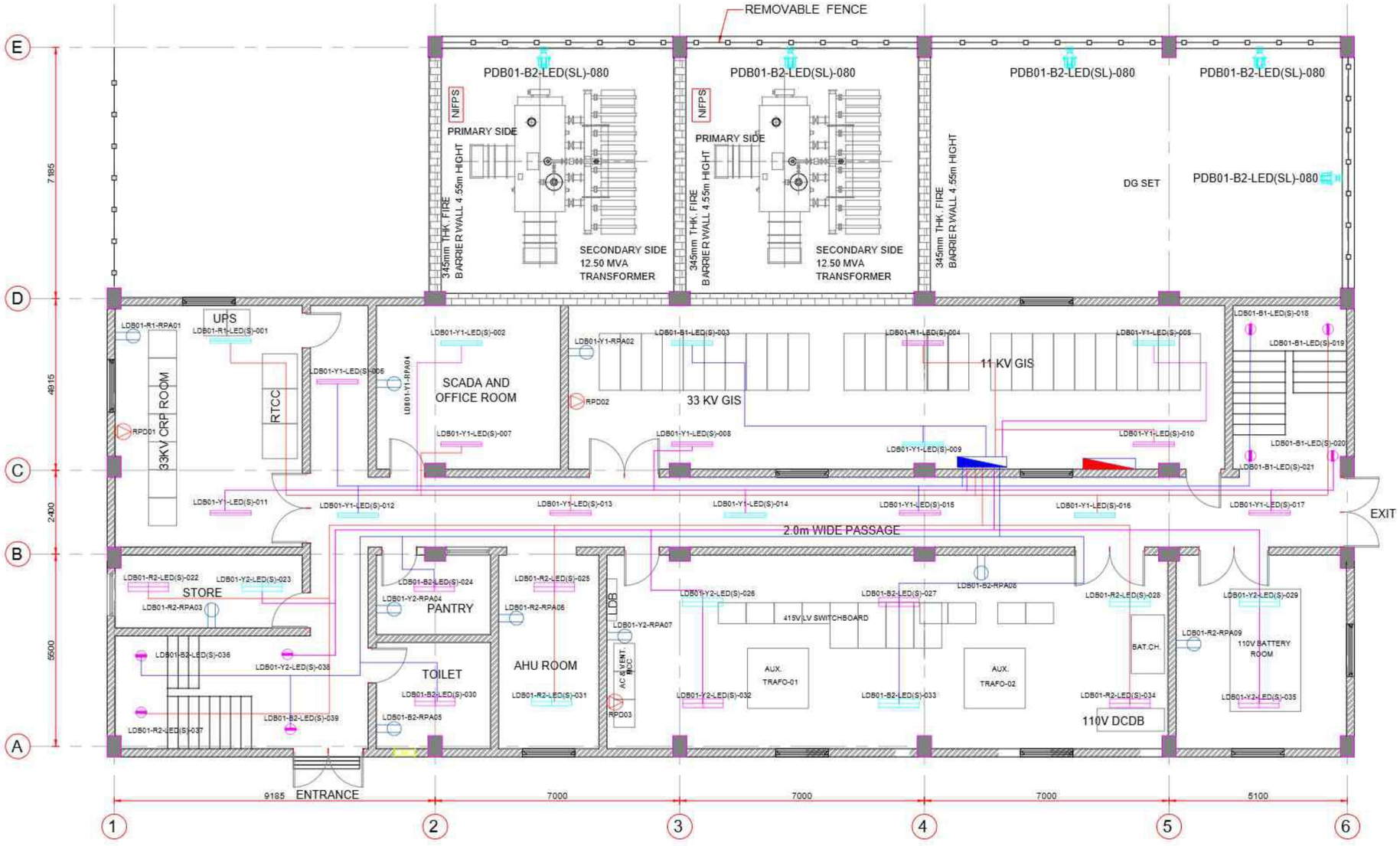
2							CONSULTANT :	Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.	DRAWING TITLE :	LIGHTING LAYOUT FOR 33/11KV SUBSTATIONS1&3 (SH 2 OF 3)		Tender Drawing	✓
1									DRAWING NO :	VSPL/IPD/2324-066/DPR/EL/010	SHEET SIZE	Revision	R1
0					P.B	S.B.R			GRAPHIC SCALE :		A2	Date	FEB. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY							



TYPICAL 33/11KV SUBSTATION (ESS-2) LAYOUT

(CLEAR HEIGHT OF SUBSTATION BUILDING 4.5M)
(SCALE 1:75)

NOTES

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3. THE LIGHTING EQUIPMENTS SHALL BE MOUNTED AS FOLLOWS :-
   SWITCH BOX : +1200 MM FROM FFL
   SOCKET OUTLET : 400MM ABOVE FFL
   EXIT/ENTRANCE : 300MM ABOVE DOOR
   LIGHTING PANEL: : +1500MM FROM FFL
4. LIGHTING LUMINARIES SHALL BE MOUNTED AS PER HEIGHT MENTIONED IN THE LIGHTING CALCULATION.
5. 415V, 63A POWER OUTLET SHALL BE FED FROM 415V PDB, LOCATED AT 33/11kV BUILDING (SWITCHGEAR ROOM).
6. EACH SINGLE CIRCUIT FEEDER SHALL BE LIMITED TO MAXIMUM FOUR (4) SOCKET OUTLET.
7. LIGHTING WIRES SHALL BE ROUTED IN THE CONCRETE/BRICK WALL BUILDING VIA EMBEDDED GI PIPES IN THE FLOOR SLAB/BUILDING WALLS.
8. LIGHTING WIRE SHALL BE ROUTED THROUGH RGS PIPE IN THE STEEL COLOUMN BUILDING HAVING METAL CLAD WALLS. EXIT SIGNS ARE PROVIDED WITH RECHARGEABLE BATTERIES FOR 2Hrs BACKUP. THE BATTERY PACK SHALL HAVE ITS OWN BUILT-IN CHARGER AND THESE EXIT SIGNS SHALL BE CONNECTED TO THE NORMAL SUPPLY. UPON FAILURE OF NORMAL SUPPLY, THE BATTERY PACK SHALL CONTINUE TO PROVIDE POWER SUPPLY FOR TWO HOURS.
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10. CLOUD REPRESENTATION WILL BE EXCLUDE FROM THE EPC SCOPE.

NORMAL CIRCUIT DETAILS:

LDB 01 R1 F1001
- FIXTURE TYPE'F1', FIXTURE No. 001
- PHASE No. R, CKT No. 1
- SERIAL NO. 1
- LIGHTING DISTRIBUTION BOARD

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :	PROJECT TITLE :	NOTE : ALL THE DIMENSIONS ARE IN METERS (M)	
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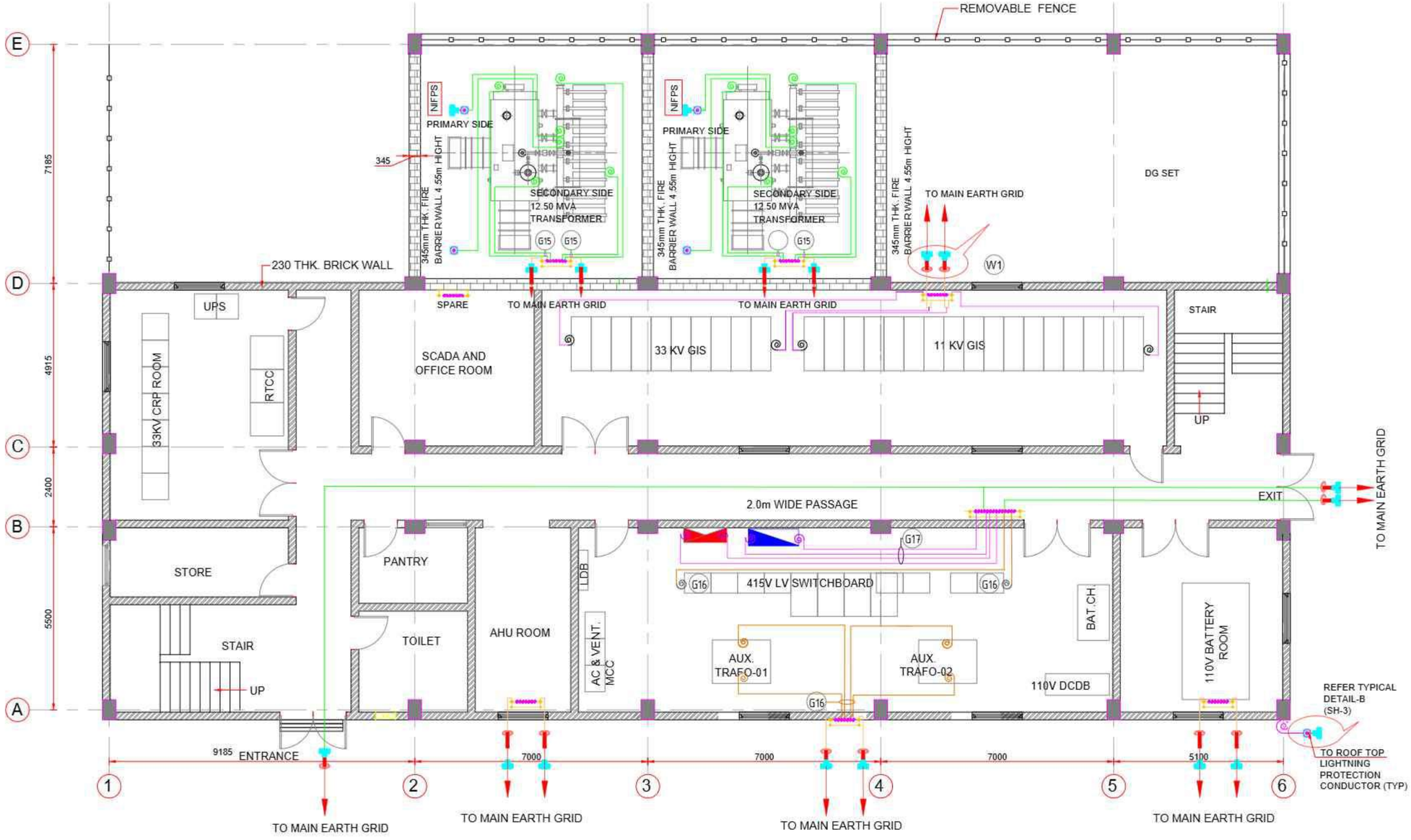
4										Concept
3										DFR/DPR
2							CONSULTANT : Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.	DRAWING TITLE : LIGHTING LAYOUT FOR 33/11KV SUBSTATIONS 2 (SH 1 OF 3)		Tender Drawing ✓
1								DRAWING NO : VSPL/IPD/2324-066/DPR/EL/010	SHEET SIZE A2	Revision R1
0					P.B	S.B.R		GRAPHIC SCALE :		Date FEB. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY				



GROUNDING & LIGHTNING PROTECTION LAYOUT FOR 33/11kV

(SCALE 1:75)

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS NOTED OTHERWISE.
2. ONLY WRITTEN DIMENSIONS ARE TO BE FOLLOWED, DRAWING SHOULD NOT BE SCALED UNDER ANY CIRCUMSTANCES.
3. ELECTRICAL EQUIPMENT RATING SIZE, EQUIPMENT LAYOUT, BUILDING DIMENSIONS INDICATED HERE IS TENTATIVE ONLY.
4. CONTRACTOR TO FINALIZE ELECTRICAL EQUIPMENT LAYOUT/BUILDING DIMENSIONS ACCORDING TO VENDOR DATA DURING DETAIL ENGINEERING STAGE.
5. NECESSARY PATHWAY SHALL BE PROVIDED ALONG THE SUBSTATION BUILDING PERIPHERY FOR PROPER ACCESSIBILITY OF THE BUILDING.
6. CABLE TRENCH DEPTH AND WIDTH WILL BE SELECTED DURING DETAIL DESIGN BY EPC CONTRACTOR.
7. CLOUD REPRESENTATION WILL BE EXCLUDE FROM THE EPC SCOPE

LEGEND FOR EARTHING & BILL OF QUANTITY (TABLE-1)

SYMBOL	DESCRIPTION	QTY.
	32mm DIA MS ROD	5.50 Mtrs.
(G1)	50X10 Sq.mm G.I FLAT	132.00 Mtrs.
(G2)	50X6 Sq.mm G.I FLAT	36.00 Mtrs.
(G7)	25X6 Sq.mm G.I FLAT	68.00 Mtrs.
	THERMOWELD T-JOINT	18.00 Nos.
	7 WAY GROUND PLATE WITH DISCONNECTING LINK	7.0 Nos.
	14 WAY GROUND PLATE WITH DISCONNECTING LINK	1.0 Nos.
	LIGHTNING PROTECTION EARTH ELECTRODE 22MM DIA, 3M LONG COPPER BOND ROD	4.0 Nos.
	EARTH ELECTRODE FOR TRANSFORMER 22MM DIA, 3M LONG COPPER BOND ROD	4.0 Nos.

REVISION BLOCK			DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY
5						
4						
3						
2						
1						
0					P.B	S.B.R
REV.	DATE	DESCRIPTION				

QUALITY ASSURANCE
The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency

CLIENT : Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT : Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE : **PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.**

DRAWING TITLE : EARTHING & LIGHTNING PROTECTION LAYOUT FOR 33/11KV SUB-STATIONS 2 (SH 1 OF 3)

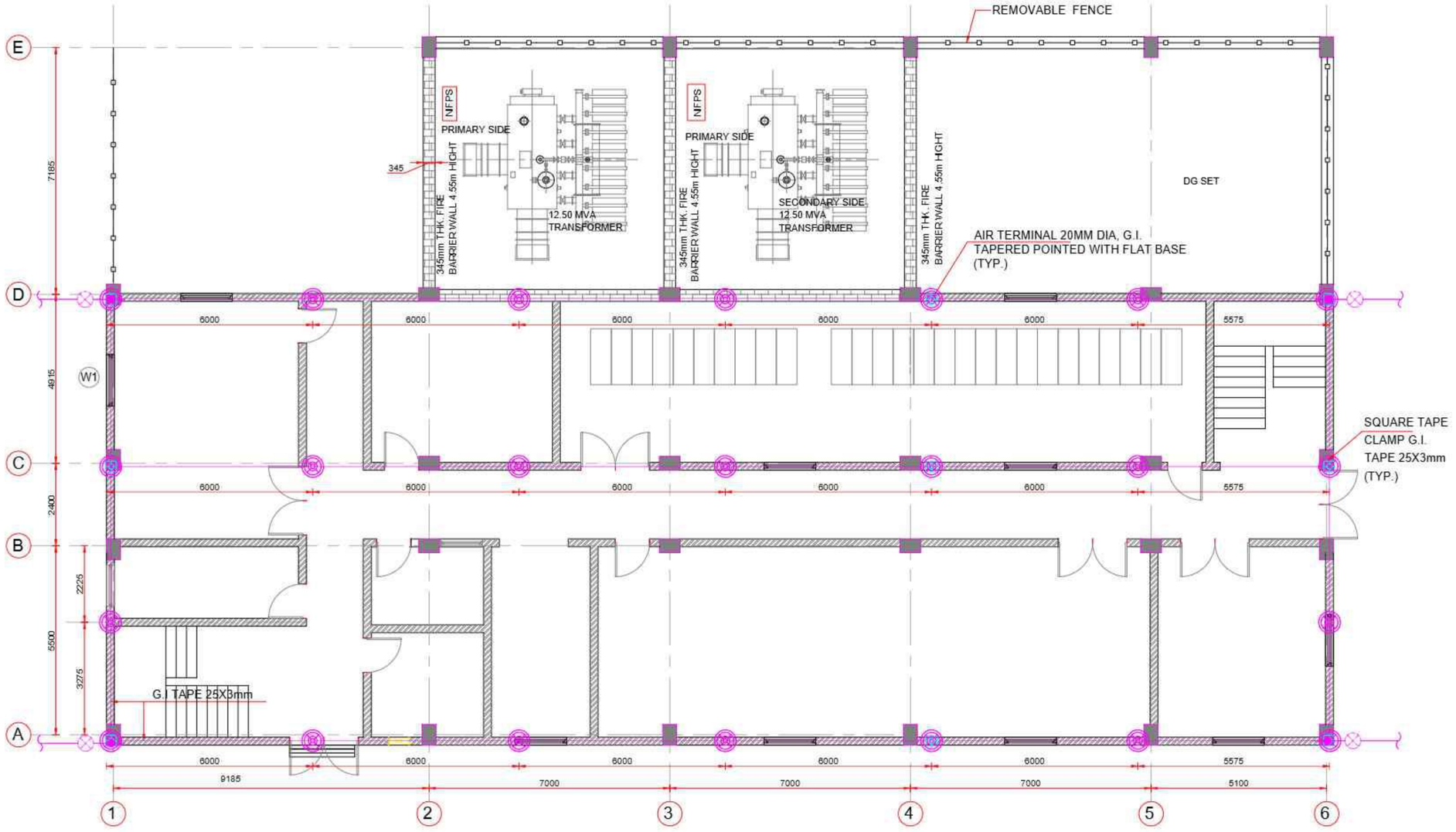
DRAWING NO : **VSPL/IPD/2324-066/DPR/EL/009**

GRAPHIC SCALE :

NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

SHEET SIZE A2

ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DFR/DPR	
Tender Drawing	✓
Revision	R1
Date	FEB. 2025



GROUNDING & LIGHTNING PROTECTION LAYOUT FOR 33/11kV

(CLEAR HEIGHT OF SUBSTATION BUILDING 4.5M)

(SCALE 1:75)

NOTES

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7. CLOUD REPRESENTATION WILL BE EXCLUDE FROM THE EPC SCOPE.

BILL OF QUANTITY & LEGEND FOR SUBSTATION:-

SYMBOL	DESCRIPTION	QTY.
	LIGHTNING PROTECTION MAIN CONDUCTOR	133 Mtrs.
	LIGHTNING PROTECTION DOWN CONDUCTOR	04 Nos.
	AIR TERMINAL 20MM DIA G.S ROD	23 Nos.
	TEST LINK	04 Nos.
	EARTH ELECTRODE FOR LIGHTNING PROTECTION	04 Nos.

REVISION BLOCK			QUALITY ASSURANCE			
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency			
4						
3						
2						
1						
0					P.B	S.B.R
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

CLIENT : Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT : Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE : **PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.**

DRAWING TITLE : EARTHING & LIGHTNING PROTECTION LAYOUT FOR 33/11KV SUB-STATIONS-2 (SH 2 OF 3)

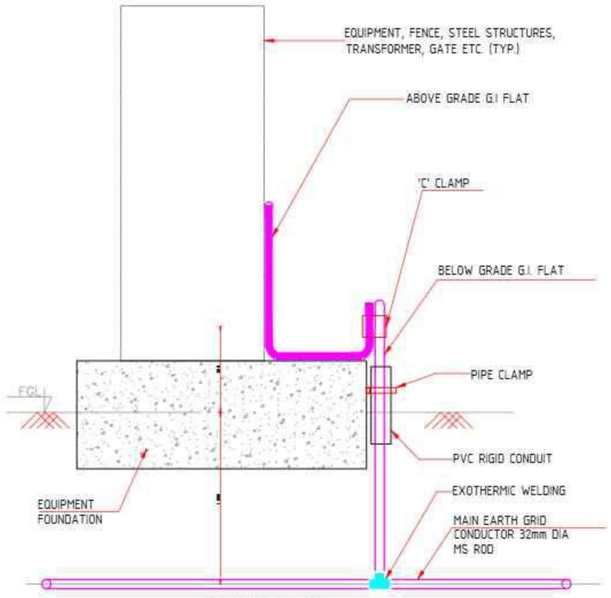
DRAWING NO : **VSPL/IPD/2324-066/DPR/EL/009**

GRAPHIC SCALE :

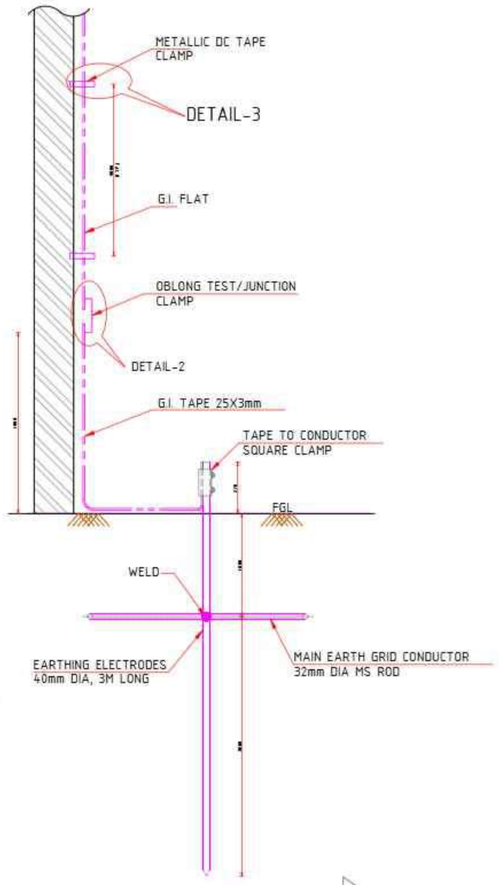
NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

SHEET SIZE A2

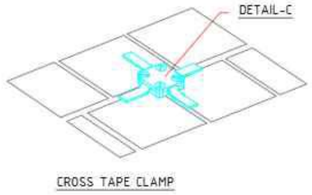
ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DFR/DPR	
Tender Drawing	✓
Revision	R1
Date	FEB. 2025



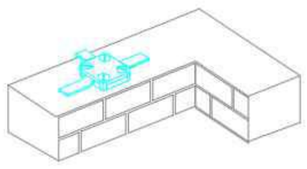
DETAIL-GD 01
CONCEPT FOR EARTHING CONNECTION



DETAIL -B

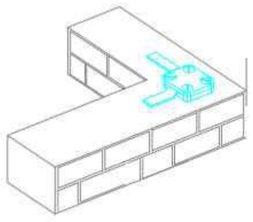


CROSS TAPE CLAMP



CROSS TAPE CLAMP

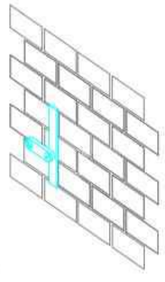
DETAIL -1
CROSS CLAMP

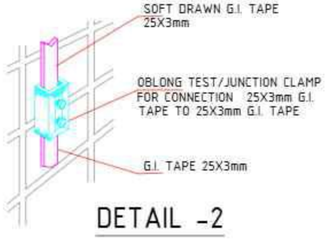


CROSS TAPE CLAMP

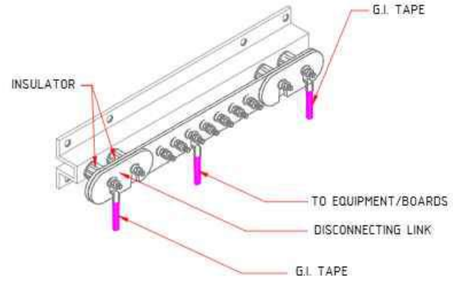
DETAIL-C

DETAIL-D

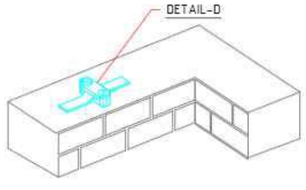




DETAIL -2



TYPICAL DETAIL OF GROUND PLATE INSTALLATION FOR INDOOR PANEL GROUNDING



DC TAPE CLIP

DETAIL -3
BAR CABLE SADDLE

NOTES

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REVISION BLOCK			QUALITY ASSURANCE			
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4						
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2						
1					P.B	S.B.R
0						
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

CLIENT : Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT : Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE : **PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.**

DRAWING TITLE : EARTHING & LIGHTNING PROTECTION LAYOUT FOR 33/11KV SUBSTATION-2 (SH 3 OF 3)

DRAWING NO : **VSPL/IPD/2324-066/DPR/EL/009**

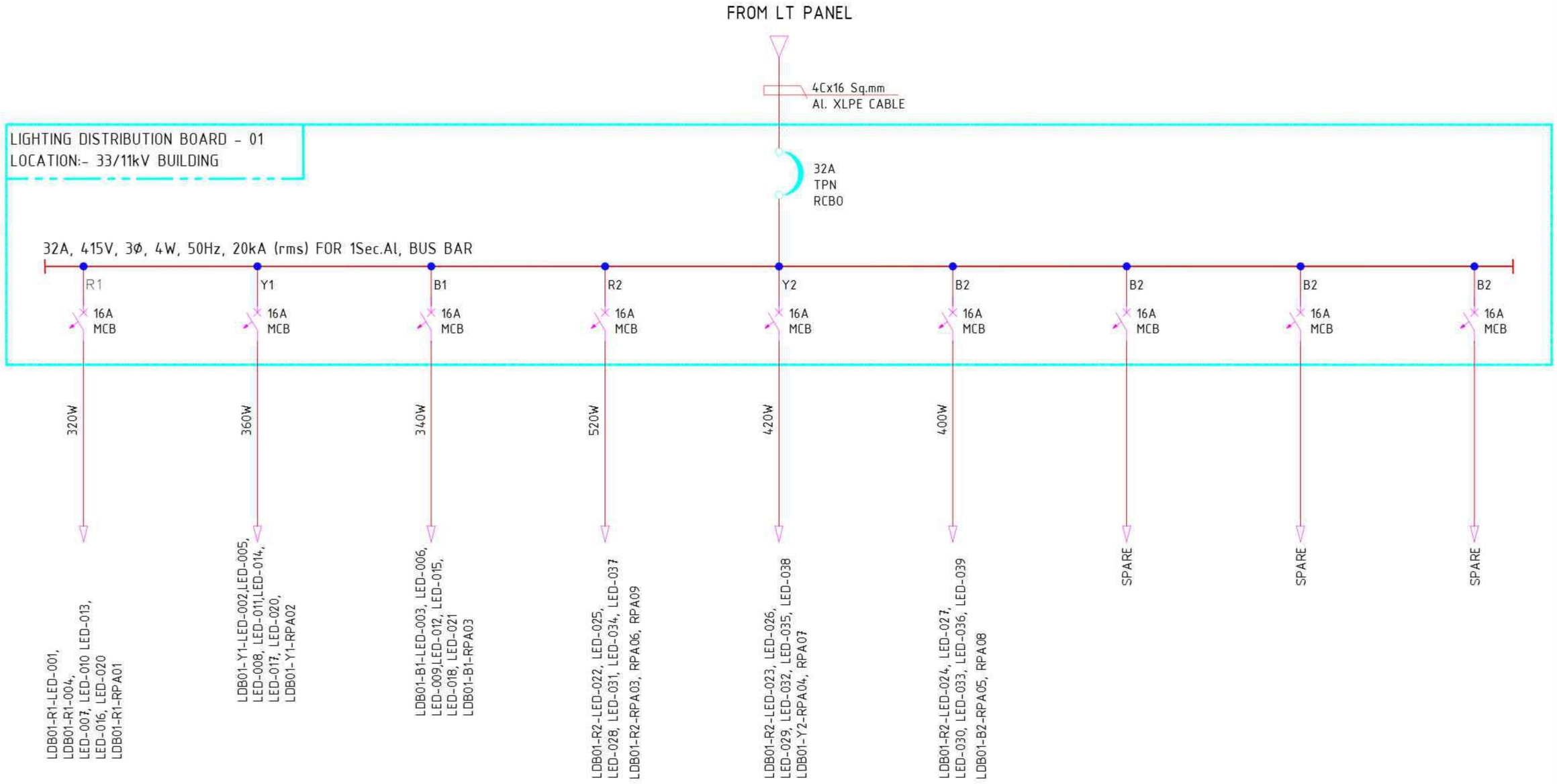
GRAPHIC SCALE :

NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

N / W E / S

SHEET SIZE : A2

ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DFR/DPR	
Tender Drawing	✓
Revision	**R1**
Date	**FEB. 2025**



REVISION BLOCK			QUALITY ASSURANCE			
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1						
0					P.B	S.B.R
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

CLIENT :
Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT :
Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE : **PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.**

DRAWING TITLE : LIGHTING LAYOUT FOR 33/11KV SUBSTATIONS -2 (SH 2 OF 3)

DRAWING NO : **VSPL/IPD/2324-066/DPR/EL/010**

GRAPHIC SCALE :

SHEET SIZE : A2

NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DFR/DPR	
Tender Drawing	✓
Revision	R1
Date	FEB. 2025

LEGEND:

S.NO.	SYMBOL	TAG	DESCRIPTION	QUANTITY
1		LED (S)	SURFACE MOUNTED LUMINAIRE WITH 40 W LED	09 Nos.
2		LED (R)	RECESSED MOUNTED LUMINAIRE WITH 40 W LED	08 Nos.
3		LED (S)	SURFACE MOUNTED LUMINAIRE WITH 40 W LED (WITH UPS BACKUP)	08 Nos.
4		LED (R)	RECESSED MOUNTED LUMINAIRE WITH 40 W LED (WITH UPS BACKUP)	06 Nos.
5		LED (S)	20 W SURFACE MOUNTED LED	08 No.
6	EXIT	EX	8W EXIT SIGN FIXTURE WALL/SURFACE MOUNTED, 240V, 50HZ.,1PH. WITH 2HRS. BATTERY BACK-UP	04 Nos.
7		RPA	100V AC, 6/16A, 50Hz, SINGLE PHASE 5PIN DUPLEX POWER RECEPTACLES (SURFACE MOUNTED).	10 Nos.
8		LDB	LIGHTING DISTRIBUTION BOARD (LDB)	01 No.
9		PDB	POWER DISTRIBUTION BOARD (PDB)	01 No.
10		RPD	415V AC, 63A, 50Hz, 3Ph+N+E WITH DISCONNECTING SWITCH WELDING RECEPTACLES, IP55 (WEATHERPROOF)	03 Nos.
11		TJB	THREE WAY JUNCTION BOXES	10 Nos.
12		FJB	FOUR WAY JUNCTION BOXES	03 Nos.
13		LED (SL)	45W LED STREET LIGHTS	06 Nos.

LIGHTING DISTRIBUTION BOARD – 02

DESCRIPTION	CONNECTED LOAD (W)			TOTAL CONNECTED LOAD (W)	DIVERSITY FACTOR	DIVERSIFIED LOAD (W)
	R	Y	B			
LIGHTING	840W	780W	740W	2360W	1.0	2360W
TOTAL	840W	780W	740W	2360W	1.0	2360W

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :	PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (M)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010	PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.		ISSUE RECORD	APPROVED FOR ISSUE
4										Concept	
3										DFR/DPR	
2							CONSULTANT :	DRAWING TITLE :	LIGHTING LAYOUT FOR 33/11KV SUBSTATIONS - 2 (SH 3 OF 3)	Tender Drawing	✓
1								DRAWING NO :	VSPL/IPD/2324-066/DPR/EL/010	Revision	R1
0					P.B	S.B.R	Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.	GRAPHIC SCALE :		SHEET SIZE A2	Date FEB. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY					

NOTES

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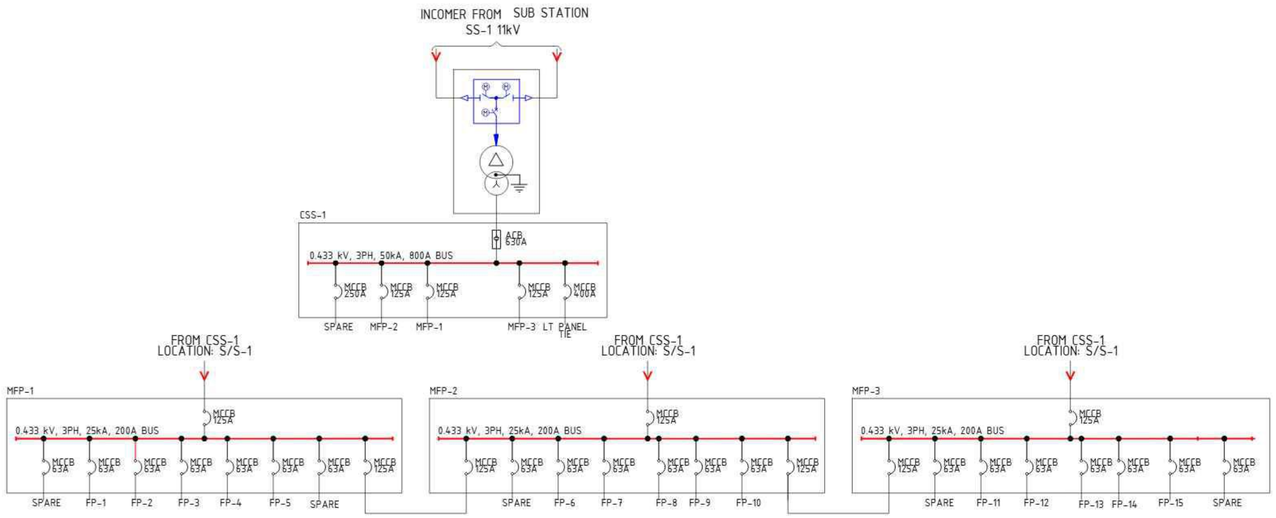
LEGEND

SYMBOLS	DESCRIPTION
	LOAD BREAK SWITCH
	CIRCUIT BREAKER
	AIR CIRCUIT BREAKER
	MOULDED CASE CIRCUIT BREAKER (MCCB)



REVISION BLOCK		
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REV.	DATE	DESCRIPTION

QUALITY ASSURANCE

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DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY
		P.B	S.B.R

CLIENT :

Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT :

Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE : **PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.**

DRAWING TITLE : **OVEREALL SLD FOR SMART STREET LIGHTING FOR ATAL PURAM TOWNSHIP-AGRA**

DRAWING NO : **VSPL/IPD/2324-066/DPR/EL/012_R1**

GRAPHIC SCALE :

NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

SHEET SIZE A2

ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DFR/DPR	
Tender Drawing	✓
Revision	R1
Date	FEB. 2025

LIGHTING LEGENDS

SYMBOL	MARKING	DESCRIPTION	NOS./ LENGTH (M)
	FP	FEEDER PILLAR	37
	MFP	MAIN FEEDER PILLAR	08
1		35W POST TOP LIGHT	141
2		45W POST TOP LIGHT	96
L1		90W STREET LIGHT	441
L2		120W STREET LIGHT	310
L3		150W STREET LIGHT (SINGLE BRACKET)	52
L4		150W STREET LIGHT (DOUBLE BRACKET)	190
L5		120W STREET LIGHT (DOUBLE BRACKET)	34
		9.0M POLE (SINGLE BRACKET)	803
		9.0M POLE (DOUBLE BRACKET)	112
		6.0M POLE (DECORATIVE)	237
		300Sqmm XLPE CABLE (CSS-MFP)	4393.00
		300Sqmm XLPE CABLE (MFP-MFP)	3060.00
	UG CABLE	25 Sq.mm XLPE CABLE+6SWG GI WIRE	7600.00
	UG CABLE	16Sqmm XLPE CABLE	30500.00
	UG CABLE	150 Sq.mm XLPE Cable (MFP-FP)	9468.00

TOWARDS AGRA
PROPOSED MP RD. 45M ROW
RAILWAY LINE
TOWARDS GWALIOR
PROPOSED RD. 18M ROW
PROPOSED 30M ROW
MASTER PLAN ROAD 75.0M WIDE
ENTRY /EXIT
BHANDAI
KAKUA VILLAGE
PROPOSED MP RD. 45M ROW
EXISITNG CANAL
EXISITNG CANAL
ENTRY
EXIT
TOWARDS MATHURA, DELHI
NH - 44
TOWARDS YAMUNA EXPRESSWAY
INNER RING ROAD
PROPOSED 220KV GIS
TOWARDS AGRA

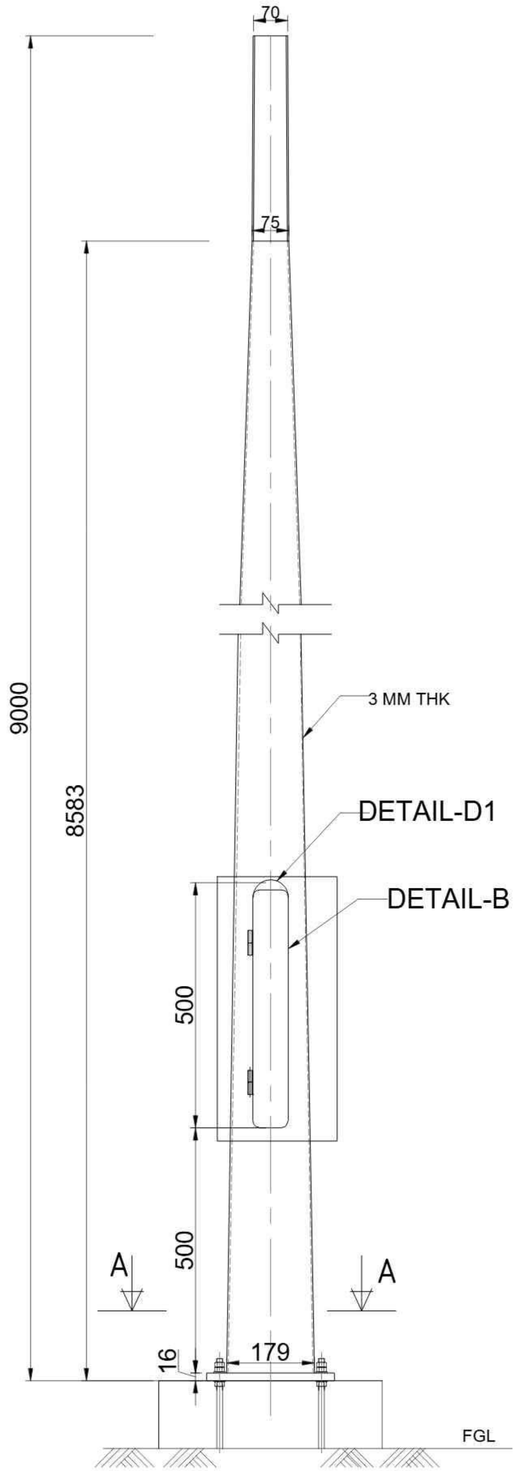
CLIENT
AGRA DEVELOPMENT AUTHORITY ADA
RATAN MUNI RD, JAIPUR HOUSE, JAIPUR HOUSE COLONY, AGRA, UTTAR PRADESH 282010

CONSULTANT
VOYANTS SOLUTIONS PVT. LTD.
403, 4TH FLOOR, PARK CENTRA, SEC-30, NH-8, GURGAON - 122001, HR.

PROJECT TITLE:	**PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.**		
DRAWING TITLE:	**STREET LIGHTING CIRCUITING LAYOUT FOR ATAL PURAM TOWNSHIP-AGRA**		
DRG. No. :	VSPL/IPD/2324-066/DPR/EL/013/R1	DATE :	
DRAWN BY :	VOYANTS TEAM	SCALE :	0 25 125 250

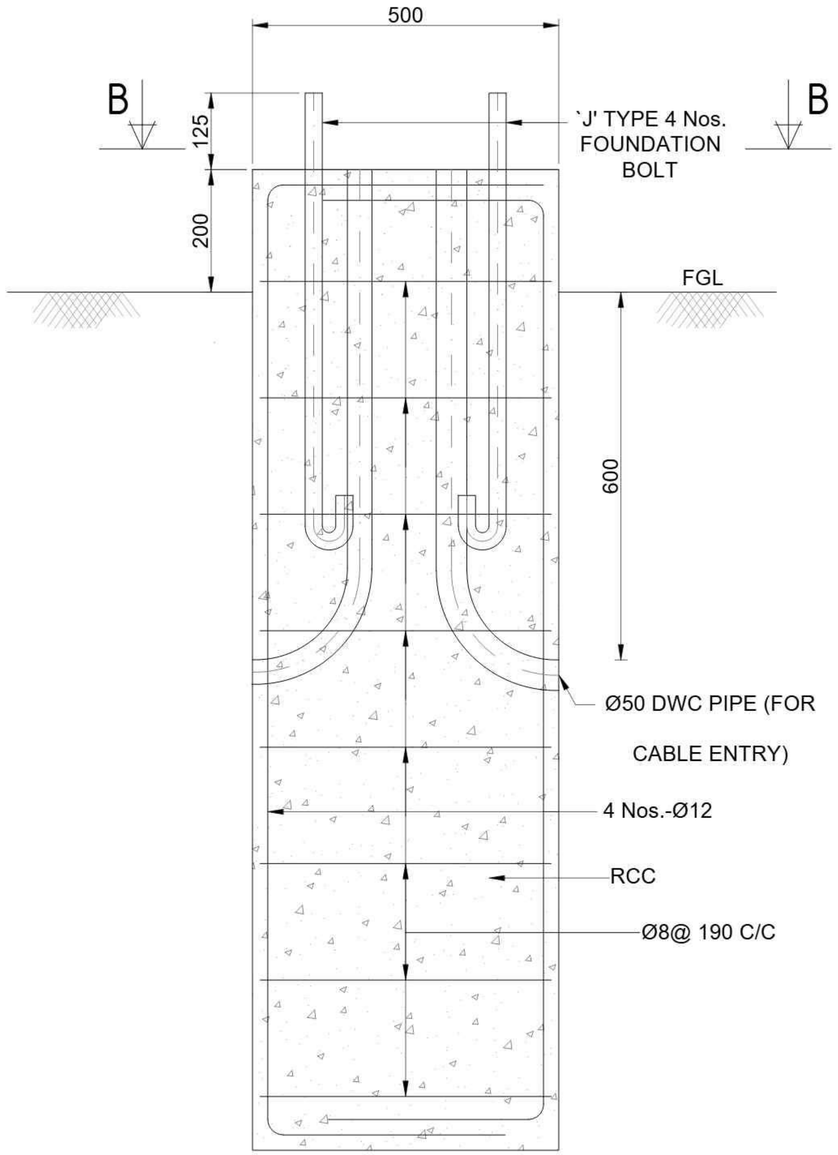
N W E S

DRAFTSMAN	J. E.	A. E.
E. E.	T. P.	I/C L. A.
C. E.	SECRETARY	VICE CHAIRMAN



ELEVATION

(SCALE 1:10)



DETAIL OF CIVIL FOUNDATION

(SCALE 1:10)

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS IN METERS.
2. MATERIAL OF POLE -S 355 CONFORMING TO BSEN 10025.
3. MATERIAL OF BASE PLATE Fe410 CONFORMING TO IS 2062.
4. GALVANIZATION BS EN ISO 1461 OR EQUI.
5. POLE SHALL BE HOT DIP GALVANIZED.
6. FOUNDATION BOLTS SHALL BE OF EN8 GRADE.
7. POLE TESTING FACILITY SHALL BE AS PER BSEN 40-21 &3.
8. DESIGN CRITERIA:
   (i) BASIC WIND SPEED - IS : 875 PART III :1987
   (ii) DESIGN LIFE - 25 YEARS.
9. IN CASE OF NO AVAILABILITY OF MATERIALS OF DESIRED. SIZE/ THICKNESS, MATERIAL OF HIGHER SIZE/ THICKNESS MAY BE USED.
10. CROSS SECTION OF POLE CONICAL.

TOLERANCES

CIRCUMFERENCE ±1%
POLE TOTAL LENGTH +25MM
POLE STRAIGHTNESS 0.1%

REVISION BLOCK			QUALITY ASSURANCE			
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REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

CLIENT : Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT : Voyants Solutions Pvt. Ltd.
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NH-8,Gurgaon - 122001,India.

PROJECT TITLE : **PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.**

DRAWING TITLE : **GENERAL ARRANGEMENT OF 9.0M STREET LIGHT POLE (SH 1 OF 3)**

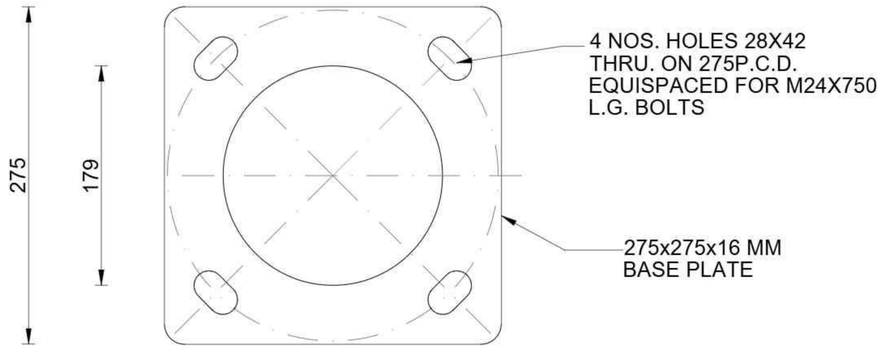
DRAWING NO : **VSPL/IPD/2324-066/DPR/EL/014**

GRAPHIC SCALE :

NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

SHEET SIZE A2

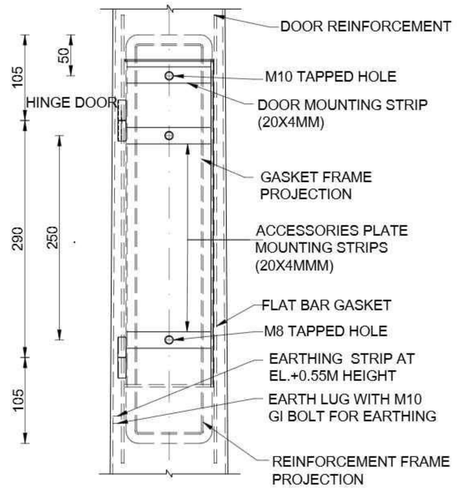
ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DFR/DPR	
Tender Drawing	✓
Revision	**R1**
Date	FEB. 2025



SECTION A-A

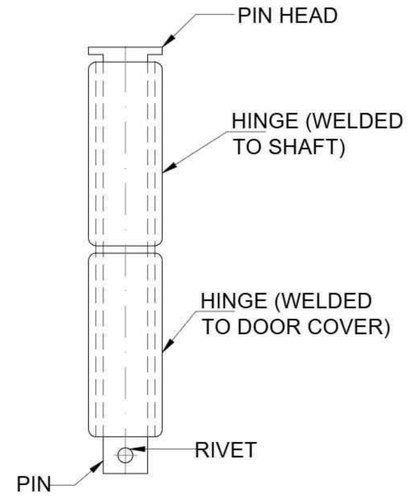
BASE PLATE

(SCALE 1:50)



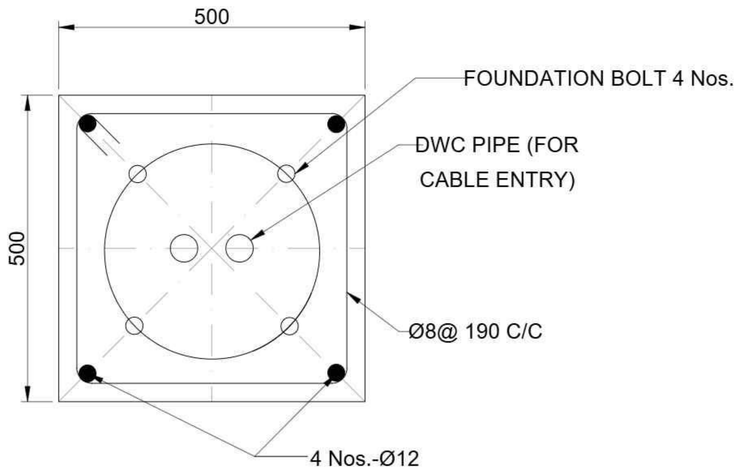
DETAIL-D1

(SCALE 1:50)



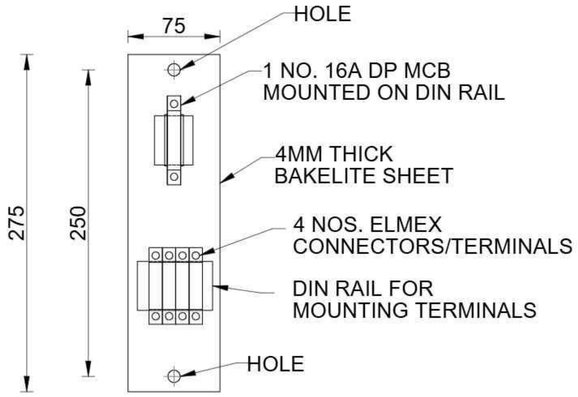
HINGE DETAIL-B

(SCALE 1:25)



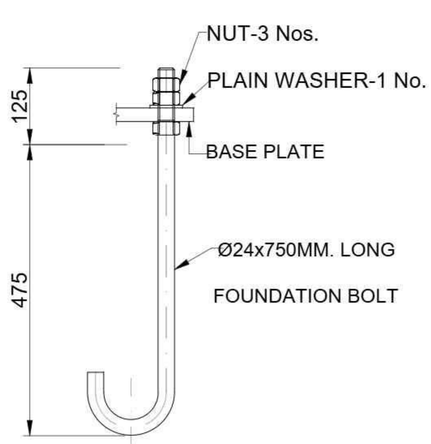
SECTION B-B

(SCALE 1:10)



BAKELITE SHEET

(SCALE 1:50)



FOUNDATION BOLT DETAIL

(SCALE 1:10)

REVISION BLOCK			QUALITY ASSURANCE			
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency			
4						
3						
2						
1						
0					P.B	S.B.R
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

CLIENT : Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT : Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE : **PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.**

DRAWING TITLE : **GENERAL ARRANGEMENT OF 9.0M STREET LIGHT POLE (SH 2 OF 3)**

DRAWING NO : **VSPL/IPD/2324-066/DPR/EL/014**

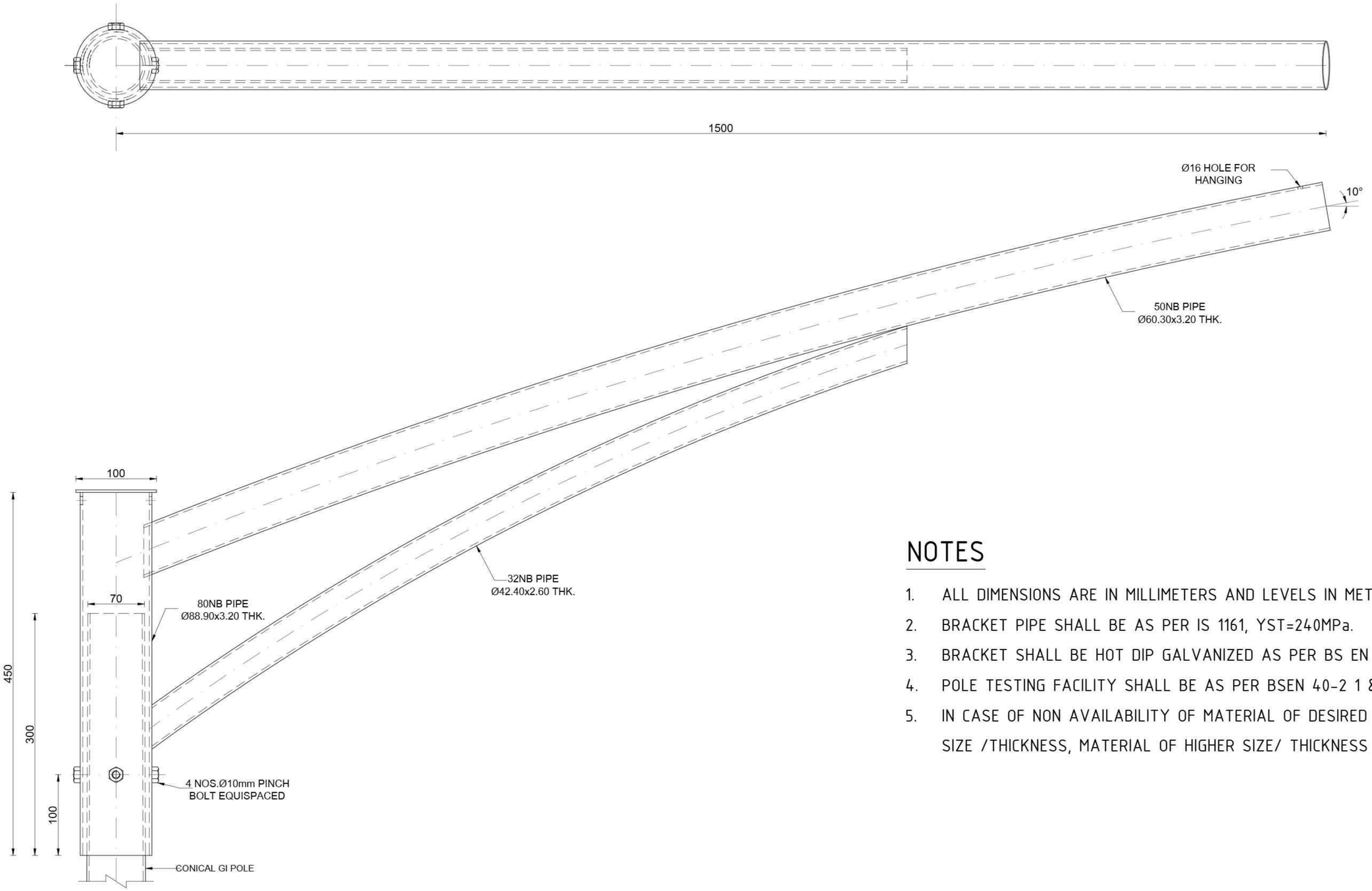
GRAPHIC SCALE :

NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

N W E S

SHEET SIZE A2

ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DFR/DPR	
Tender Drawing	✓
Revision	R1
Date	FEB. 2025



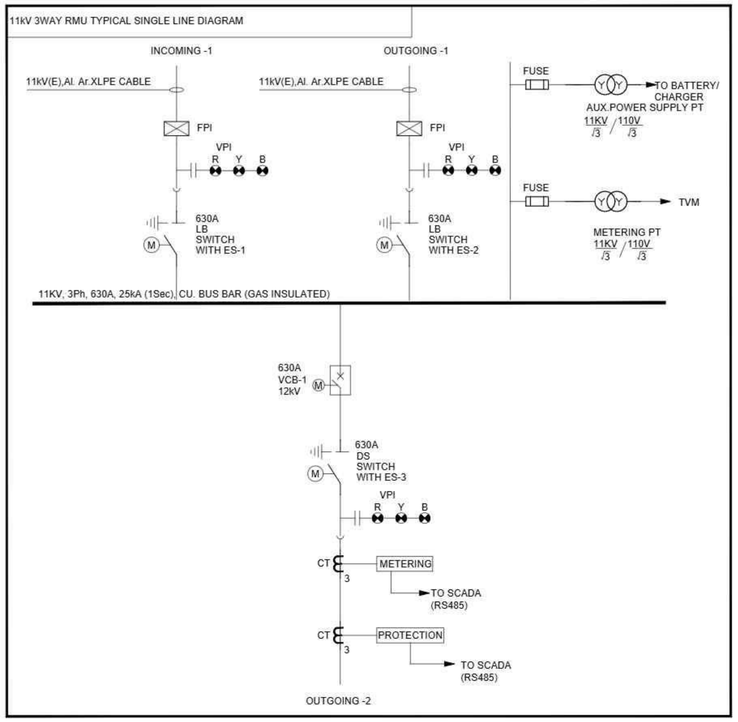
DETAIL FOR SINGLE ARM BRACKET

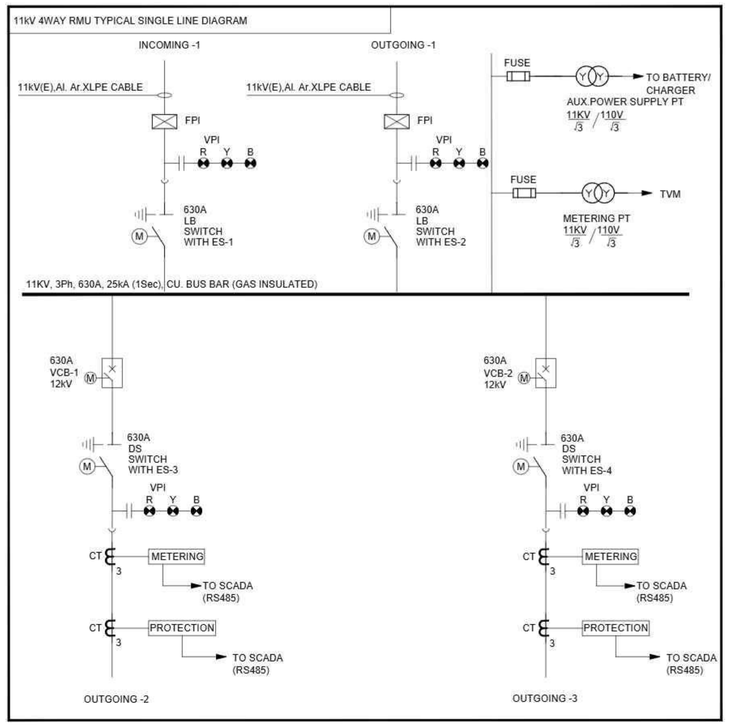
(SCALE 1:30)

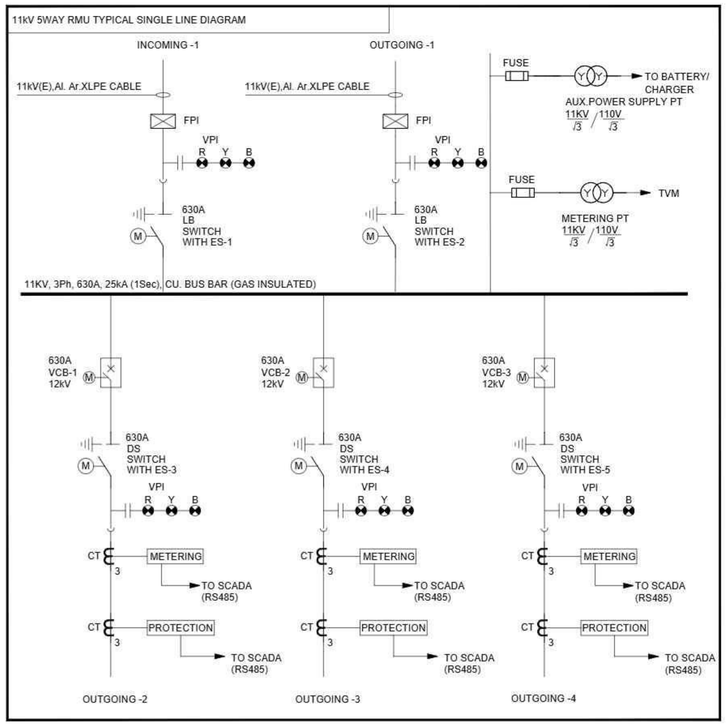
NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS IN METERS.
2. BRACKET PIPE SHALL BE AS PER IS 1161, YST=240MPa.
3. BRACKET SHALL BE HOT DIP GALVANIZED AS PER BS EN ISO 1461 OR EQUI.
4. POLE TESTING FACILITY SHALL BE AS PER BSEN 40-2 1 &3.
5. IN CASE OF NON AVAILABILITY OF MATERIAL OF DESIRED SIZE /THICKNESS, MATERIAL OF HIGHER SIZE/ THICKNESS MAY BE USED.

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :	PROJECT TITLE :	NOTE : ALL THE DIMENSIONS ARE IN METERS (M)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010	PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.	N / W E / S	ISSUE RECORD / APPROVED FOR ISSUE
4										Concept
3										DFR/DPR
2							CONSULTANT :	DRAWING TITLE : GENERAL ARRANGEMENT OF 9.0M STREET LIGHT POLE (SH 3 OF 3)		Tender Drawing ✓
1							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.	DRAWING NO : VSPL/IPD/2324-066/DPR/EL/014	SHEET SIZE	Revision R1
0					P.B	S.B.R		GRAPHIC SCALE :	A2	Date FEB. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY				



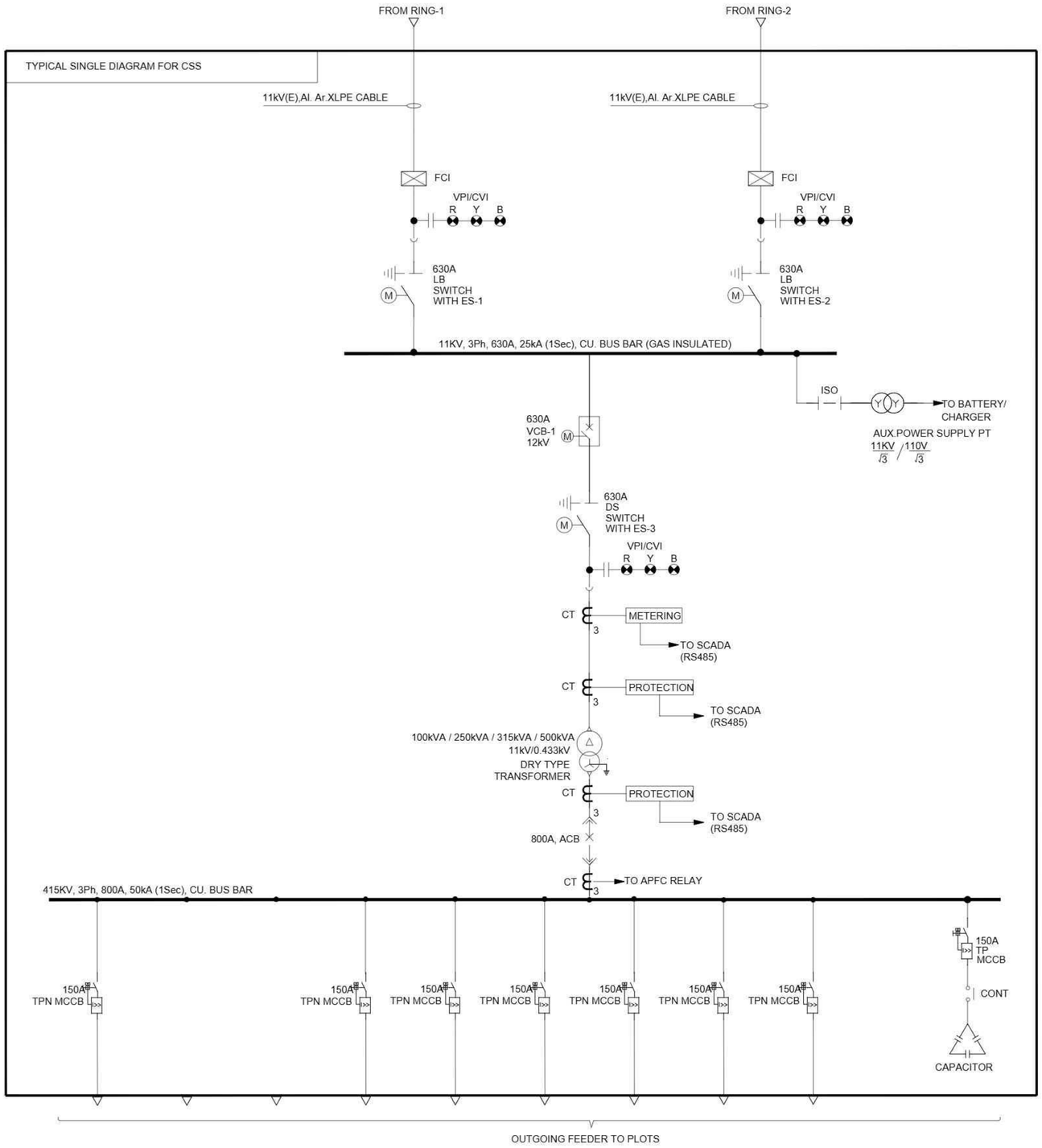




NOTE:

1. THE DRAWING DEPICTS THE KEY POWER DISTRIBUTION SCHEME. DETAILED ENGINEERING CONTRACTOR SHALL VERIFY AND AGAIN DEVELOP THE DRAWING BASED ON THE BASIS OF CONFIRMED LOAD/VENDOR DATA.

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :			
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010	PROJECT TITLE :	**PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.**	NOTE : ALL THE DIMENSIONS ARE IN METERS (M)
4										
3										
2							CONSULTANT :	DRAWING TITLE :	TYPICAL SINGLE LINE DIAGRAM FOR 11KV, 3WAY, 4WAY AND 5 WAY RMU	ISSUE RECORD / APPROVED FOR ISSUE
1							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.	DRAWING NO :	**VSPL/IPD/2324-066/DPR/EL/015**	Concept / DFR/DPR / Tender Drawing ✓
0					P.B	S.B.R		GRAPHIC SCALE :	SHEET SIZE A2	Revision **R1**
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY				Date FEB. 2025



NOTES:

CSS-OUTDOOR METAL ENCLOSURE:

1. DESIGN PARAMETERS:
   - A) APPLICATION : OUTDOOR
   - B) SYSTEM VOLTAGE : 11KV +6%,-9%
   - C) HIGHEST SYSTEM VOLTAGE : 12kV
   - D) SYSTEM FREQUENCY : 50HZ +3%,-3%
   - E) FAULT LEVEL : CB 50kA, 3Sec and ES 25kA/1Sec.
   - F) AMBIENT TEMPERATURE : 50° C
   - G) PROTECTION LEVEL : IP4X
2. OUTDOOR METAL ENCLOSED COMPACT SUBSTATION SHALL CONSIST OF 2NOS MOTORIZED LOAD BREAK SWITCH WITH EARTH SWITCH, BUS BAR, VCB AND MANUAL DISCONNECTOR WITH EARTH SWITCH AS HV PORTION OF MULTIPLE OPERATING DEVICES MOUNTED ON SF6 GAS TANK, I.E., PRIMARY INSULATION AND LV PART SUCH AS DRY TYPE TRANSFORMER, LV BUS BAR, INBUILT CAPACITOR BANK AND ADEQUATE NUMBER OF OUTGOING CIRCUIT BREAKERS INCLUDING FRTU.
3. ALL PROTECTIVE RELAY WILL BE NUMERICAL TYPE WITH RS485 COMMUNICATION. NUMERICAL RELAY SHALL BE WITH PROGRAMMABLE LOGIC AND CAPABLE OF COMMUNICATING WITH CSS FRTU AS WELL AS SUBSTATION PLC/SCADA SYSTEM FOR REMOTE CONTROL AND MONITORING.
4. SWITCHGEAR CONTROL SUPPLY FOR PROTECTIVE RELAYS, AUXILIARY RELAYS, BREAKER CLOSING COIL, TRIPPING COIL & INDICATION LAMPS WILL BE OPERATED 110V DC. SPRING CHARGING MOTOR, LAMP & SPACE HEATER WILL BE 240V AC SUPPLY.
5. CSS WILL HAVE INBUILT POWER PACK UNIT 24V DC WITH BATTERY BACKUP TO CATER THE DC LOAD OF FRTU. THE INPUT POWER SUPPLY FOR POWER PACK WILL BE DRIVED FROM LT SIDE BUS OF CSS. BATTERY AUTONOMY TIME WILL BE 8 HOURS.
6. MULTIFUNCTION METER WILL BE MICROPROCESSOR BASED GIVING DETAILS OF VOLTS, AMPS, FREQUENCY, KW, KWH, PF, KVA, KVARH AND MAXIMUM DEMAND. IT SHALL BE COMMUNICABLE TYPE THROUGH RS 485 PORT. ACCURACY WILL BE CLASS 0.5S.
7. THE INTERLOCK SHALL BE PROVIDED BETWEEN BUSBAR ISOLATOR & OUTGOING EARTHING SWITCH AND INTERLOCK BETWEEN BUSBAR ISOLATOR AND CIRCUIT-BREAKER.
8. MECHANICAL INTERLOCK BETWEEN THE SWITCH DISCONNECTOR AND THE OUTGOING EARTHING SWITCH WILL BE PROVIDED.
9. CIRCUIT BREAKER DRIVE MECHANISM SHALL BE DESIGNED FOR BOTH MANUAL AND MOTOR OPERATION AND SHALL ALLOW AUTO RECLOSING.
10. BUS BAR SHALL BE ELECTROLYTIC COPPER. BUS BAR SIZES WILL BE REFLECTED IN THE HT PANEL VENDOR DOCUMENTS. TEMPERATURE RISE WILL BE AS PER IEC 62271.
11. ALL INDICATING LAMPS WILL BE LED TYPE.

12. TO MAINTAIN THE REDUNDANCY AND RELIABILITY IN THE POWER SUPPLY DISTRIBUTION NETWORK, 11 KV INCOMING POWER SUPPLY SHALL BE CONNECTED IN A RING CONFIGURATION. THE HV SUPPLY. DISTRIBUTION SYSTEM SHALL BE PLANNED IN RING FORMATION WITH AN OPEN POINT, SO AS TO OPERATE THE SYSTEM AS RADIAL FEEDER AT CSS. EACH RING START & END SHALL BE CONNECTED TO SEPARATE SOURCES THROUGH THE FEEDERS ON THE DIFFERENT BUSES.
13. TRANSFORMER LOADING SHALL BE DESIGNED IN SUCH THAT EACH TRANSFORMER IS NOT LOADED BEYOND APPROXIMATELY 80%. HOWEVER IN CASE OF EMERGENCY 100% CONTINUOUS LOADING SHALL BE PERMITTED.
14. THE CSS ENCLOSURE SHALL BE SUITABLE TO BE INSTALLED ON A BASE FRAME SUPPLIED IN ONE PIECE ALONG WITH FOUNDATION BOLTS,TOP PORTION SHALL BE SLOPED.
15. ALL OPERATING INSTRUMENTS,RESETTING FLAGS, SWITCHES, SETTING AND ADJUSTMENT POINTS SHALL BE AT A CONVENIENT HEIGHT,EASY TO OPERATE AND READ AND IN NO CASE BEYOND 1700 mm AND LESS THAN 700 MM FROM GROUND. HOWEVER SAME SHALL BE ENSURED BASED ON MANUFACTURER STANDARD.
16. THE DRAWING DEPICTS THE KEY POWER DISTRIBUTION SCHEME. DETAILED ENGINEERING CONTRACTOR SHALL VERIFY AND DEVELOP THE DRAWING BASED ON THE BASIS OF CONFIRMED LOAD/VENDOR DATA.

REVISION BLOCK			QUALITY ASSURANCE			
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency			
4						
3						
2						
1						
0					P.B	S.B.R
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

CLIENT :
Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT :
Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE : **PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.**

DRAWING TITLE : TYPICAL SINGLE LINE DIAGRAM FOR COMPACT SUBSTATION (CSS)

DRAWING NO : **VSPL/IPD/2324-066/DPR/EL/016**

GRAPHIC SCALE :

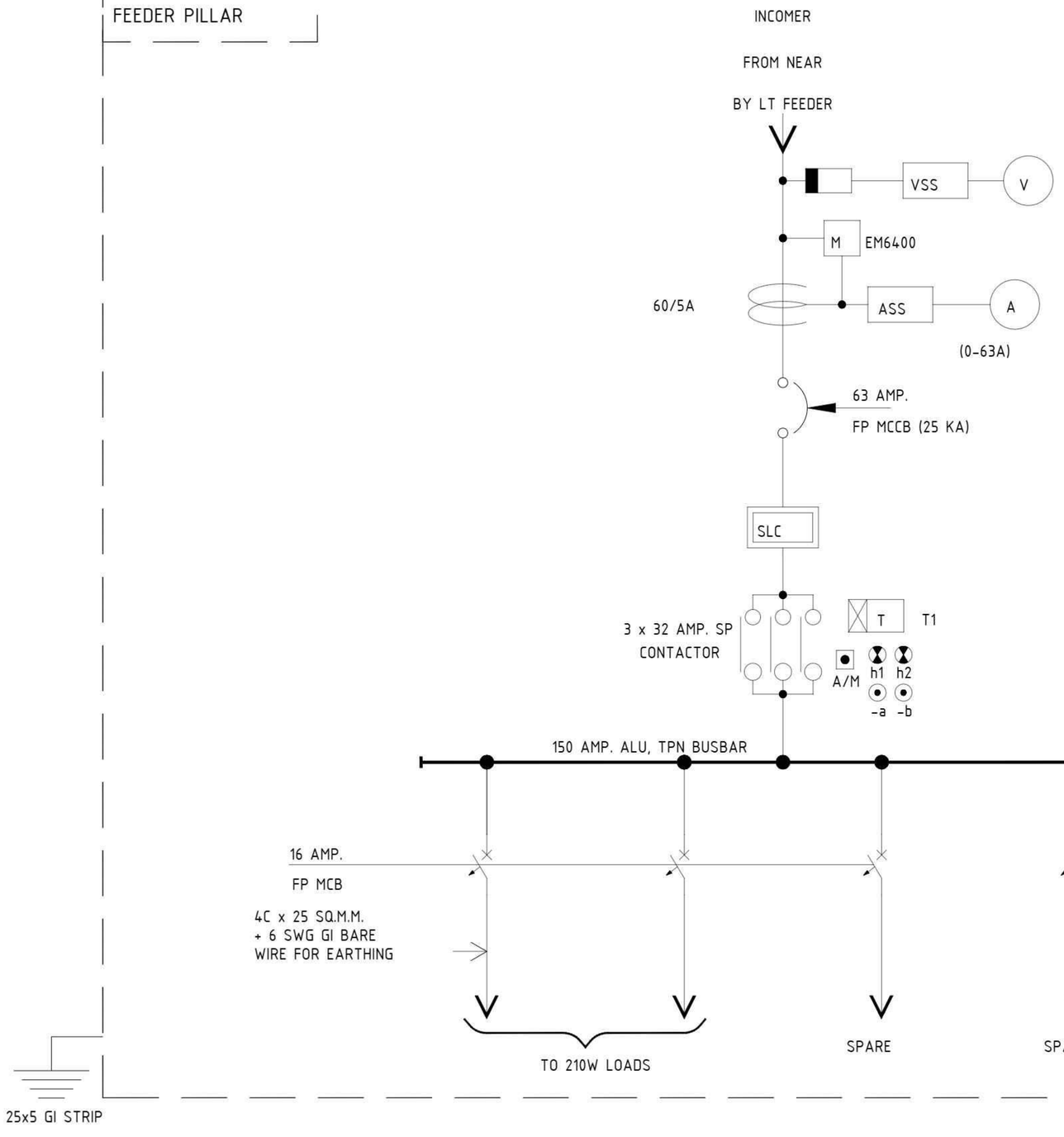
NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

N W E S

SHEET SIZE A2

ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DFR/DPR	
Tender Drawing	✓
Revision	**R1**
Date	FEB. 2025

TYPICAL DETAILS FOR FEEDER PILLAR



TIMER SETTING (T1)	
PHASE	TIMING
R	6 PM TO 10 PM
Y	6 PM TO 1 AM
B	6 PM TO 6 AM

LEGEND/SYMBOL:

REVISION BLOCK			QUALITY ASSURANCE			
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency			
4						
3						
2						
1					P.B	S.B.R
0						
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

CLIENT :
Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT :
Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE : **PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.**

DRAWING TITLE : **TYPICAL FEEDER PILLAR SLD FOR ATAL PURAM TOWNSHIP-AGRA**

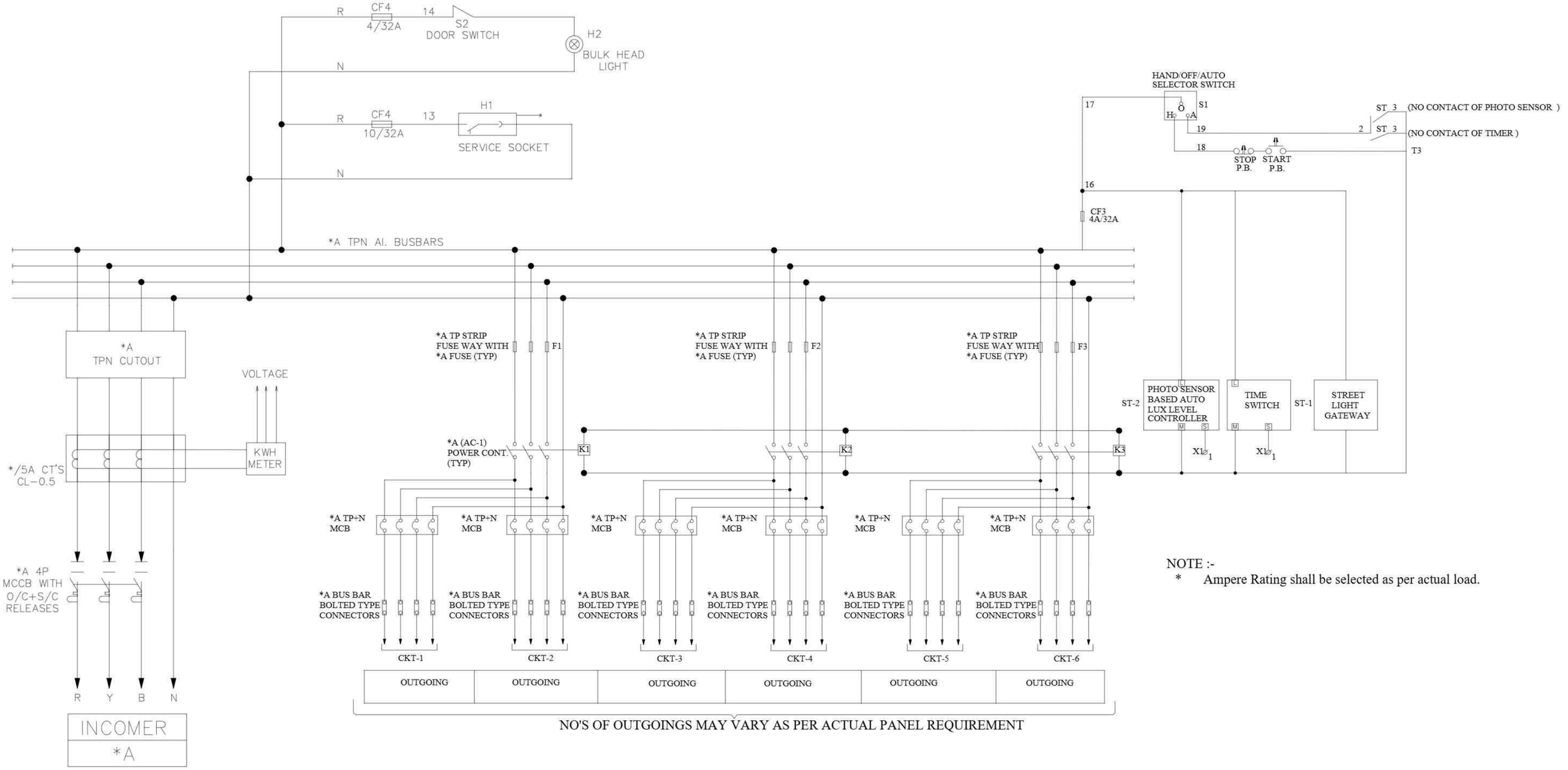
DRAWING NO : **VSPL/IPD/2324-066/DPR/EL/017 (SH 1 OF 2)**

GRAPHIC SCALE :

NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DFR/DPR	
Tender Drawing	✓
Revision	R1
Date	FEB. 2025

SHEET SIZE A2



NOTE :-

* Ampere Rating shall be selected as per actual load.

TYPICAL SINGLE LINE DIAGRAM FOR ROAD LIGHTING FEEDER PILLAR

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :	PROJECT TITLE :	NOTE : ALL THE DIMENSIONS ARE IN METERS (M)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010	**PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.**	N / W E / S	ISSUE RECORD / APPROVED FOR ISSUE
4										Concept
3										DFR/DPR
2							CONSULTANT :	DRAWING TITLE : **TYPICAL FEEDER PILLAR SLD FOR ATAL PURAM TOWNSHIP-AGRA**		Tender Drawing ✓
1							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.	DRAWING NO : **VSPL/IPD/2324-066/DPR/EL/017 (SH 2 OF 2)**	SHEET SIZE A2	Revision **R1**
0					P.B	S.B.R		GRAPHIC SCALE :		Date FEB. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY				

NOTES

1. ALL DIMENSIONS ARE IN MILLIMETERS AND LEVELS ARE IN METERS, UNLESS NOTED OTHERWISE.
2. ONLY WRITTEN DIMENSIONS ARE TO BE FOLLOWED, DRAWING SHOULD NOT BE SCALED UNDER ANY CIRCUMSTANCES.

LIGHTING LEGENDS

SYMBOL	MARKING	DESCRIPTION	NOS.
	FP	FEEDER PILLAR	37
	MFP	MAIN FEEDER PILLAR	08

REVISION BLOCK			QUALITY ASSURANCE			
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency			
4						
3						
2						
1						
0					P.B	S.B.R
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

CLIENT :
Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT :
Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE : **PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.**

DRAWING TITLE : **MAIN FEEDER PILLER (MFP) & FEEDER PILLER (FP) LOCATION LAYOUT**

DRAWING NO : **VSPL/IPD/2324-066/DPR/EL/019**

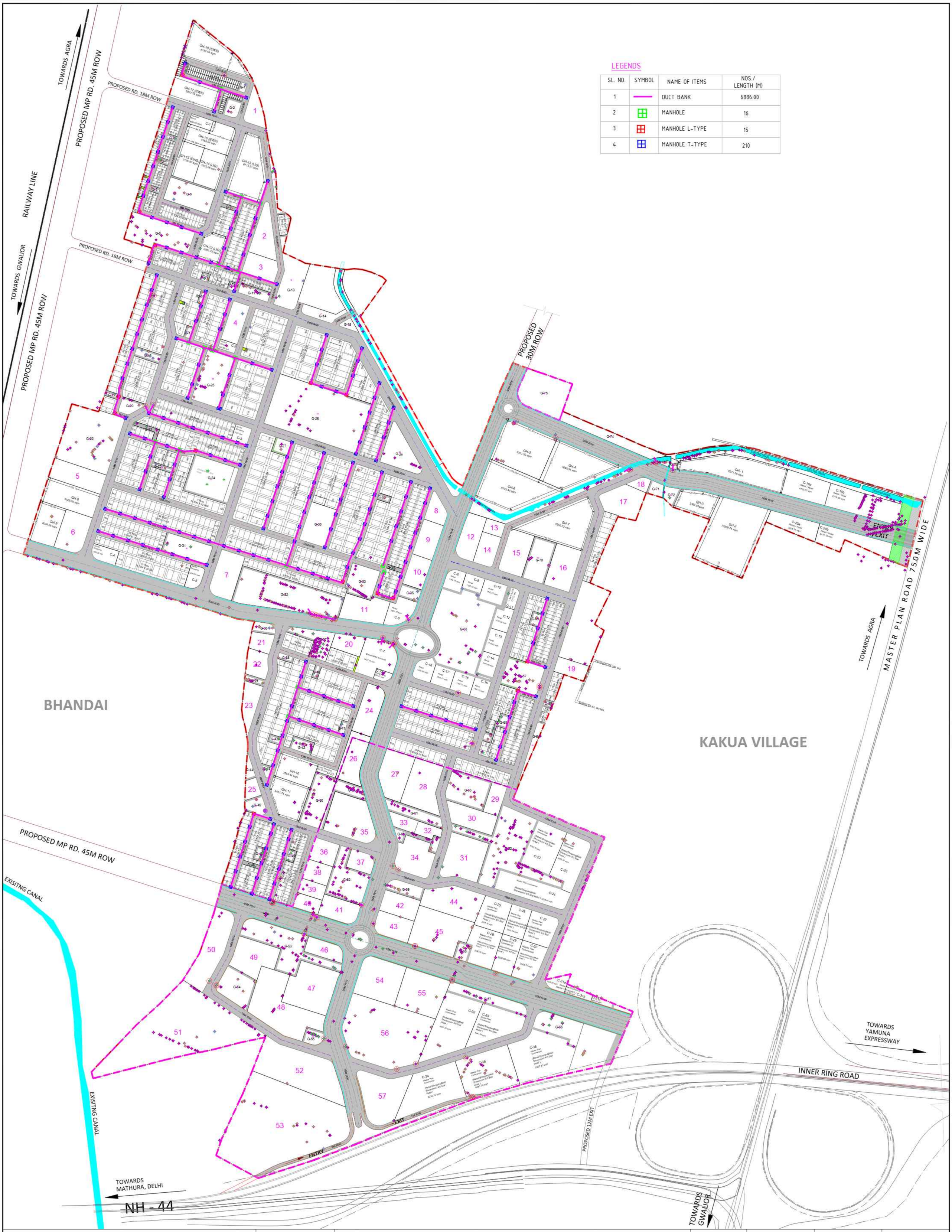
GRAPHIC SCALE :

NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

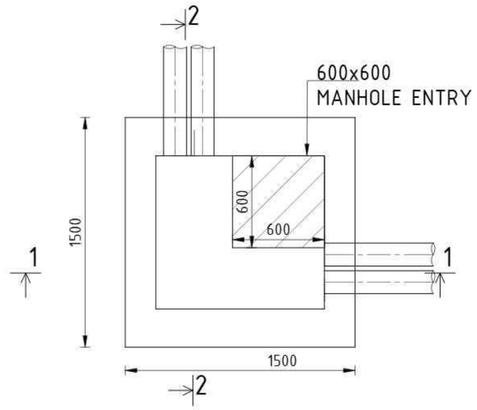
	ISSUE RECORD	APPROVED FOR ISSUE
N W E S	Concept	
	DFR/DPR	
SHEET SIZE	Tender Drawing	✓
A2	Revision	**R1**
	Date	FEB. 2025

LEGENDS

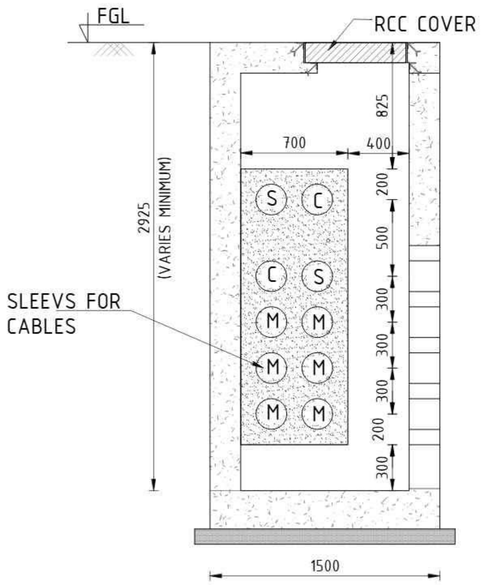
SL. NO.	SYMBOL	NAME OF ITEMS	NOS./ LENGTH (M)
1		DUCT BANK	6886.00
2		MANHOLE	16
3		MANHOLE L-TYPE	15
4		MANHOLE T-TYPE	210



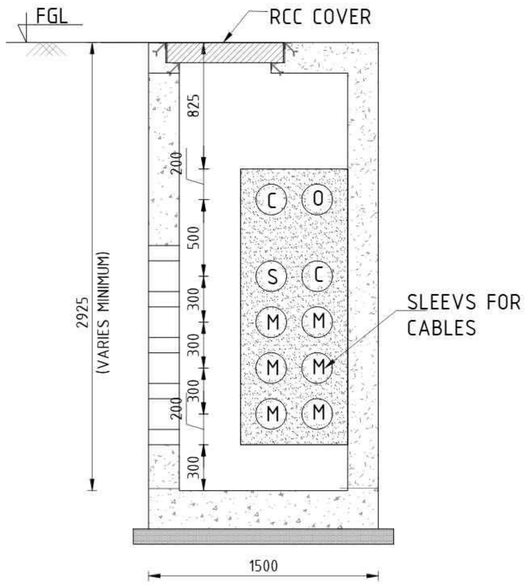
CLIENT AGRA DEVELOPMENT AUTHORITY ADA RATAN MUNI RD, JAIPUR HOUSE, JAIPUR HOUSE COLONY, AGRA, UTTAR PRADESH 282010	PROJECT TITLE:	**PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.**		N W E S	DRAFTSMAN	J. E.	A. E.
CONSULTANT VOYANTS SOLUTIONS PVT. LTD. 403, 4TH FLOOR, PARK CENTRA, SEC-30, NH-8, GURGAON - 122001, HR.	DRAWING TITLE:	**CABLING & TRENCH LAYOUT FOR ATAL PURAM TOWNSHIP-AGRA**			E. E.	T. P.	I/C L. A.
	DRG. No. :	VSPL/IPD/2324-066/DPR/EL-020	DATE :		C. E.	SECRETARY	VICE CHAIRMAN
	DRAWN BY :	VOYANTS TEAM	SCALE :	0 25 125 250			



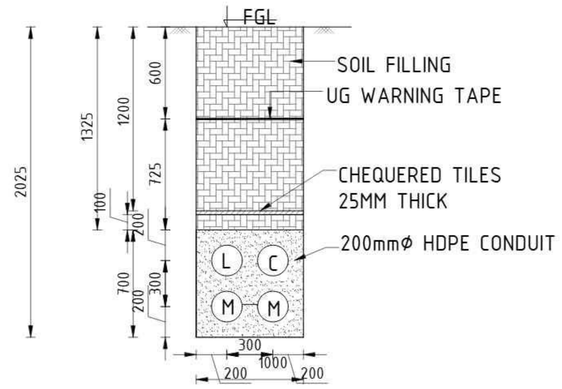
PLAN OF 1.50m(L) x1.50m(W)
2 WAY MANHOLE FOR 2x4 LAYER
(FOR 2x4 LAYER)
(TYPE-1)
(SCALE 1:40)



SECTION 1-1 OF 1.50m(L)x1.50m(W)
2 WAY MANHOLE FOR 2X4 LAYER
(SCALE 1:40)



SECTION 2-2 OF 1.50m(L)x1.50m(W)
2 WAY MANHOLE FOR 2X4 LAYER
(SCALE 1:40)



TYPICAL DUCTBANK DETAIL
(FOR 2x2 LAYER)
(SCALE 1:40)

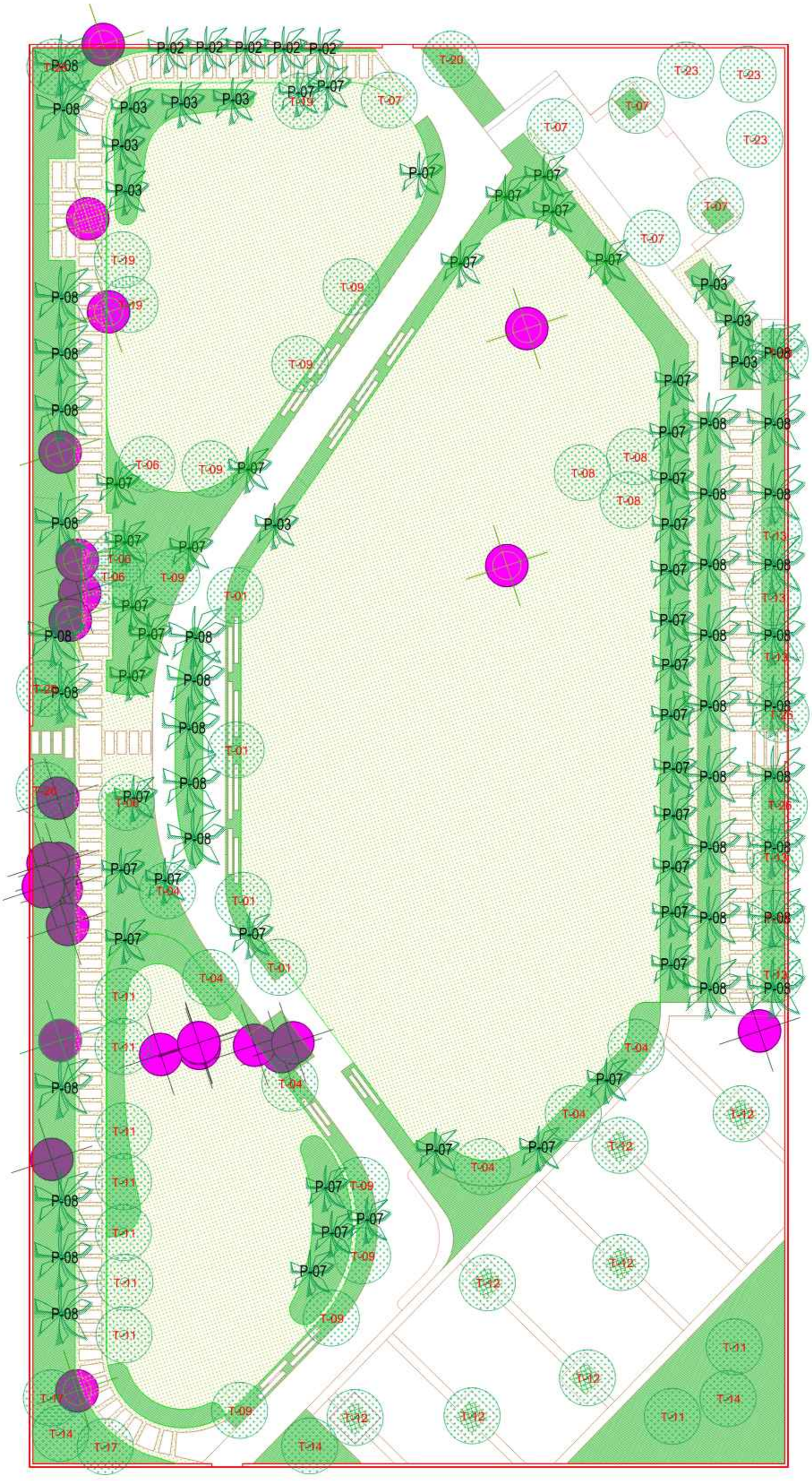
REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (M)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency					Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.		
4												
3												
2							CONSULTANT :		DRAWING TITLE :	TYPICAL DETAILS OF MANHOLE FOR POWER DISTRIBUTION		
1									DRAWING NO :	VSPL/IPD/2324-066/DPR/EL/021		
0					P.B	S.B.R		Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.	GRAPHIC SCALE :		SHEET SIZE A2	
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY						

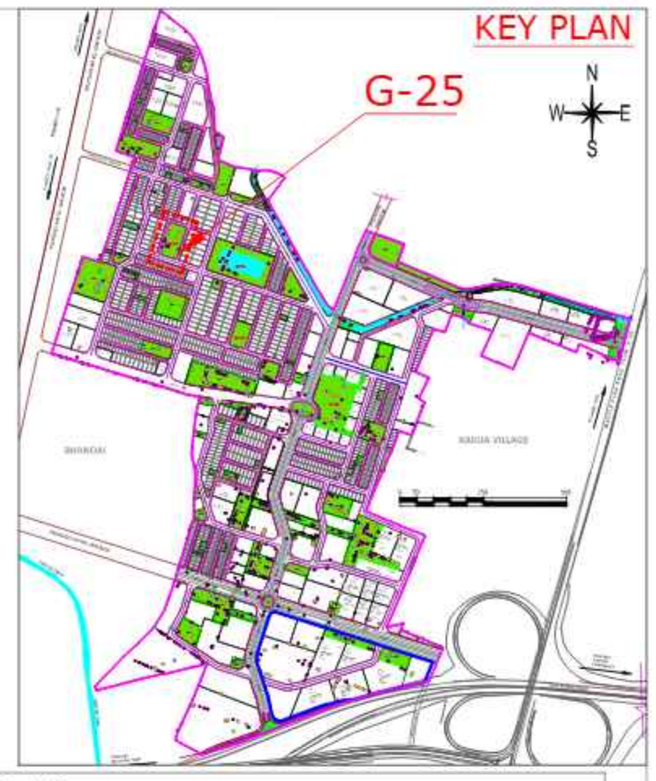
ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DFR/DPR	
Tender Drawing	✓
Revision	R1
Date	FEB. 2025

LANDSCAPING

Drawing List

ATAL PURAM AGRA- DRAWING LIST-2025			
S.NO	BUILDING NAME	NAME OF DRAWING	DRAWING NUMBER
1	FINAL MASTER PLAN	POCKET PARK (G-25) _TREE PLAN	VSPL/IPD/2324-066/DPR/TP/01
2	FINAL MASTER PLAN	POCKET PARK (G-25) _MATERIAL PLAN & SECTION	VSPL/IPD/2324-066/DPR/MPS/02
3	FINAL MASTER PLAN	POCKET PARK (G-25) _LIGHTING PLAN	VSPL/IPD/2324-066/DPR/LP/03
4	FINAL MASTER PLAN	POCKET PARK (G-25) _GRADING AND SETTING OUT PLAN	VSPL/IPD/2324-066/DPR/GSP/04
5	FINAL MASTER PLAN	CENTRAL GREEN (G-26) _TREE PLAN	VSPL/IPD/2324-066/DPR/TP/05
6	FINAL MASTER PLAN	CENTRAL GREEN (G-26) _SHRUBS & GROUND COVER	VSPL/IPD/2324-066/DPR/SGC/06
7	FINAL MASTER PLAN	CENTRAL GREEN (G-26) _MATERIAL PLAN	VSPL/IPD/2324-066/DPR/MP/07
8	FINAL MASTER PLAN	CENTRAL GREEN (G-26) _LIGHTING PLAN	VSPL/IPD/2324-066/DPR/LP/08
9	FINAL MASTER PLAN	CENTRAL GREEN (G-26) _GRADING AND SETTING OUT PLAN	VSPL/IPD/2324-066/DPR/GSP/09
10	FINAL MASTER PLAN	CENTRAL GREEN (G-26) _LANDSCAPE DETAIL-1	VSPL/IPD/2324-066/DPR/LD/10
11	FINAL MASTER PLAN	CENTRAL GREEN (G-26) _LANDSCAPE DETAIL-2	VSPL/IPD/2324-066/DPR/LD/11
12	FINAL MASTER PLAN	CENTRAL GREEN (G-26) _LANDSCAPE DETAIL-3	VSPL/IPD/2324-066/DPR/LD/12
13	FINAL MASTER PLAN	POCKET PARK (G-30) _TREE PLAN	VSPL/IPD/2324-066/DPR/TP/13
14	FINAL MASTER PLAN	POCKET PARK (G-30) _MATERIAL PLAN & SECTION	VSPL/IPD/2324-066/DPR/MPS/14
15	FINAL MASTER PLAN	POCKET PARK (G-30) _LIGHTING PLAN	VSPL/IPD/2324-066/DPR/LP/15
16	FINAL MASTER PLAN	POCKET PARK (G-30) _GRADING AND SETTING OUT PLAN	VSPL/IPD/2324-066/DPR/GSP/16
17	FINAL MASTER PLAN	CENTRAL PLAZA (G-68) _TREE PLAN	VSPL/IPD/2324-066/DPR/TP/17
18	FINAL MASTER PLAN	CENTRAL PLAZA (G-68) _MATERIAL PLAN & SECTION	VSPL/IPD/2324-066/DPR/MPS/18
19	FINAL MASTER PLAN	CENTRAL PLAZA (G-68) _LIGHTING PLAN	VSPL/IPD/2324-066/DPR/LP/19
20	FINAL MASTER PLAN	CENTRAL PLAZA (G-68) _GRADING AND SETTING OUT PLAN	VSPL/IPD/2324-066/DPR/GSP/20
21	FINAL MASTER PLAN	CENTRAL PLAZA (G-68) _LANDSCAPE DETAIL	VSPL/IPD/2324-066/DPR/LD/21
22	FINAL MASTER PLAN	CENTRAL PARK BOUNDARY WALL- DETAILS	VSPL/IPD/2324-066/DPR/BWD/22
23	FINAL MASTER PLAN	TYPICAL POCKET PARK BOUNDARY WALL DETAIL	VSPL/IPD/2324-066/DPR/BWD/23
24	FINAL MASTER PLAN	ENTRY GATE-1 DETAIL	VSPL/IPD/2324-066/DPR/EG/24
25	FINAL MASTER PLAN	ENTRY GATE-2	VSPL/IPD/2324-066/DPR/EG/25
26	FINAL MASTER PLAN	ADMIN BUILDING-GROUND FLOOR PLAN	VSPL/IPD/2324-066/DPR/ADMIN/GF/26
27	FINAL MASTER PLAN	ADMIN BUILDING-FIRST FLOOR PLAN	VSPL/IPD/2324-066/DPR/ADMIN/FF/27
28	FINAL MASTER PLAN	ADMIN BUILDING-TERRACE FLOOR PLAN	VSPL/IPD/2324-066/DPR/ADMIN/TF/28
29	FINAL MASTER PLAN	ADMIN BUILDING-SECTION AA & BB	VSPL/IPD/2324-066/DPR/ADMIN/SEC/29
30	FINAL MASTER PLAN	ADMIN BUILDING-ELEVATION A	VSPL/IPD/2324-066/DPR/ADMIN/ELE/30
31	FINAL MASTER PLAN	ADMIN BUILDING-PLANTING PLAN	VSPL/IPD/2324-066/DPR/ADMIN/PP/31
32	FINAL MASTER PLAN	ADMIN BUILDING-MATERIAL AND LIGHTING PLAN	VSPL/IPD/2324-066/DPR/ADMIN/MLP/32
33	FINAL MASTER PLAN	FIRE STATION- PLAN, ELEVATION & SECTION	VSPL/IPD/2324-066/DPR/FIRE/33
34	FINAL MASTER PLAN	POLICE STATION- GROUND PLAN	VSPL/IPD/2324-066/DPR/POLICE/34
35	FINAL MASTER PLAN	POLICE STATION- FIRST PLAN	VSPL/IPD/2324-066/DPR/POLICE/35
36	FINAL MASTER PLAN	POLICE STATION- SECOND PLAN	VSPL/IPD/2324-066/DPR/POLICE/36
37	FINAL MASTER PLAN	POLICE STATION- SECTIONS & ELEVATION	VSPL/IPD/2324-066/DPR/POLICE/37





LIST OF TREES :

CODE	SYMBOL	SCIENTIFIC NAME	COMMON NAME
BIG TREES			
T-01	T-01	Terminalia mantaly	Saaj Tree
T-02	T-02	Peltophorum pterocarpum	Peela Gulmohar
T-03	T-03	Erythrina indica	Pangara
T-04	T-04	Thevetia peruviana	Pila kaner
T-05	T-05	Cordia sebestena	Bohari
T-06	T-06	Mimusops elengi	Bakul
T-07	T-07	Plumeria alba	White Champa
T-08	T-08	Cassia fistula	Amaltas
T-09	T-09	Tabebuia rosea	Basant rani
T-10	T-10	Polyalthia pendula	Ashok
T-11	T-11	Carissa carandas	Karand
T-12	T-12	Plumeria rubra	Red Champa
T-13	T-13	Spathodea campanulata	Rugtoora
T-14	T-14	Samanea saman	Rain tree
T-15	T-15	Delonix regia	Gulmohar
T-16	T-16	Jacaranda mimosifolia	Nili Gulmohar
T-17	T-17	Bauhinia blakeana	Kachnar
T-18	T-18	Lagerstroemia speciosa	Jarul
T-19	T-19	Callistemon lanceolatus	Bottlebrush
T-20	T-20	Cassia javanica	Pink shower
T-21	T-21	Pongamia pinnata	Karanj
T-22	T-22	Terminalia catappa	Badam
T-23	T-23	Schleichera oleosa	Kusum
T-24	T-24	Ficus benghalensis	Banyan
T-25	T-25	Grevillea robusta	Silver Oak
T-26	T-26	Bombax ceiba	Semal
T-27	T-27	Madhuca longifolia	Mahua
T-28	T-28	Ficus religiosa	Peepal

LIST OF PALMS :

CODE	SYMBOL	SCIENTIFIC NAME	COMMON NAME
BIG TREES			
P-01	P-01	Areca catechu	Puga / Supari
P-02	P-02	Veitchia merrillii	Christmas palm
P-03	P-03	Caryota mitis	Fishtail palm
P-04	P-04	Bismarckia nobilis	Norvisnee
P-05	P-05	Cocos nucifera	Nariyal
P-06	P-06	Wodyetia bifurcata	Foxtail palm
P-07	P-07	Dictyosperma album	Hurricane Palm
P-08	P-08	Roystonea regia	Royal palm
P-09	P-09	Hyophorbe lagenicaulis	Bottle palm

LIST OF AQUATIC PLANTS :

CODE	SYMBOL	SCIENTIFIC NAME	COMMON NAME
A-Cp		Cyperus papyrus	Papyrus
A-Ce		Colocasia esculenta	Elephant Ear
A-Ip		Ipomoea	Elephant Ear
A-Vz		Vetiveria zizanioides	Vetiver Grass
A-Pp		Pennisetum purpureum	Pennisetum
A-Cc		Cymbopogon citratus	Lemon grass

REVISION BLOCK

REV.	DATE	DESCRIPTION
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QUALITY ASSURANCE

The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency

DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY
S.M	S.M	P.S	S.S.R.

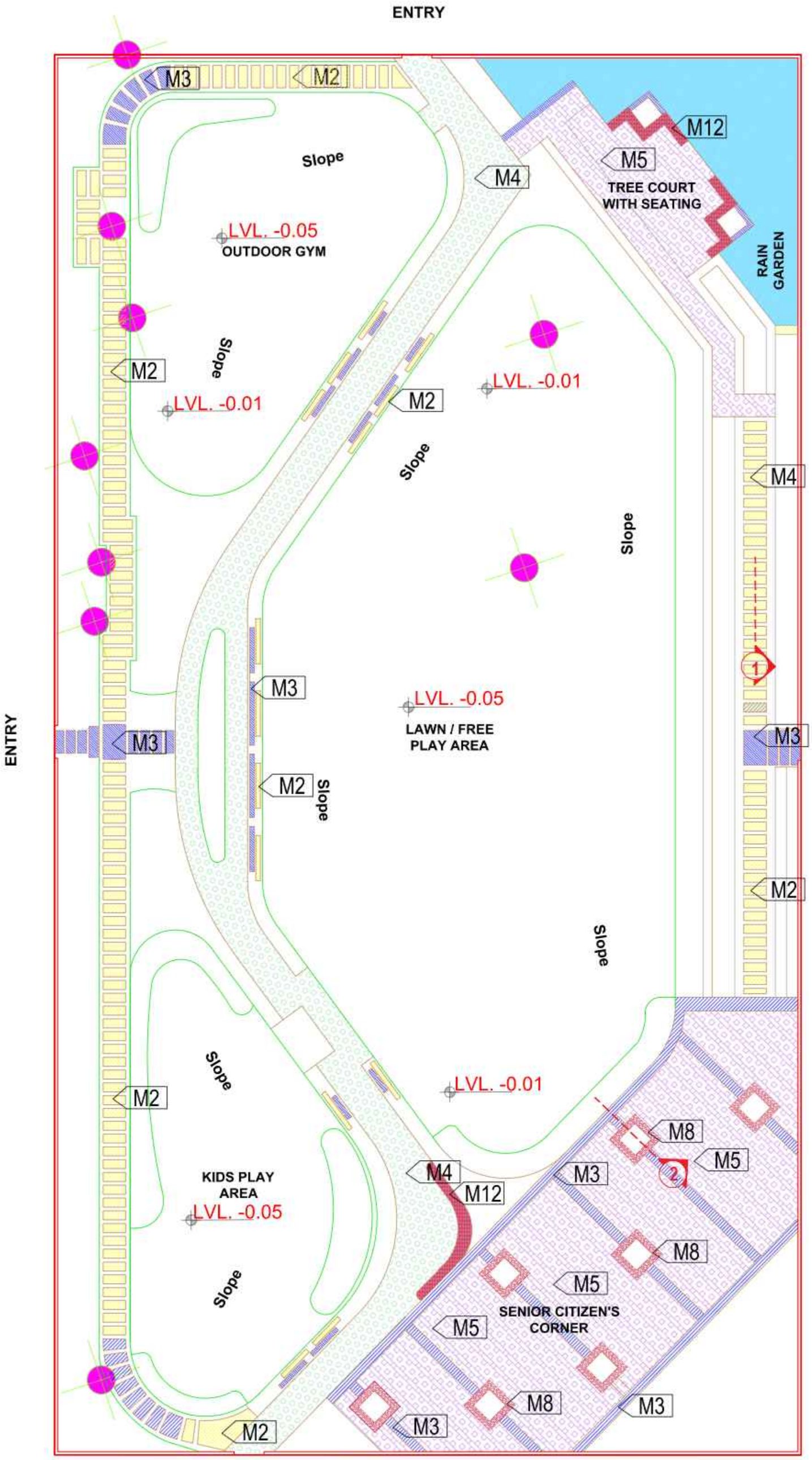
CLIENT :
Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

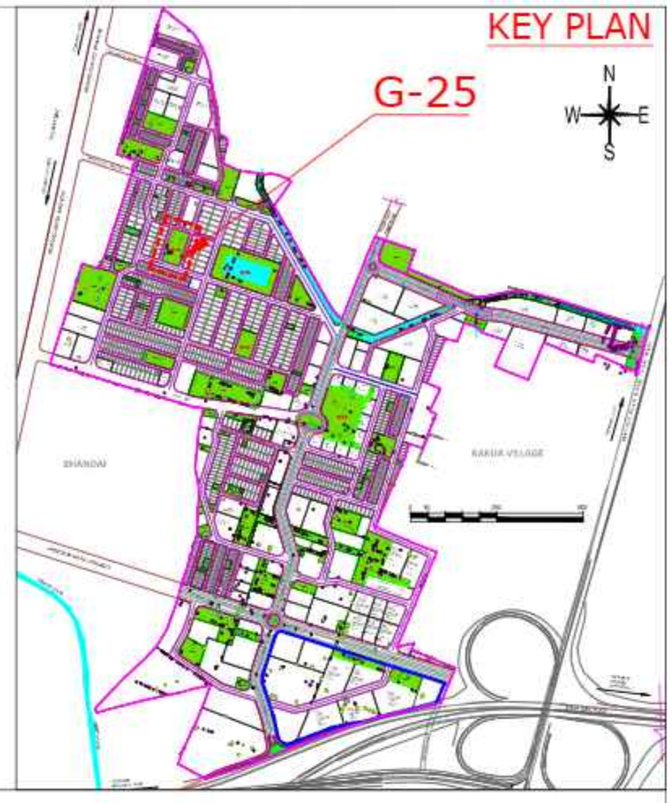
CONSULTANT.
Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE :	PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.
DRAWING TITLE :	POCKET PARK (G-25) _TREE PLAN
DRAWING NO :	VSPL/IPD/2324-066/DPR/TP/01
GRAPHIC SCALE :	0 2 4 6 8 10 M

NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

SHEET SIZE	ISSUE RECORD	APPROVED FOR ISSUE
A2	Concept	
	DPR/DPR	
	Tender Drawing	✓
	Revision	R0
	Date	FEB, 2025





MATERIAL CHART

CODE	AREA	SYM.	MATERIAL	COLOUR	SIZE
DRIVEWAY					
M1			KERB STONE		
PATHWAY, STEPPING STONES & PARKING					
M2	PARKS / GARDEN		ROUGH KOTA STONE	HONEY	40MM THK.
M3	PARKS / GARDEN		PEARL GREY GRANITE	PEARL GREY	40MM THK.
M4	PATHWAY		CONCRETE GRASS PAVER		75MM THK.
M5	CYCLE TRACK		MURRAM		
SPORTS SEATING					
M6	COPING & CLADDING		RED SAND STONE	RED	40MM THK.
FOUNTAIN INTERNAL CLADDING					
M7			GLASS MOSAIC TILES AS/ SPEC		
COPING AND CLADDING					
M8	COPING		POLISHED STEEL GREY GRANITE	GREY	40MM THK.
SPORTS & CHILDREN'S PLAY AREA					
M9	SPORTS AREA		RUBBERISED FLOORING		A per Vendor
M10	FENCE		CHAINLIKE WIRE NETTING		
M11	CONCRETE FLOOR		PLAY COURT		
VIEWING DECK					
M12	Deck		WPC WOODEN DECK		A per Vendor
PEBBLE					
M13			1.5-2" DIA UNIFORMLY ROUND RIVER WASHED PEBBLES		
M14	PATHWAY THROU-GHOUT THE SITE		LIGHT GREY CONC. PAVERS	GREY	60MM THK.

1 TYPICAL STEPPING STONE DETAIL
SCALE 1:50

2 TYPICAL PLANTER WITH SEATING SECTION
SCALE 1:50

B TYPICAL PLANTER WITH SEATING LAYOUT
SCALE 1:50

A TYPICAL STEPPING STONE LAYOUT
SCALE 1:50

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REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

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PROJECT TITLE :	PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.
DRAWING TITLE :	POCKET PARK (G-25) _MATERIAL PLAN & SECTION
DRAWING NO :	VSPL/IPD/2324-066/DPR/MPS/02
GRAPHIC SCALE :	0 2 4 6 8 10 M

NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

	ISSUE RECORD	APPROVED FOR ISSUE
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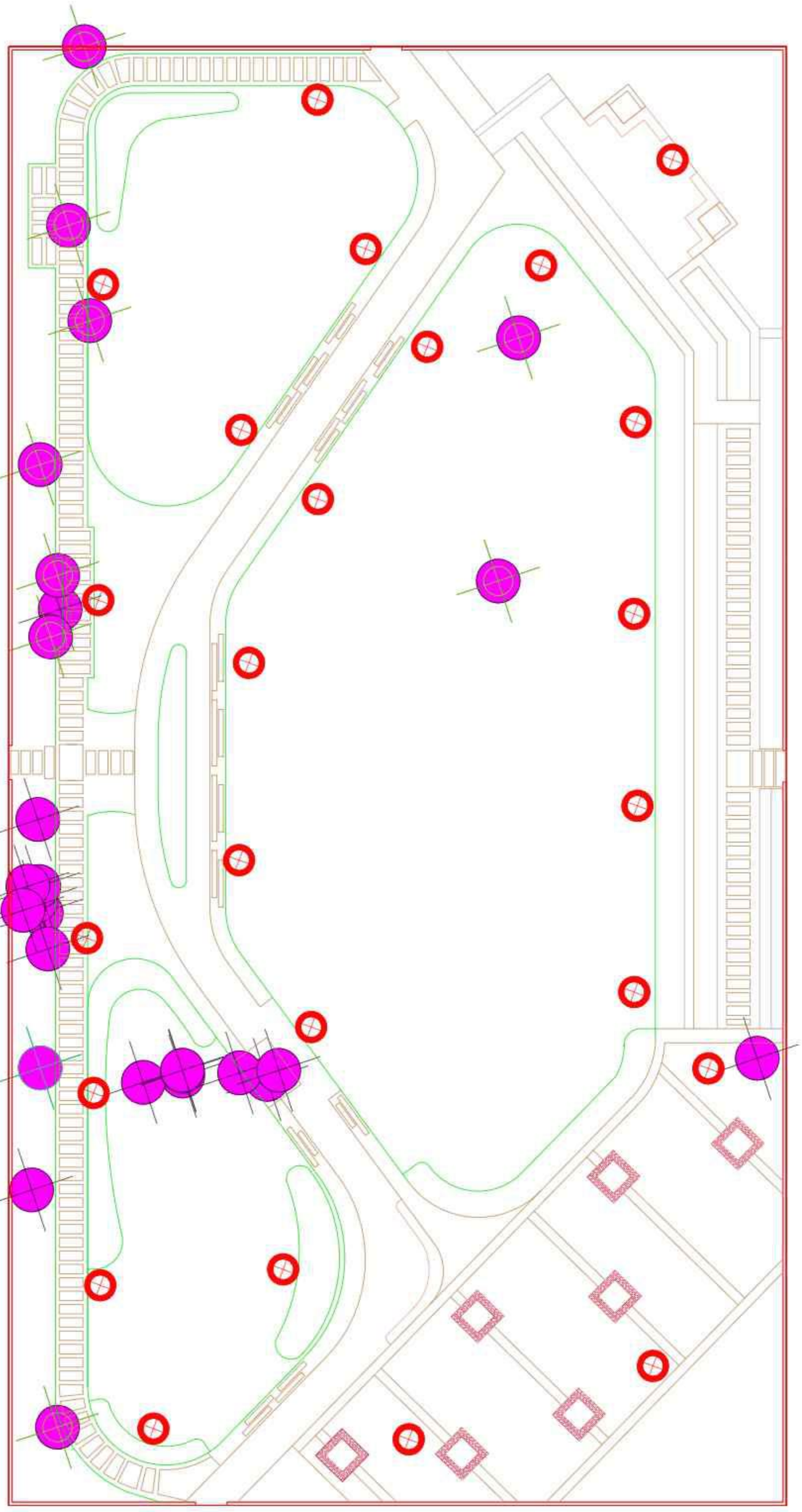
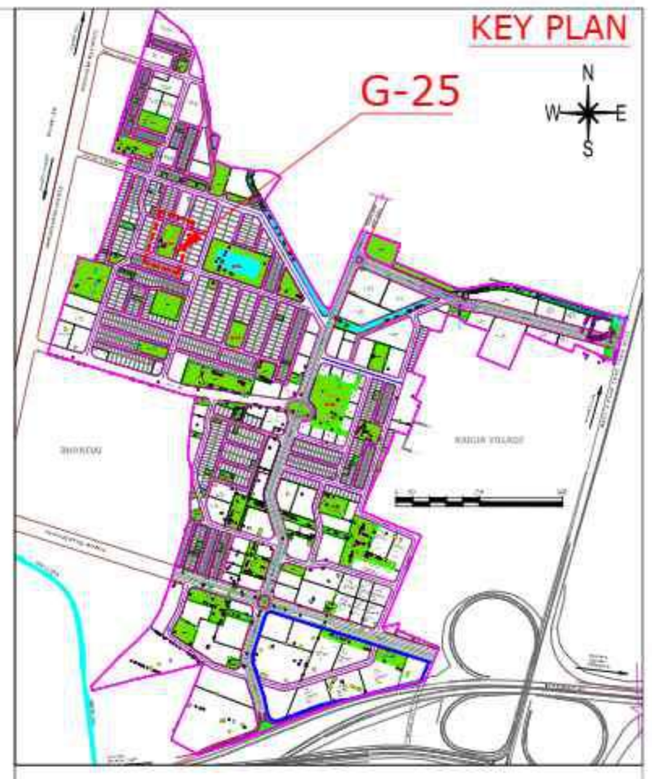
	DPR/DPR	
SHEET SIZE A2	Tender Drawing	✓
	Revision	R0
	Date	FEB. 2025





SYMBOL	TYPE OF FIXTURE	HEIGHT IN (M)
⊕	POST TOP LIGHT	6M

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :	PROJECT TITLE :	PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.	NOTE : ALL THE DIMENSIONS ARE IN METERS (M)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010				
4								DRAWING TITLE :	POCKET PARK (G-25) _LIGHTING PLAN	ISSUE RECORD	APPROVED FOR ISSUE
3							CONSULTANT.			Concept	
2							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.	DRAWING NO :	VSPL/IPD/2324-066/DPR/GSP/03	DPR/DPR	
1										Tender Drawing	✓
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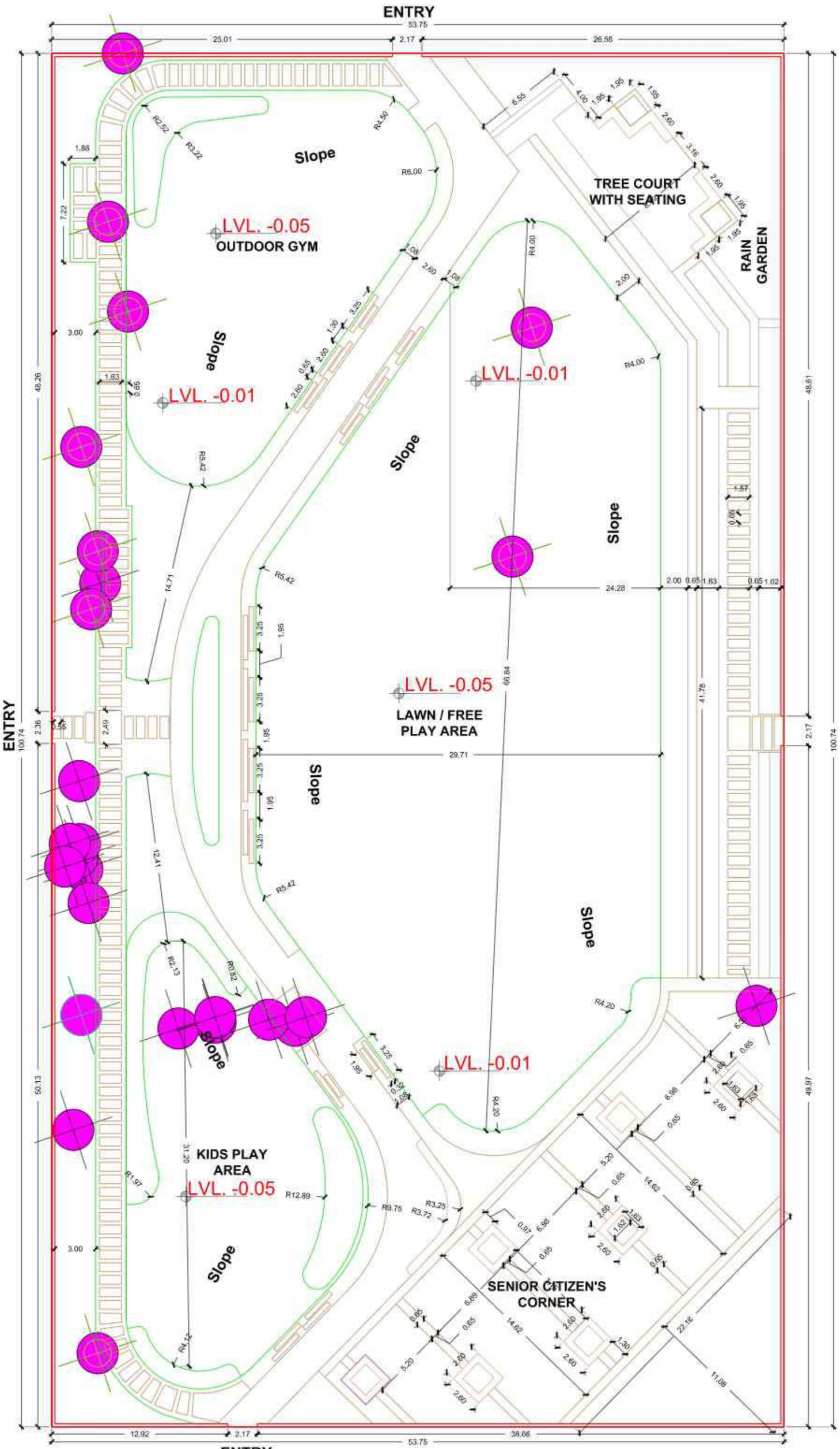
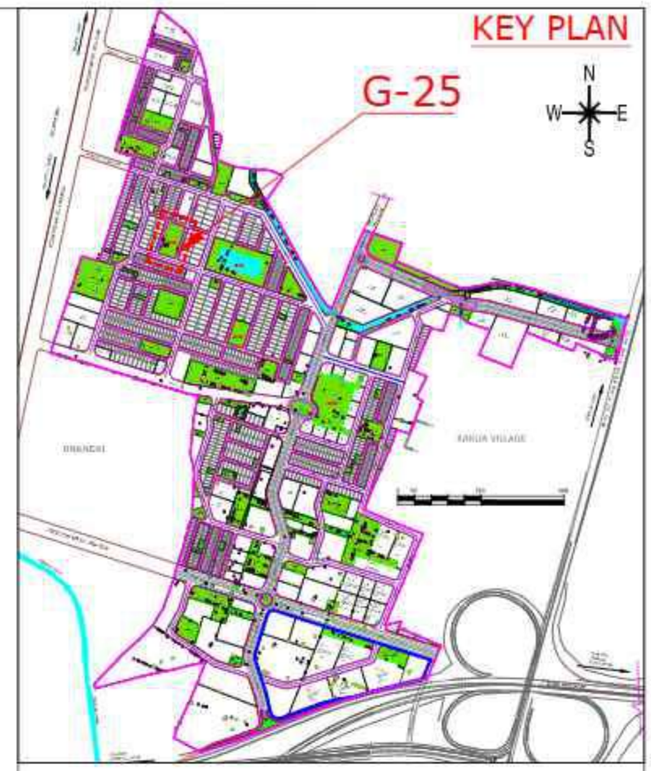
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY				SHEET SIZE A2	Date FEB, 2025





REVISION BLOCK			QUALITY ASSURANCE			
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REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

CLIENT :
Agra Development Authority ADA
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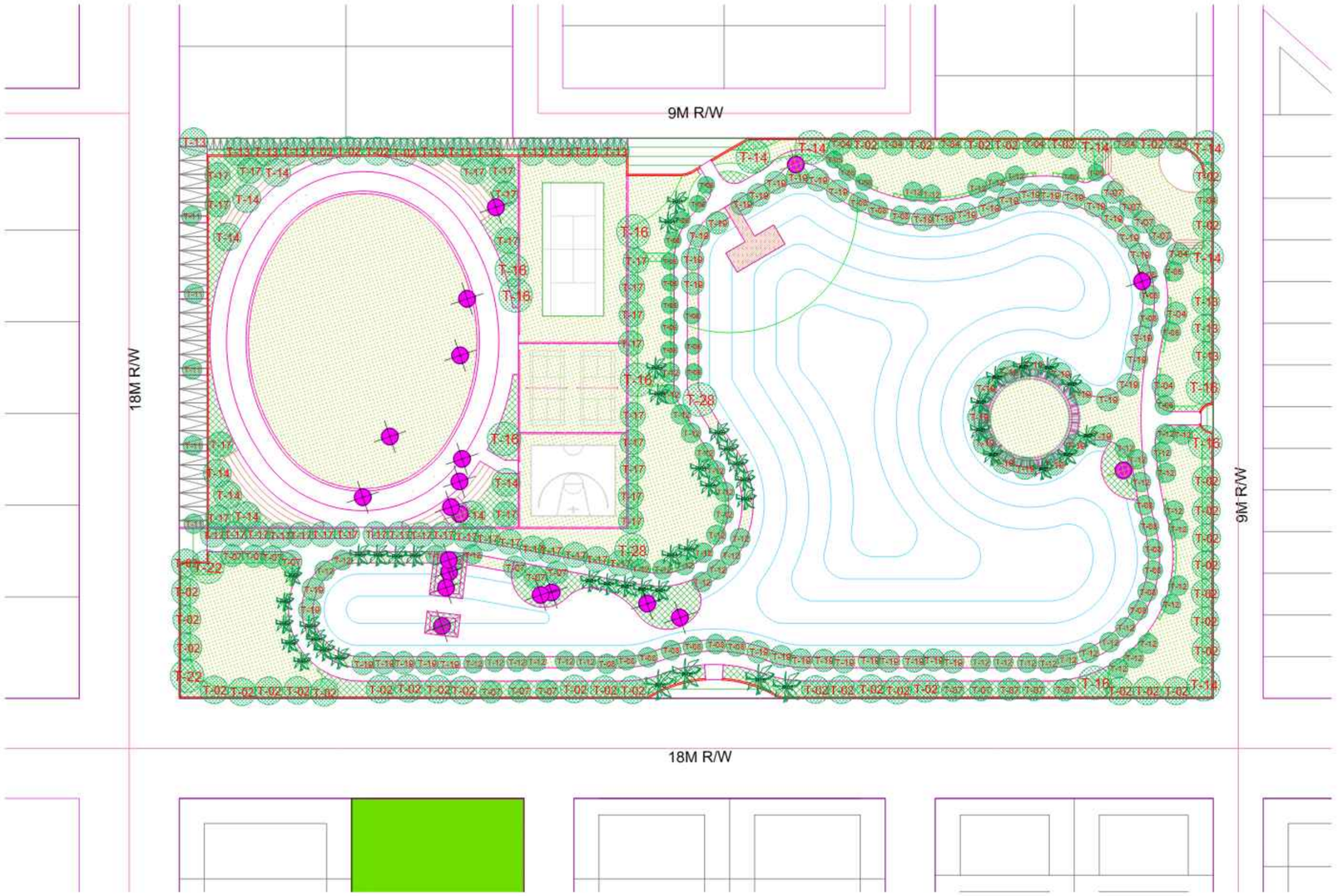
Agra, Uttar Pradesh - 282010

CONSULTANT.
Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE :	PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.
DRAWING TITLE :	POCKET PARK (G-25) _GRADING AND SETTING OUT PLAN
DRAWING NO :	VSPL/IPD/2324-066/DPR/GSP/04
GRAPHIC SCALE :	0 2 4 6 8 10 M

NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

SHEET SIZE	ISSUE RECORD	APPROVED FOR ISSUE
A2	Concept	
	DPR/DPR	
	Tender Drawing	✓
	Revision	R0
	Date	FEB, 2025



LIST OF TREES :

CODE	SYMBOL	SCIENTIFIC NAME	COMMON NAME
BIG TREES			
T-01	T-01	Terminalia mantaly	Saaj Tree
T-02	T-02	Peltophorum pterocarpum	Peela Gulmohar
T-03	T-03	Erythrina indica	Pangara
T-04	T-04	Thevetia peruviana	Pila kaner
T-05	T-05	Cordia sebestena	Bohari
T-06	T-06	Mimusops elengi	Bakul
T-07	T-07	Plumeria alba	White Champa
T-08	T-08	Cassia fistula	Amaltas
T-09	T-09	Tabebuia rosea	Basant rani
T-10	T-10	Polyalthia pendula	Ashok
T-11	T-11	Carissa carandas	Karand
T-12	T-12	Plumeria rubra	Red Champa
T-13	T-13	Spathodea campanulata	Rugtoora
T-14	T-14	Samanea saman	Rain tree
T-15	T-15	Delonix regia	Gulmohar
T-16	T-16	Jacaranda mimosifolia	Nili Gulmohar
T-17	T-17	Bauhinia blakeana	Kachnar
T-18	T-18	Lagerstroemia speciosa	Jarul
T-19	T-19	Callistemon lanceolatus	Bottlebrush
T-20	T-20	Cassia javanica	Pink shower
T-21	T-21	Pongamia pinnata	Karanj
T-22	T-22	Terminalia catappa	Badam
T-23	T-23	Schleichera oleosa	Kusum
T-24	T-24	Ficus benghalensis	Banyan
T-25	T-25	Grevillea robusta	Silver Oak
T-26	T-26	Bombax ceiba	Semal
T-27	T-27	Madhuca longifolia	Mahua
T-28	T-28	Ficus religiosa	Peepal

LIST OF PALMS :

CODE	SYMBOL	SCIENTIFIC NAME	COMMON NAME
BIG TREES			
P-01	P-01	Areca catechu	Puga / Supari
P-02	P-02	Veitchia merrillii	Christmas palm
P-03	P-03	Caryota mitis	Fishtail palm
P-04	P-04	Bismarckia nobilis	Norvisnee
P-05	P-05	Cocos nucifera	Nariyal
P-06	P-06	Wodyetia bifurcata	Foxtail palm
P-07	P-07	Dictyosperma album	Hurricane Palm
P-08	P-08	Roystonea regia	Royal palm
P-09	P-09	Hyophorbe lagenicaulis	Bottle palm

EXISTING TREES

REVISION BLOCK		
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PROJECT TITLE : **PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.**

NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

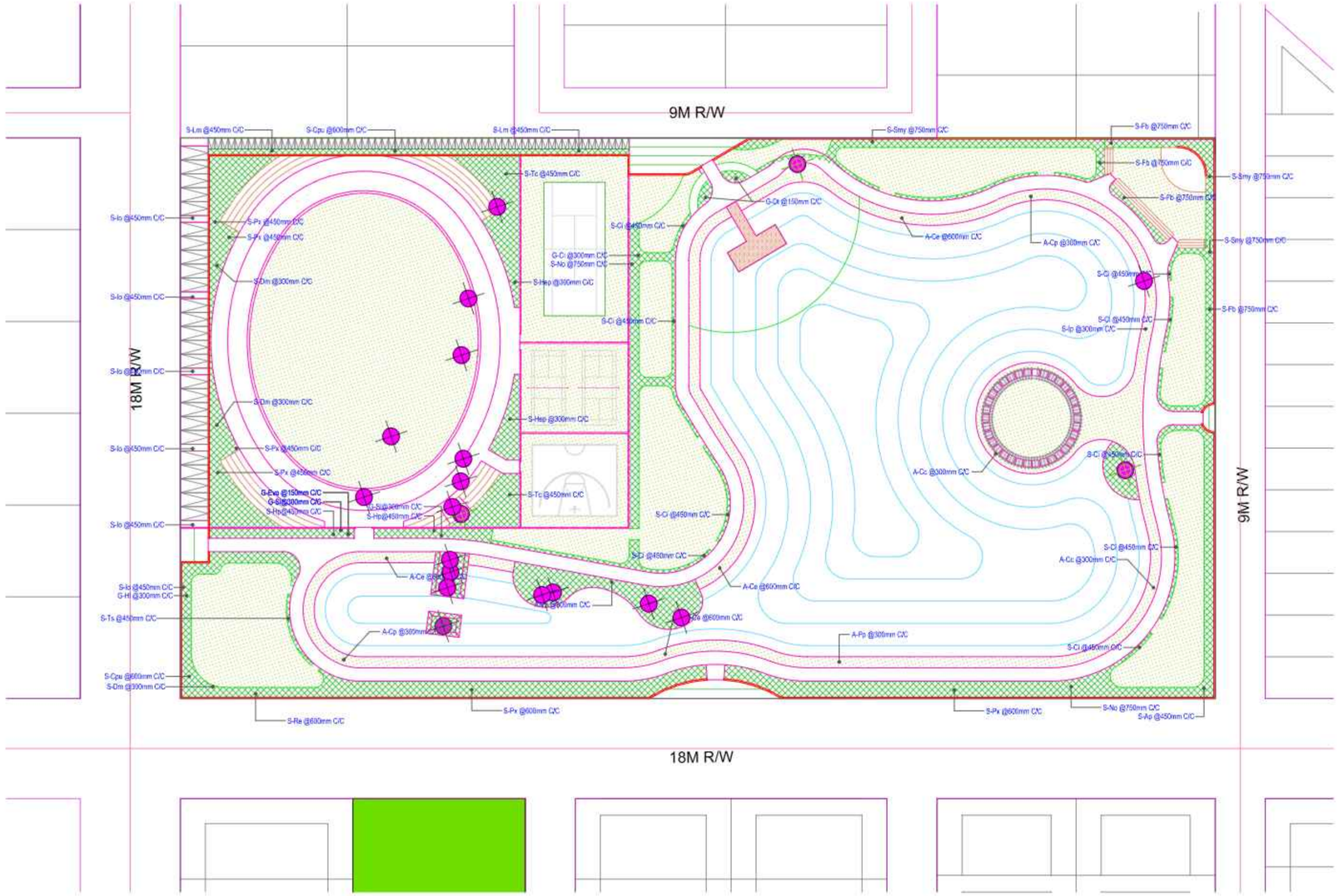
DRAWING TITLE : CENTRAL GREEN (G-26)_TREE PLAN

DRAWING NO : **VSPL/IPD/2324-066/DPR/TP/05**

GRAPHIC SCALE : 0 5 25 50

ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DFR/DPR	
Tender Drawing	✓
Revision	R0
Date	FEB. 2025

SHEET SIZE A2



LIST OF SHRUBS:

CODE	SYMBOL	SCIENTIFIC NAME	COMMON NAME
S-No		Nerium oleander	
S-Re		Rhapis excelsa	
S-Tc		Tabernaemontana coronaria	Chadni
S-Sr		Strelitzia reginae	
S-Cg		Calliandra grandiflora	
S-Sg		Schefflera green	
S-Bp		Bougainvillea pink	
S-Hr		Hibiscus red	
S-Dmr		Dracena marginata	
S-Dr		Duranta repens	
S-Dm		Dracena mahatma	
S-Cv		Codiaeum variegatum	
S-Ts		Tecoma stans	
S-Io		Ixora orange	
S-Lm		Lantana mix	
S-Dg		Duranta Gold	
S-Sva		Schefflera variegated	
S-Smy		Syzygium myrtifolium	
S-Fb		Ficus benjamina	
S-Gf		Gardenia florida	
S-Az		Alpinia zerumbet	
S-Ap		Alpinia purpurata	
S-Hep		Heliconia psittacorum	
S-Epu		Euphorbia pulcherrima	
S-Px		Philodendron xanadu	
S-Cpu		Caesalpinia pulcherrima	
S-Md		Monstera deliciosa	
S-Cl		Canna indica	

LIST OF GROUND COVERS:

CODE	SYMBOL	SCIENTIFIC NAME	COMMON NAME
G-Hl		Hymenocallis littoralis	Wine lily
G-Wt		Wedelia trilobata	Pilabhangara
G-Ar		Alternanthera Red	Gudrisag
G-Oj		Ophiopogon japonicus	Mondo grass
G-Ca		Crinum asiaticum	Crinum lily
G-Ag		Alternanthera Green	Gudrisag
G-Dt		Dianella tasmanica	Flax Lily
G-Sl		Sansevieria laurentii	Snake plant
G-En		Eranthemum nigrum red	Lalsa
G-Beg		Begonia	Begonia
G-Eml		Euphorbia milii	Crown of Thorn
G-Bro		Bromeliads	Bromeliad
G-Cwp		Cuphea hyssopifolia	False Heather
G-Evo		Evolvulus spp.	Sankhpushpi
G-Rr		Ruellia rosea	Wild peturias
G-Pv		Pandanus variegata	Pandanus
G-Rst		Rhoeo spathacea (Tricolour)	Cradle Lily

LIST OF AQUATIC PLANTS :

CODE	SYMBOL	SCIENTIFIC NAME	COMMON NAME
A-Cp		Cyperus papyrus	Papyrus
A-Ce		Colocasia esculenta	Elephant Ear
A-Ip		Ipomoea	Elephant Ear
A-Vz		Vetiveria zizanioides	Vetiver Grass
A-Pp		Pennisetum purpureum	Pennisetum
A-Cc		Cymbopogon citratus	Lemon grass

REVISION BLOCK						
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REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

QUALITY ASSURANCE

The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency

CLIENT :

Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony,
Agra, Uttar Pradesh - 282010

CONSULTANT.

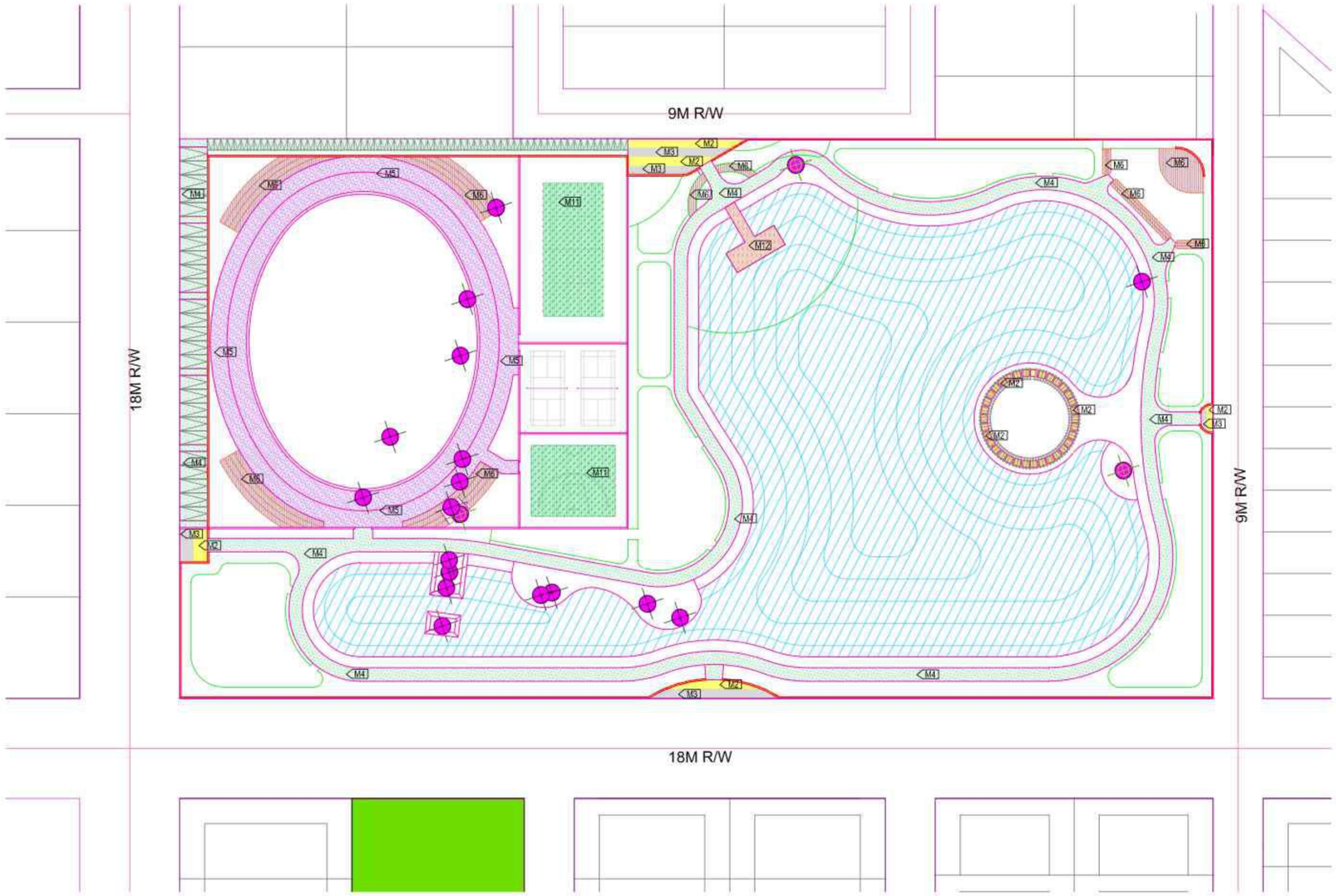
Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE :	**PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.**
DRAWING TITLE :	CENTRAL GREEN (G-26) _SHRUBS & GROUND COVER
DRAWING NO :	VSPL/IPD/2324-066/DPR/SGC/06
GRAPHIC SCALE :	0 5 25 50

NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DFR/DPR	
Tender Drawing	✓
Revision	R0
Date	FEB. 2025

SHEET SIZE A2



MATERIAL CHART

CODE	AREA	SYM.	MATERIAL	COLOUR	SIZE
DRIVEWAY					
M1			KERB STONE		
PATHWAY, STEPPING STONES & PARKING					
M2	PARKS / GARDEN		ROUGH KOTA STONE	HONEY	40MM THK.
M3	PARKS / GARDEN		PEARL GREY GRANITE	PEARL GREY	40MM THK.
M4	PATHWAY		CONCRETE GRASS PAVER		75MM THK.
M5	CYCLE TRACK		MURRAM		
SPORTS SEATING					
M6	COPING & CLADDING		RED SAND STONE	RED	40MM THK.
FOUNTAIN INTERNAL CLADDING					
M7			GLASS MOSAIC TILES AS/ SPEC		
COPING AND CLADDING					
M8	COPING		POLISHED STEEL GREY GRANITE	GREY	40MM THK.
SPORTS & CHILDREN'S PLAY AREA					
M9	SPORTS AREA		RUBBERISED FLOORING		A per Vendor
M10	FENCE		CHAINLIKE WIRE NETTING		
M11	CONCRETE FLOOR		PLAY COURT		
VIEWING DECK					
M12	Deck		WPC WOODEN DECK		A per Vendor
PEBBLE					
M13			1.5-2" DIA UNIFORMLY ROUND RIVER WASHED PEBBLES		

REVISION BLOCK		
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REV.	DATE	DESCRIPTION

QUALITY ASSURANCE

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DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY
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CLIENT :

Agra Development Authority ADA
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Agra, Uttar Pradesh - 282010

CONSULTANT.

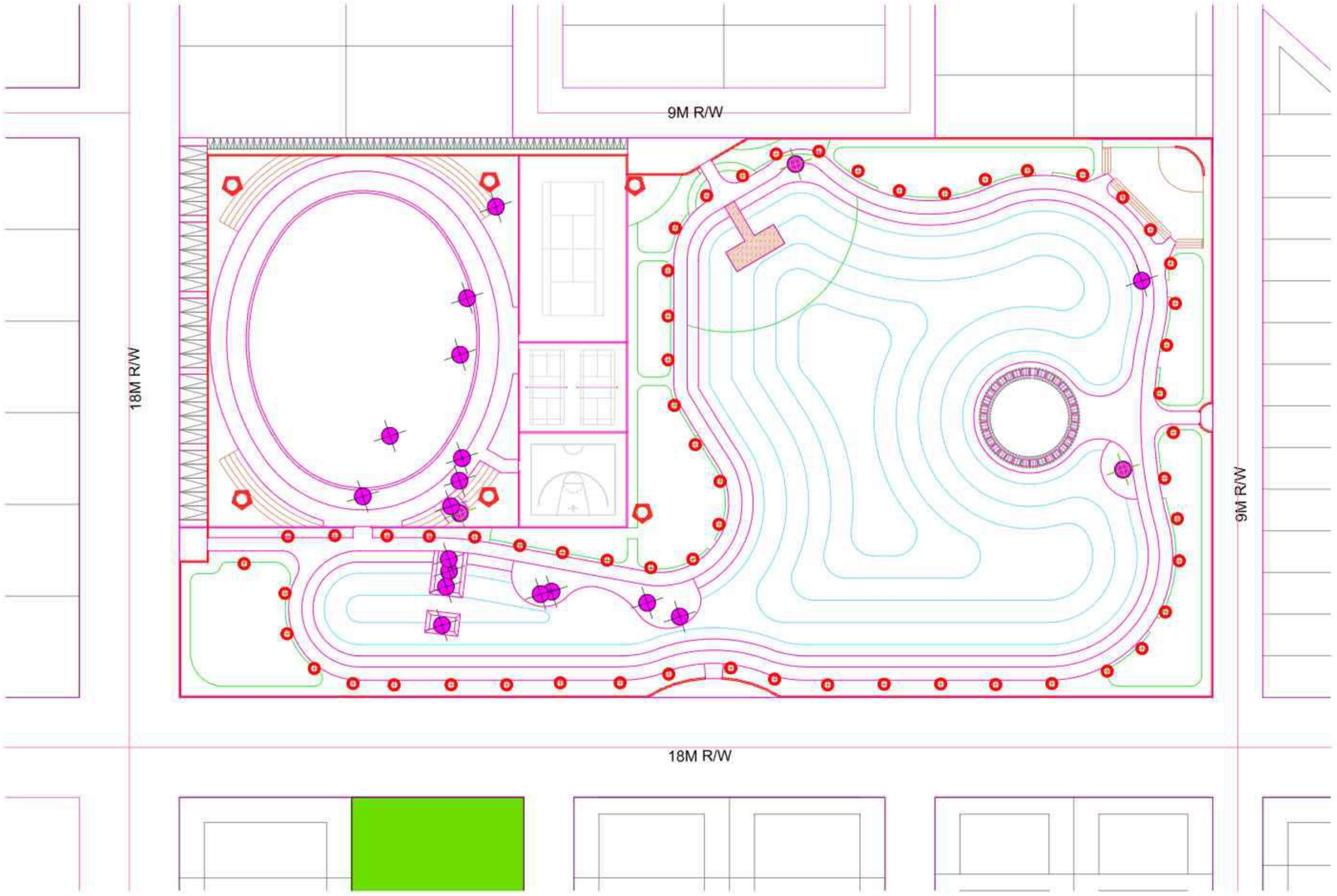
Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE :	**PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.**
DRAWING TITLE :	CENTRAL GREEN (G-26) _MATERIAL PLAN
DRAWING NO :	**VSPL/IPD/2324-066/DPR/MP/07**
GRAPHIC SCALE :	0 5 25 50

NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DFR/DPR	
Tender Drawing	✓
Revision	R0
Date	FEB.2025

SHEET SIZE A2



LEGEND: LIGHTING PLAN

SYMBOL	TYPE OF FIXTURE	HEIGHT IN (M)
	POST TOP LIGHT	7.5M
	FLOOD LIGHT	30M

REVISION BLOCK			QUALITY ASSURANCE			
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency			
4						
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0			S.M	S.M	P.B	S.B.R
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

CLIENT :
Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT.
Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE :	PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.
DRAWING TITLE :	CENTRAL GREEN (G-26) _LIGHTING PLAN
DRAWING NO :	VSPL/IPD/2324-066/DPR/LP/08
GRAPHIC SCALE :	0 5 25 50

NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

SHEET SIZE	ISSUE RECORD	APPROVED FOR ISSUE
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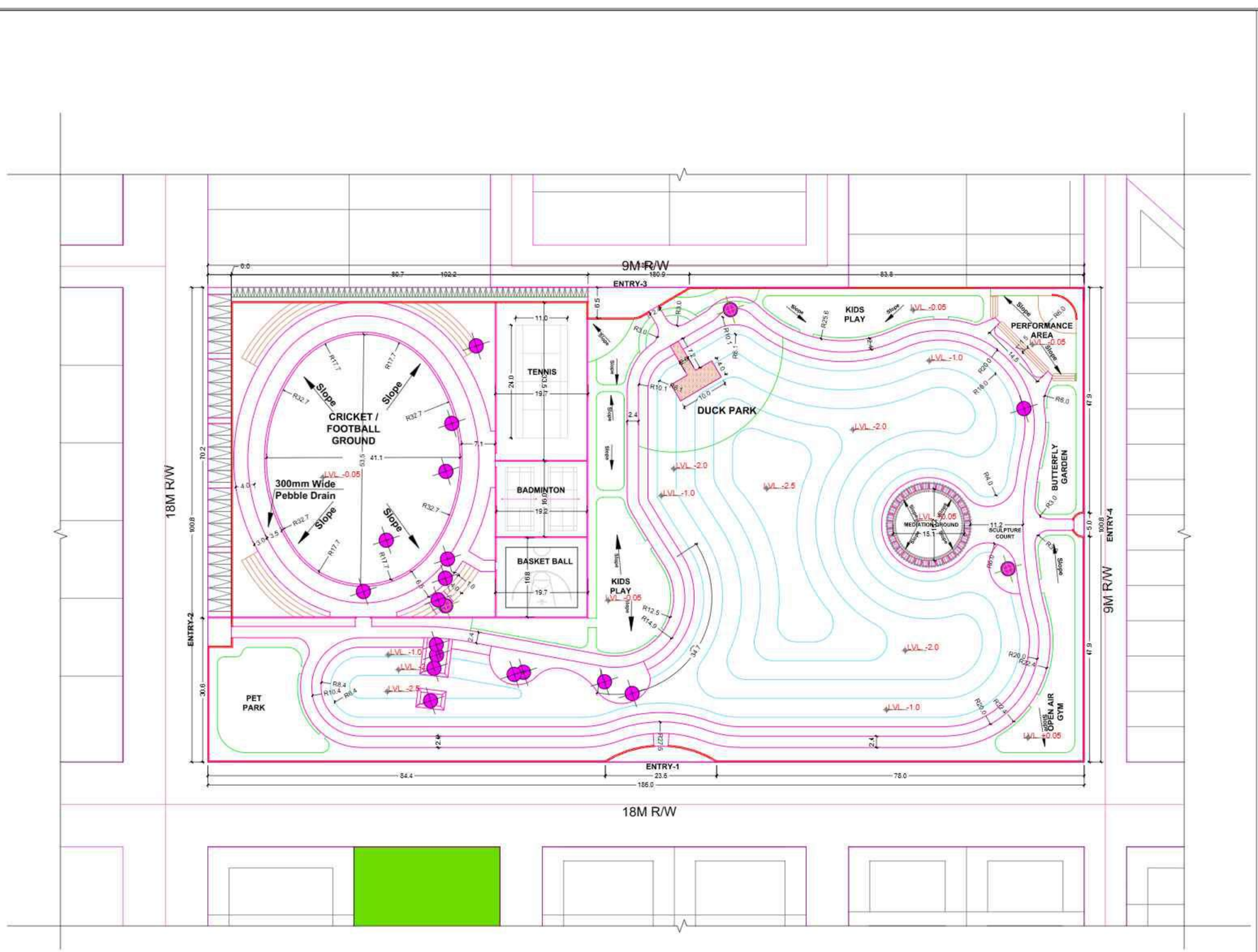
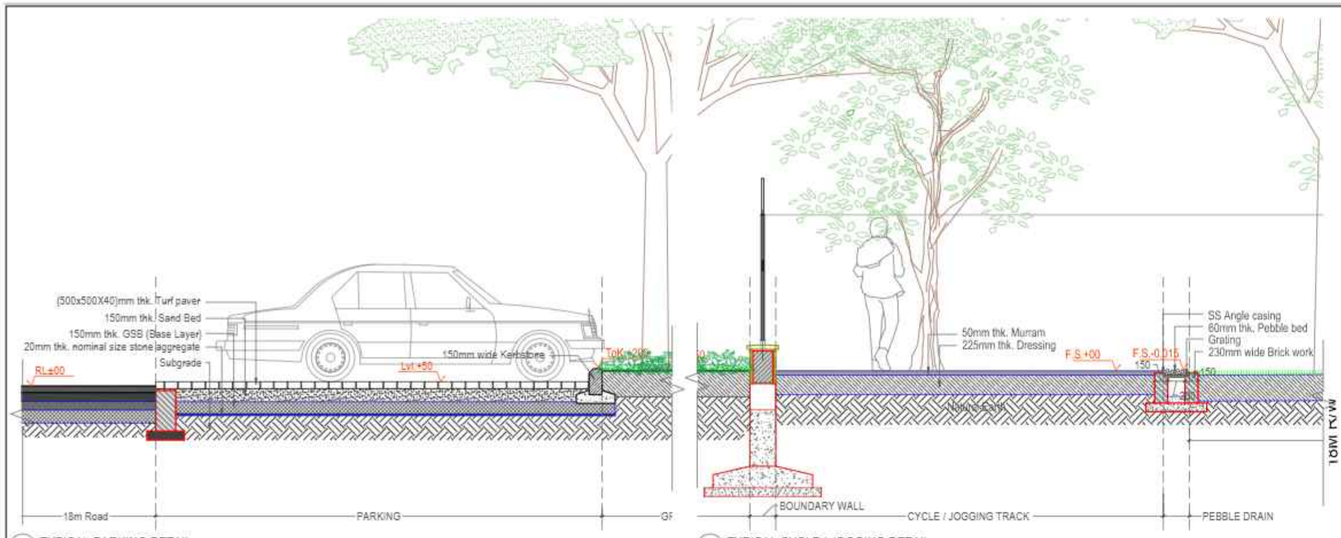
	DFR/DPR	
	Tender Drawing	✓
	Revision	R0
	Date	FEB.2025

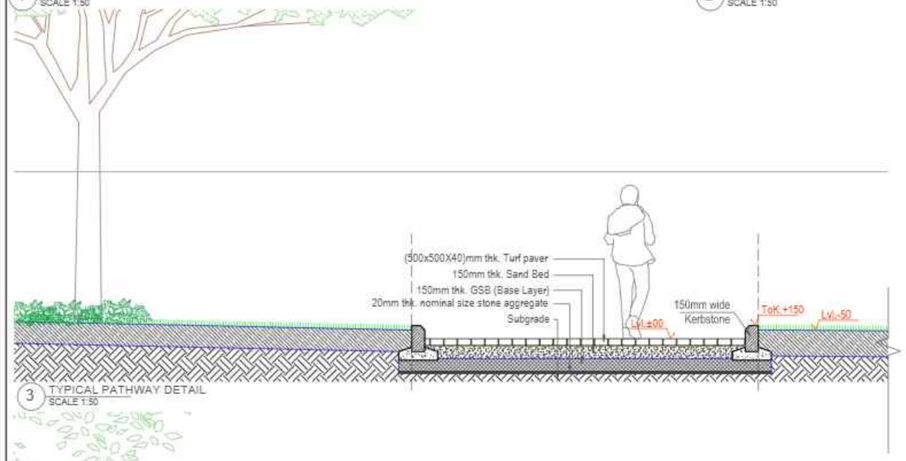


REVISION BLOCK			QUALITY ASSURANCE				CLIENT :	PROJECT TITLE :	PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.	NOTE : ALL THE DIMENSIONS ARE IN METERS (M)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010	DRAWING TITLE :	CENTRAL GREEN (G-26) _GRADING AND SETTING OUT PLAN	N W E S	ISSUE RECORD / APPROVED FOR ISSUE
4											Concept
3							CONSULTANT.	DRAWING NO :	VSPL/IPD/2324-066/DPR/GSP/09		DFR/DPR
2							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.	GRAPHIC SCALE :	0 5 25 50	SHEET SIZE A2	Tender Drawing ✓
1											Revision R0
0			S.M	S.M	P.B	S.B.R					Date FEB.2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY					

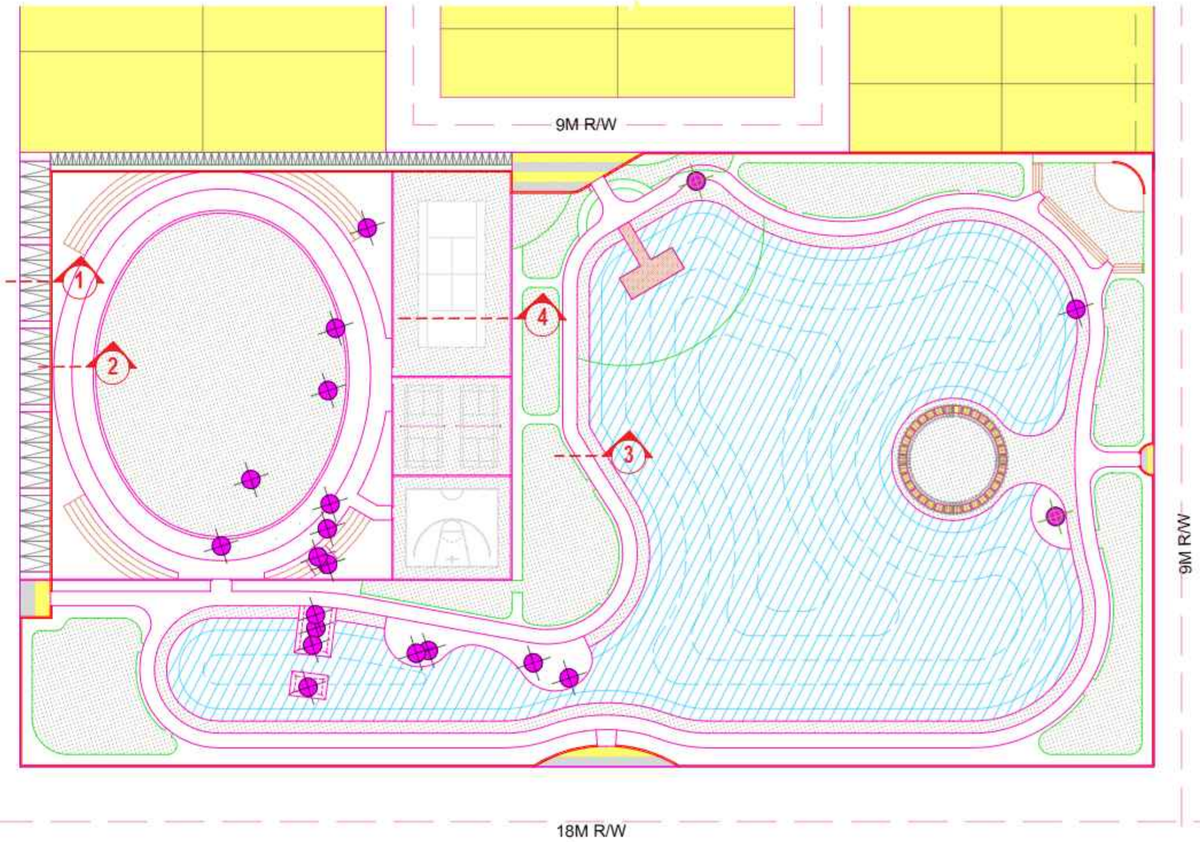


1 TYPICAL PARKING DETAIL
SCALE 1:50

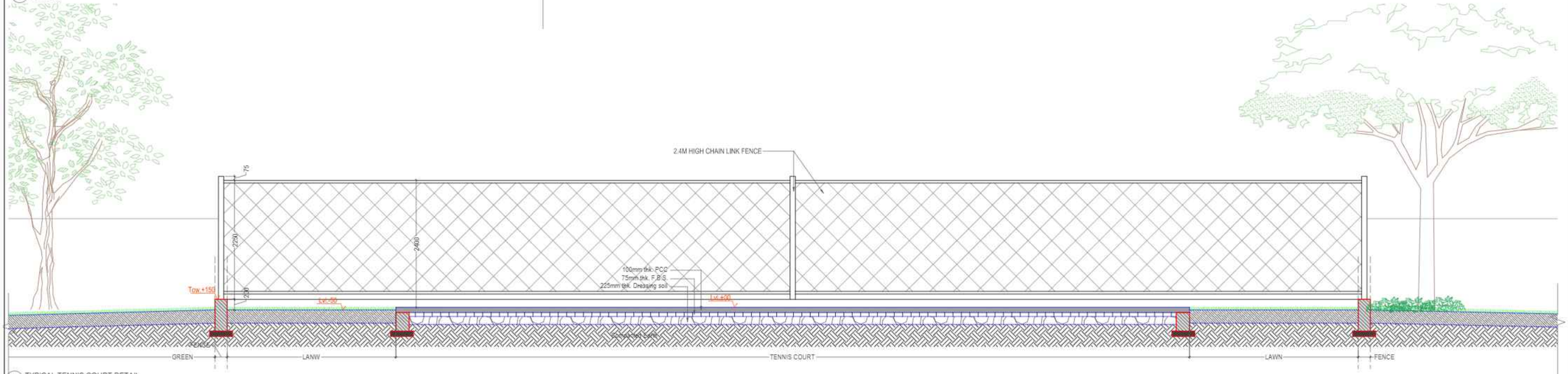
2 TYPICAL CYCLE / JOGGING DETAIL
SCALE 1:50



3 TYPICAL PATHWAY DETAIL
SCALE 1:50



1 KEY PLAN
SCALE 1:1000



4 TYPICAL TENNIS COURT DETAIL
SCALE 1:50

REVISION BLOCK			QUALITY ASSURANCE			
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency			
4						
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0			S.M	S.M	P.B	S.B.R
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

CLIENT :
Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony,
Agra, Uttar Pradesh - 282010

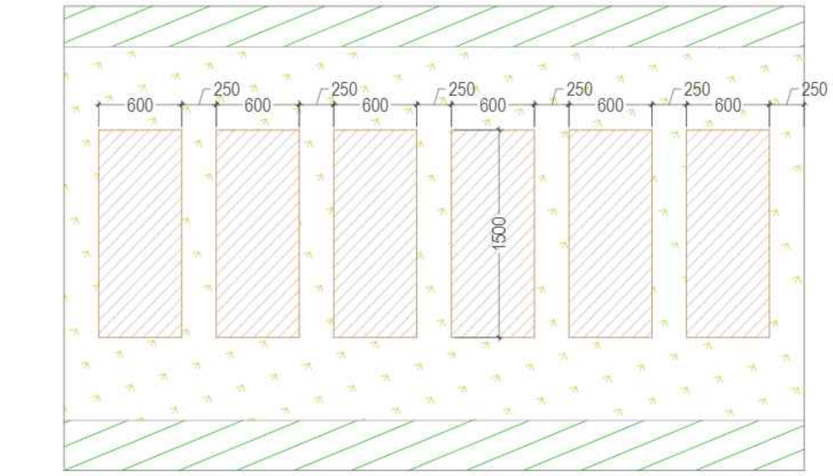
CONSULTANT.
Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE :	**PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.**
DRAWING TITLE :	CENTRAL GREEN (G-26) _LANDSCAPE DETAIL-1
DRAWING NO :	**VSPL/IPD/2324-066/DPR/LD/10**
GRAPHIC SCALE :	**AS SHOWN**

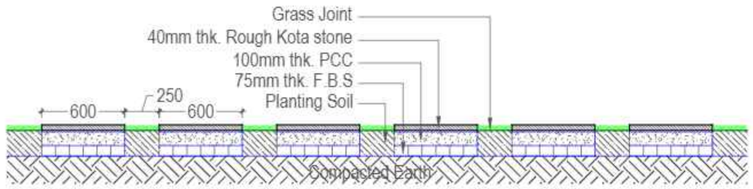
NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DFR/DPR	
Tender Drawing	✓
Revision	**R0**
Date	FEB.2025

SHEET SIZE A2

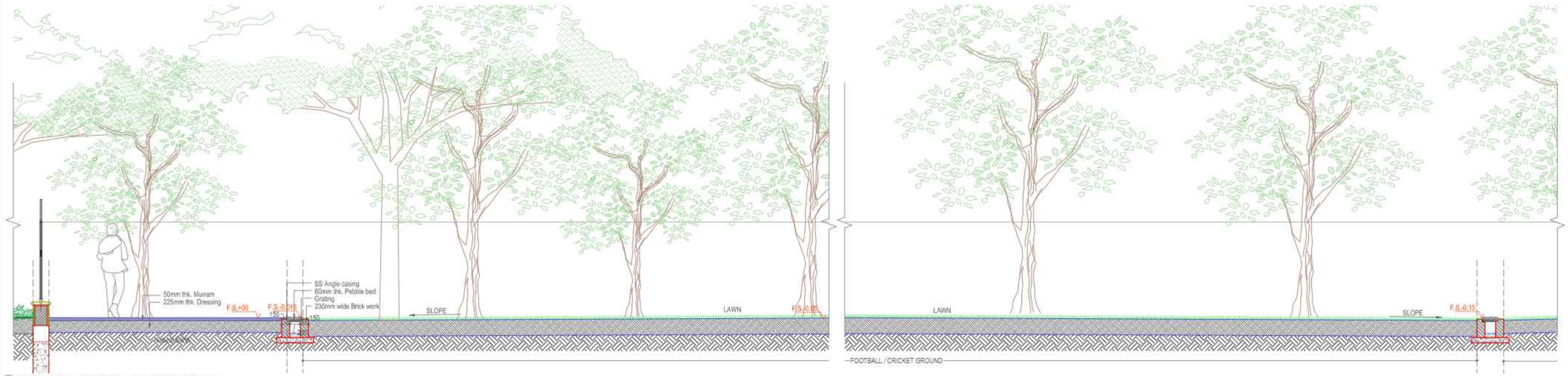


5 TYPICAL STEPPING STONE PLAN
SCALE 1:30



5A TYPICAL STEPPING STONE DETAIL
SCALE 1:30

1 KEY PLAN
SCALE 1:1000



6 TYPICAL DETAIL OF FOOTBALL CUM CRICKET GROUND
SCALE 1:50

REVISION BLOCK		
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REV.	DATE	DESCRIPTION

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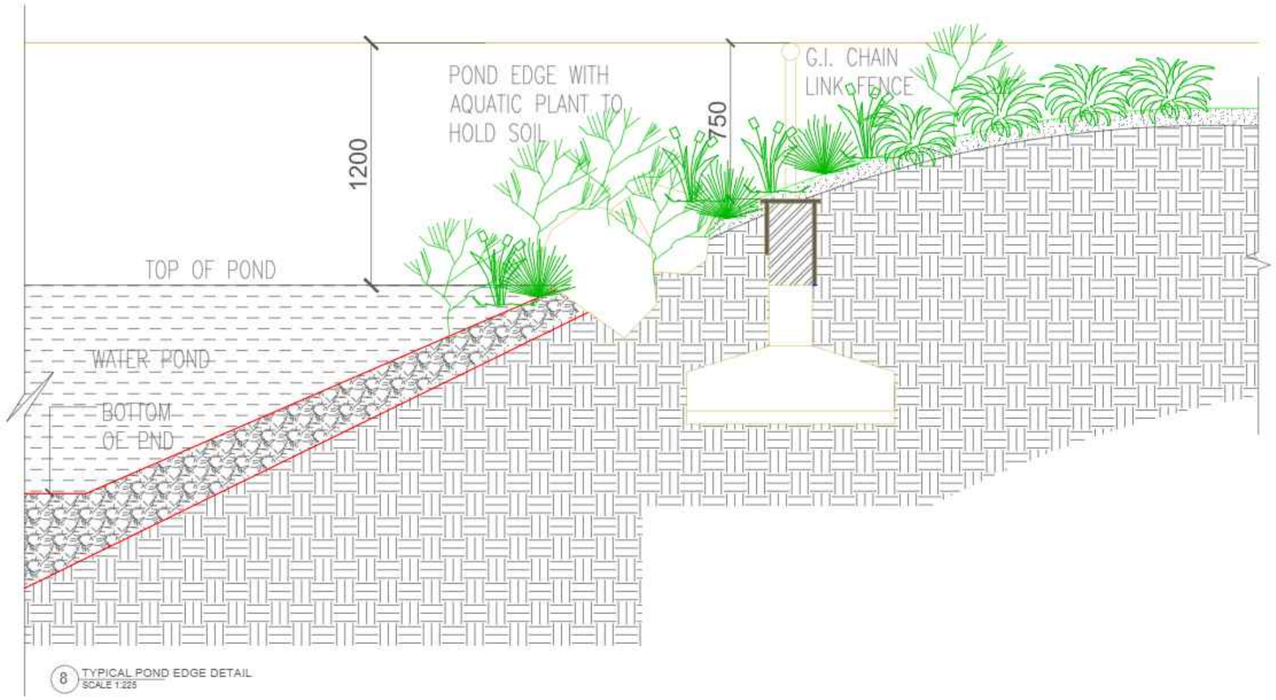
DRAWING TITLE :	CENTRAL GREEN (G-26) _LANDSCAPE DETAIL-2
DRAWING NO :	**VSPL/IPD/2324-066/DPR/LD/11**
GRAPHIC SCALE :	**AS SHOWN**

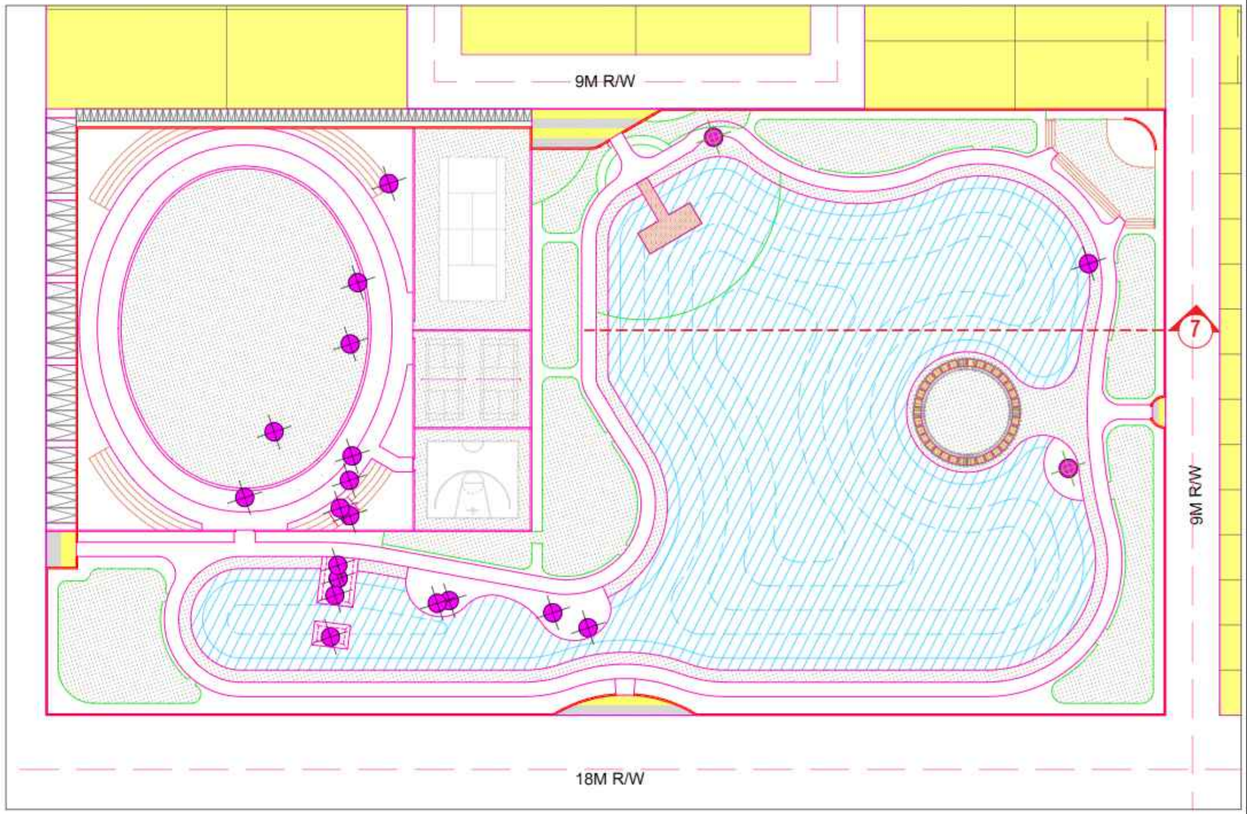
NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DPR/DPR	
Tender Drawing	✓
Revision	R0
Date	FEB.2025

SHEET SIZE A2



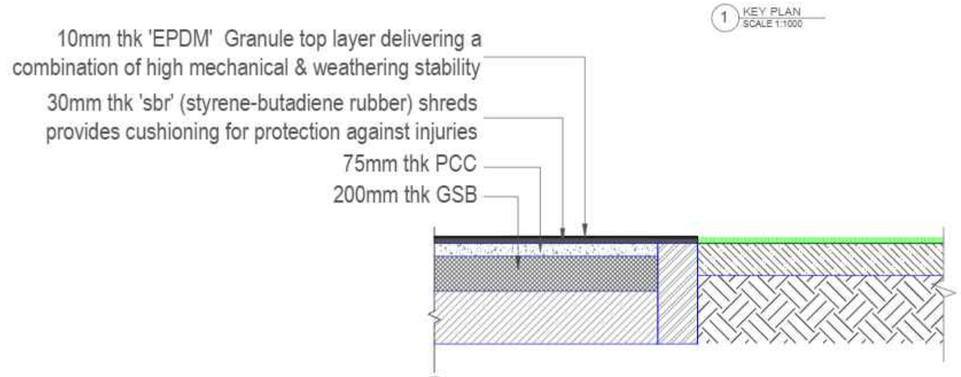
8 TYPICAL POND EDGE DETAIL
SCALE 1:225



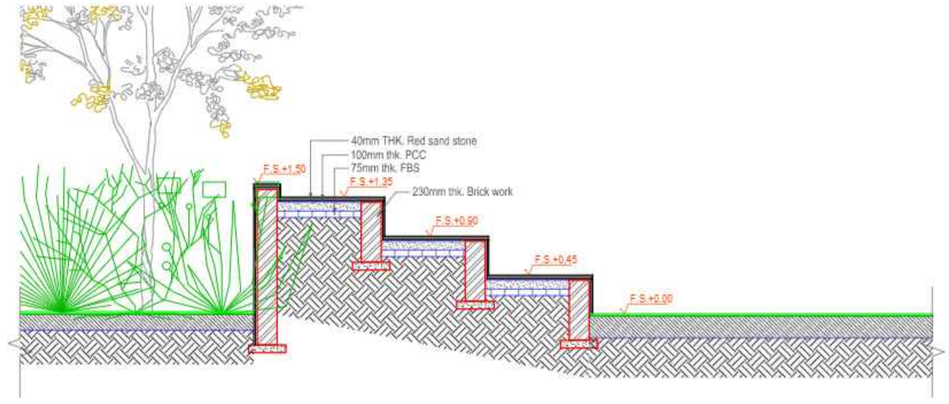
1 KEY PLAN
SCALE 1:1000

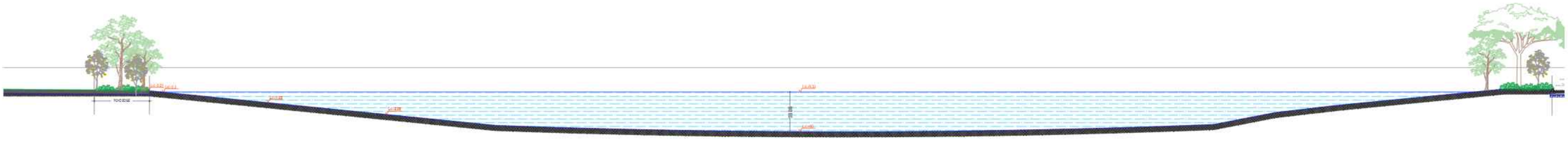
SCIENTIFIC NAME	COMMON NAME
Cyperus papyrus	Papyrus
Colocasia esculenta	Elephant Ear
Ipomoea	Elephant Ear
Vetiveria zizanioides	Vetiver Grass
Pennisetum purpureum	Pennisetum
Cymbopogon citratus	Lemon grass

9 AQUATIC PLANT LIST
SCALE 1:225



10 TYPICAL CHILDREN PLAY COURT DETAIL (EPDM FLOOR)
SCALE 1:225





7 TYPICAL POND SECTION
SCALE 1:225

REVISION BLOCK		
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REV.	DATE	DESCRIPTION

QUALITY ASSURANCE

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Agra, Uttar Pradesh - 282010

CONSULTANT.

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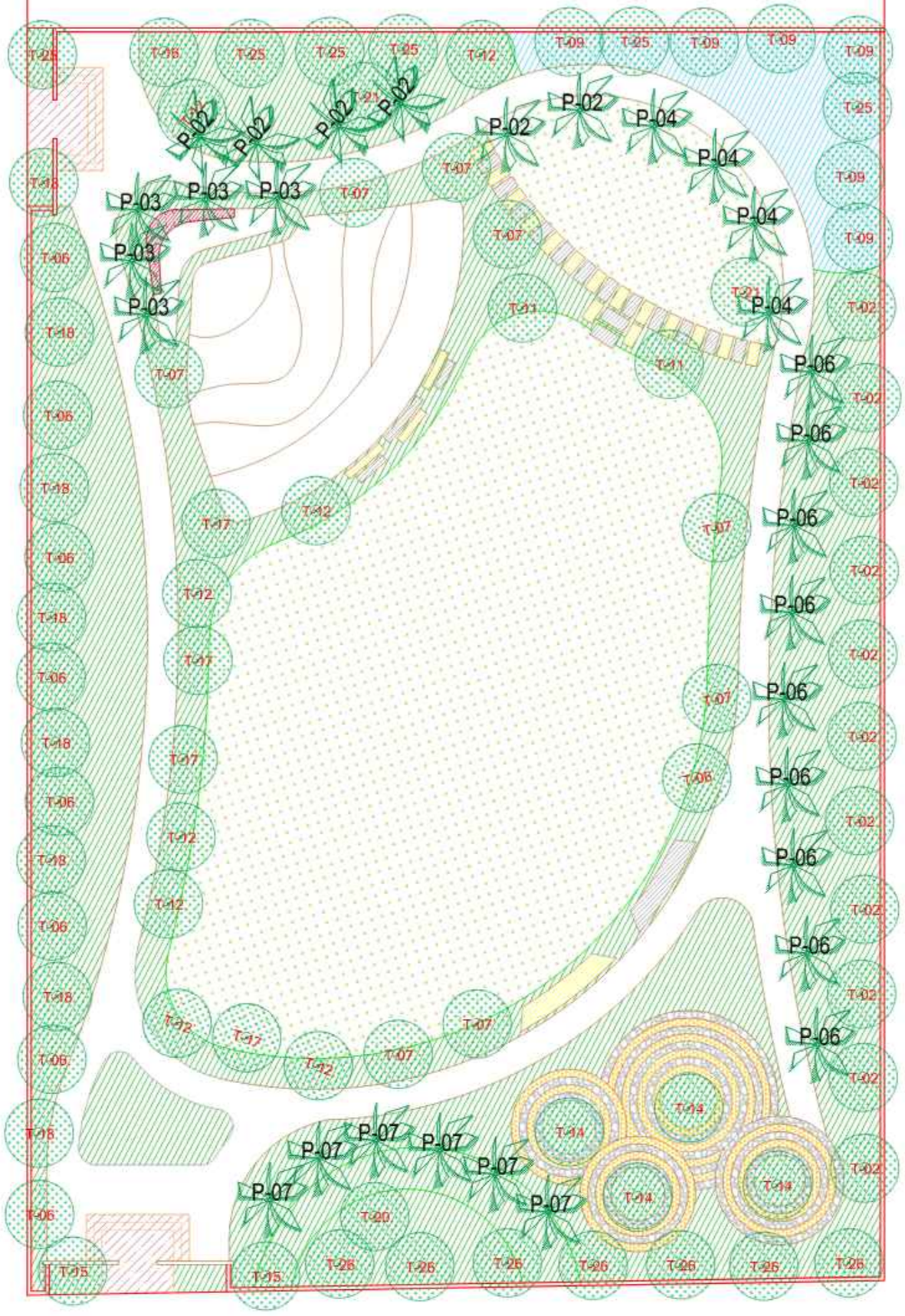
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

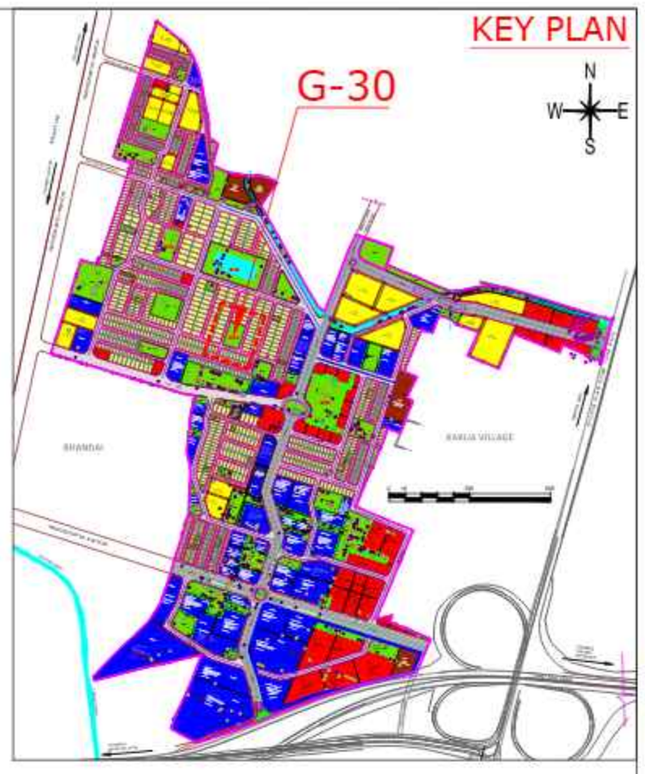
PROJECT TITLE :	PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.
DRAWING TITLE :	CENTRAL GREEN (G-26) _LANDSCAPE DETAIL-3
DRAWING NO :	VSPL/IPD/2324-066/DPR/LD/12
GRAPHIC SCALE :	AS SHOWN

NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DFR/DPR	
Tender Drawing	✓
Revision	R0
Date	FEB.2025

SHEET SIZE A2





LIST OF TREES :

CODE	SYMBOL	SCIENTIFIC NAME	COMMON NAME
BIG TREES			
T-01	T-01	Terminalia mantaly	Saaj Tree
T-02	T-02	Peltophorum pterocarpum	Peela Gulmohar
T-03	T-03	Erythrina indica	Pangara
T-04	T-04	Thevetia peruviana	Pila kaner
T-05	T-05	Cordia sebestena	Bohari
T-06	T-06	Mimusops elengi	Bakul
T-07	T-07	Plumeria alba	White Champa
T-08	T-08	Cassia fistula	Amaltas
T-09	T-09	Tabebuia rosea	Basant rani
T-10	T-10	Polyalthia pendula	Ashok
T-11	T-11	Carissa carandas	Karand
T-12	T-12	Plumeria rubra	Red Champa
T-13	T-13	Spathodea campanulata	Rugtoora
T-14	T-14	Samanea saman	Rain tree
T-15	T-15	Delonix regia	Gulmohar
T-16	T-16	Jacaranda mimosifolia	Nili Gulmohar
T-17	T-17	Bauhinia blakeana	Kachnar
T-18	T-18	Lagerstroemia speciosa	Jarul
T-19	T-19	Callistemon lanceolatus	Bottlebrush
T-20	T-20	Cassia javanica	Pink shower
T-21	T-21	Pongamia pinnata	Karanj
T-22	T-22	Terminalia catappa	Badam
T-23	T-23	Schleichera oleosa	Kusum
T-24	T-24	Ficus benghalensis	Banyan
T-25	T-25	Grevillea robusta	Silver Oak
T-26	T-26	Bombax ceiba	Semal
T-27	T-27	Madhuca longifolia	Mahua
T-28	T-28	Ficus religiosa	Peepal

LIST OF PALMS :

CODE	SYMBOL	SCIENTIFIC NAME	COMMON NAME
BIG TREES			
P-01	P-01	Areca catechu	Puga / Supari
P-02	P-02	Veitchia merrillii	Christmas palm
P-03	P-03	Caryota mitis	Fishtail palm
P-04	P-04	Bismarckia nobilis	Norvisnee
P-05	P-05	Cocos nucifera	Nariyal
P-06	P-06	Wodyetia bifurcata	Foxtail palm
P-07	P-07	Dictyosperma album	Hurricane Palm
P-08	P-08	Roystonea regia	Royal palm
P-09	P-09	Hyophorbe lagenicaulis	Bottle palm

LIST OF AQUATIC PLANTS :

CODE	SYMBOL	SCIENTIFIC NAME	COMMON NAME
A-Cp		Cyperus papyrus	Papyrus
A-Ce		Colocasia esculenta	Elephant Ear
A-Ip		Ipomoea	Elephant Ear
A-Vz		Vetiveria zizanioides	Vetiver Grass
A-Pp		Pennisetum purpureum	Pennisetum
A-Cc		Cymbopogon citratus	Lemon grass

REVISION BLOCK

REV.	DATE	DESCRIPTION
5		
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0		

QUALITY ASSURANCE

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CLIENT :
Agra Development Authority ADA
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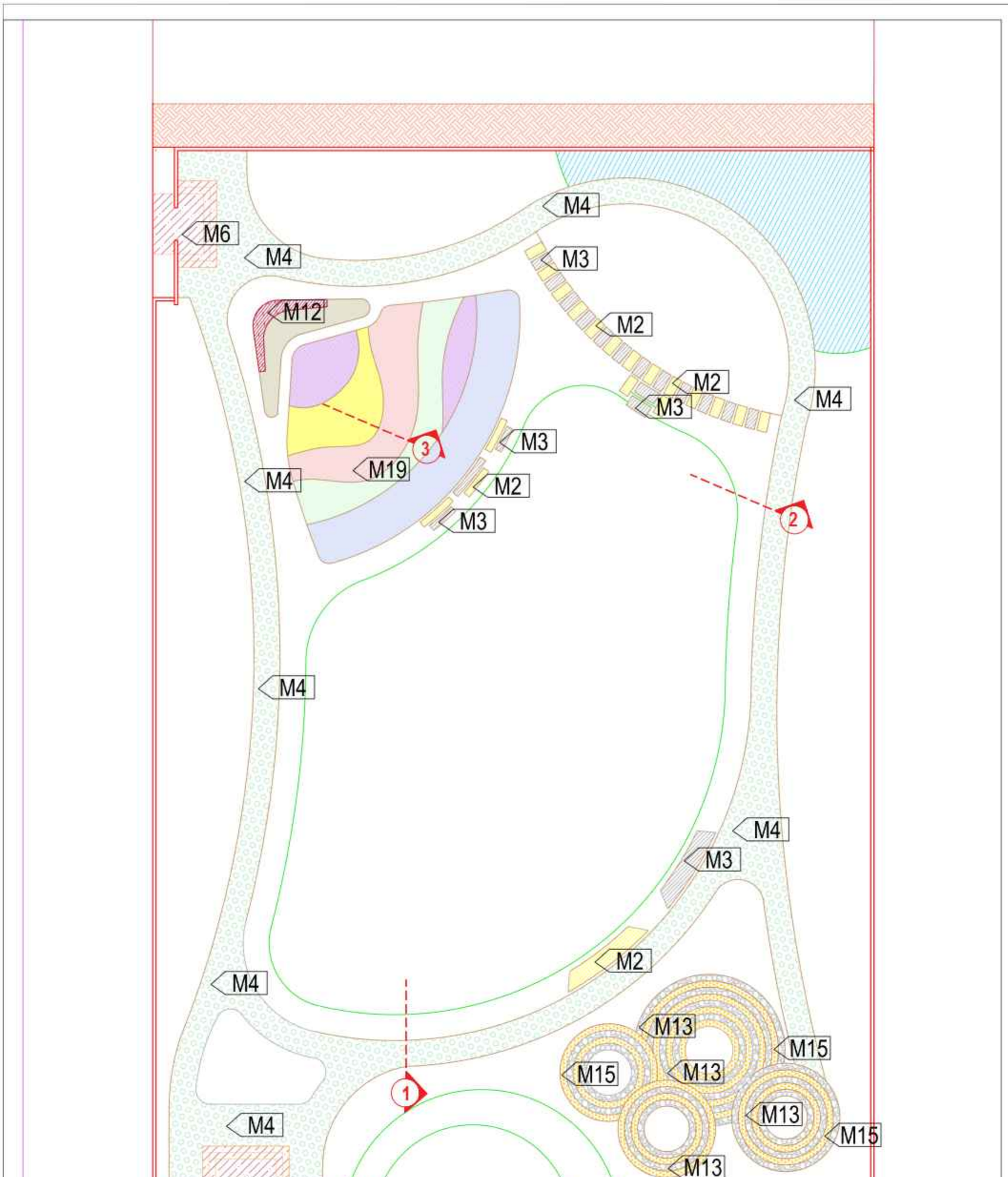
CONSULTANT.
Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE :	PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.
DRAWING TITLE :	POCKET PARK (G-30) _TREE PLAN
DRAWING NO :	VSPL/IPD/2324-066/DPR/TP/13
GRAPHIC SCALE :	0 2 4 6 8 10 M

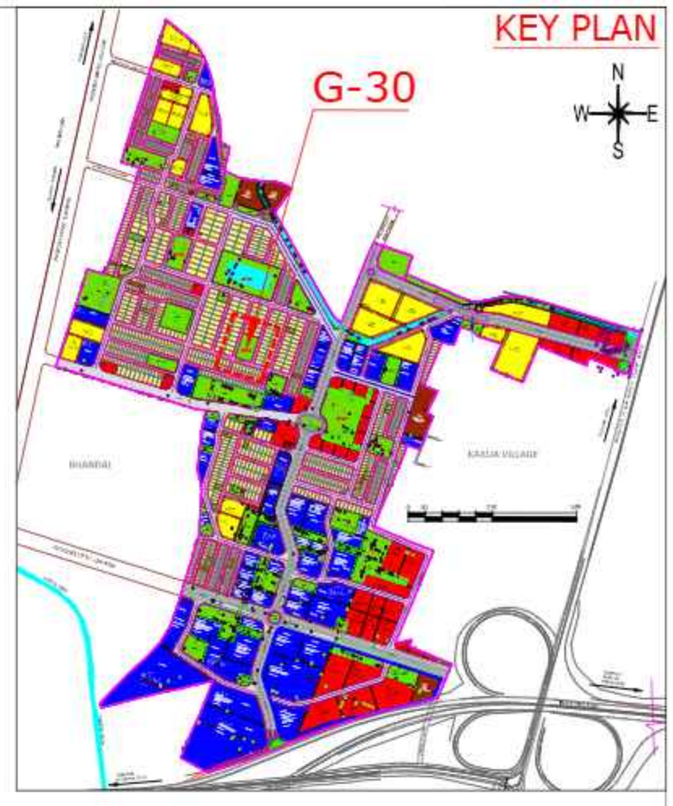
NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DPR/DPR	
Tender Drawing	✓
Revision	R0
Date	FEB. 2025

SHEET SIZE A2

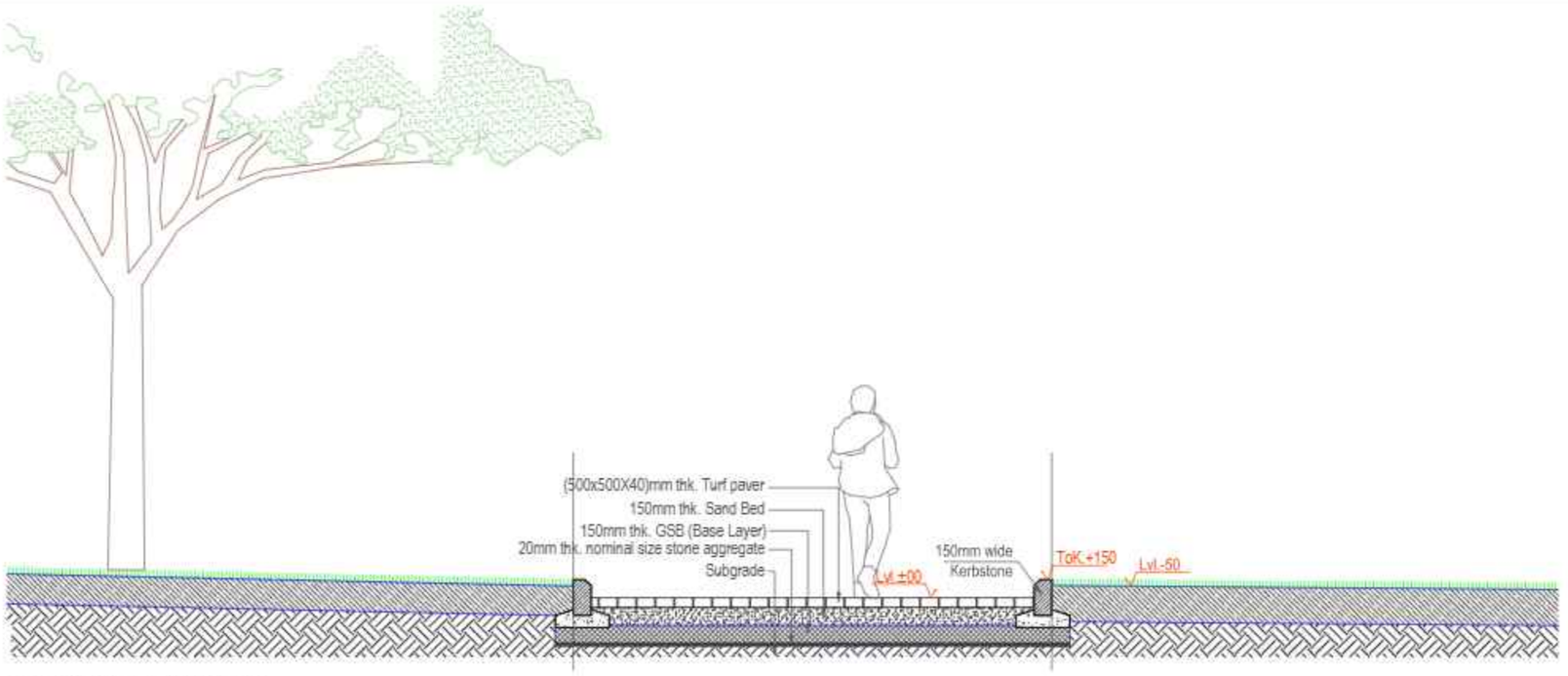


1 Material Plan
SCALE 1:250

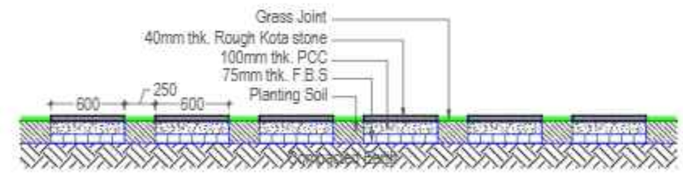


MATERIAL CHART

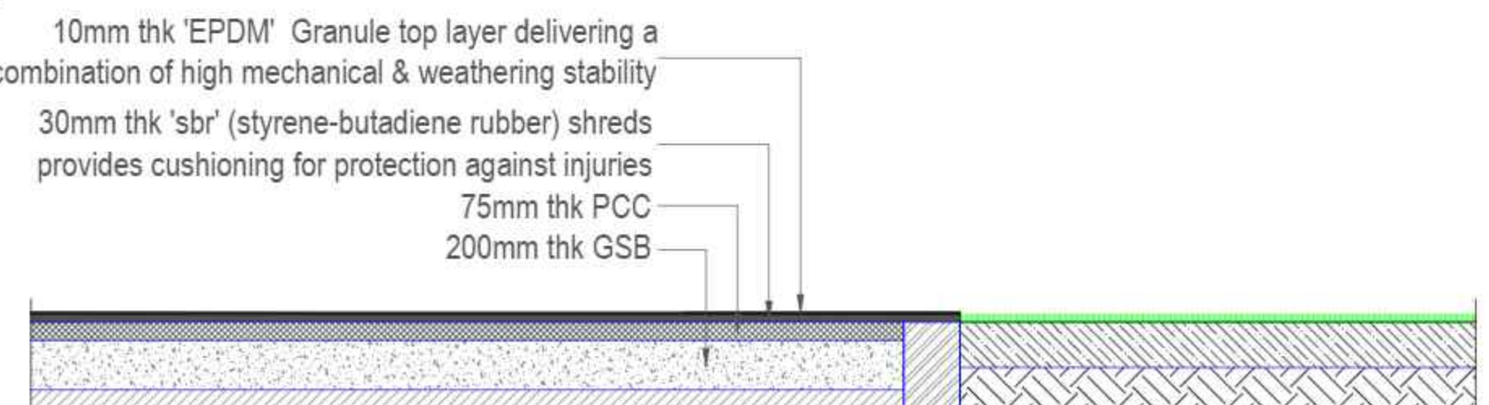
CODE	AREA	SYM.	MATERIAL	COLOUR	SIZE
DRIVEWAY					
M1			KERB STONE		
PATHWAY, STEPPING STONES & PARKING					
M2	PARKS / GARDEN		ROUGH KOTA STONE	HONEY	40MM THK.
M3	PARKS / GARDEN		PEARL GREY GRANITE	PEARL GREY	40MM THK.
M4	PATHWAY		CONCRETE GRASS PAVER		75MM THK.
M5	CYCLE TRACK		MURRAM		
SPORTS SEATING					
M6	COPING & CLADDING		RED SAND STONE	RED	40MM THK.
FOUNTAIN INTERNAL CLADDING					
M7			GLASS MOSAIC TILES AS/ SPEC		
COPING AND CLADDING					
M8	COPING		POLISHED STEEL GREY GRANITE	GREY	40MM THK.
SPORTS & CHILDREN'S PLAY AREA					
M9	SPORTS AREA		RUBBERISED FLOORING		A per Vendor
M10	FENCE		CHAINLIKE WIRE NETTING		
M11	CONCRETE FLOOR		PLAY COURT		
VIEWING DECK					
M12	Deck		WPC WOODEN DECK		A per Vendor
PEBBLE					
M13			1.5-2" DIA UNIFORMLY ROUND RIVER WASHED PEBBLES		
M14	PATHWAY THROUGHOUT THE SITE		LIGHT GREY CONC. PAVERS	GREY	60MM THK.
M15			ROUGH COBBLE STONE	CHARCOAL GREY	



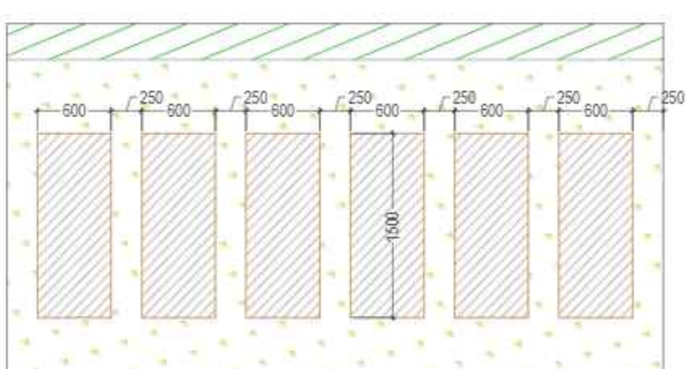
2 TYPICAL PATHWAY DETAIL
SCALE 1:50



4 TYPICAL STEPPING STONE DETAIL
SCALE 1:50



3 TYPICAL KIDS PLAY AREA DETAIL (EPDM MAT)
SCALE 1:50



A TYPICAL STEPPING STONE LAYOUT
SCALE 1:50

REVISION BLOCK			QUALITY ASSURANCE			
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency			
4						
3						
2						
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0			S.M	S.M	P.S	S.S.R
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

CLIENT :
Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

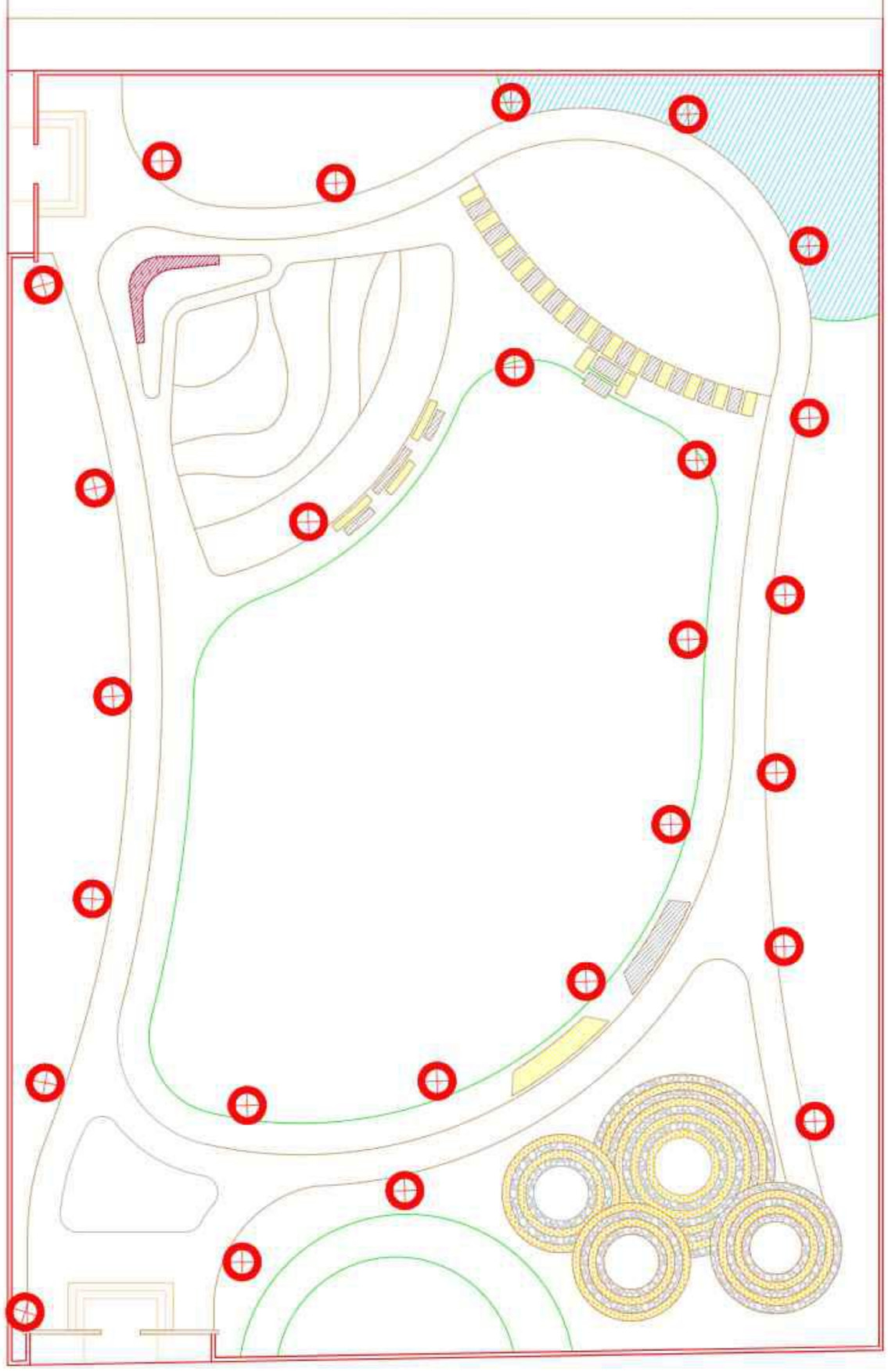
CONSULTANT.
Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

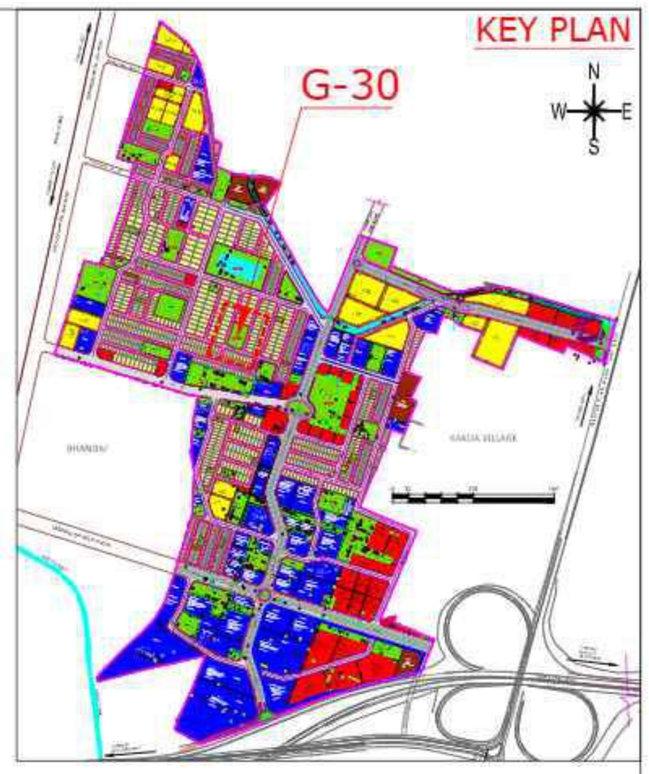
PROJECT TITLE :	PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.
DRAWING TITLE :	POCKET PARK (G-30) _MATERIAL PLAN & SECTION
DRAWING NO :	VSPL/IPD/2324-066/DPR/MPS/14
GRAPHIC SCALE :	0 2 4 6 8 10 M

NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DPR/DPR	
Tender Drawing	✓
Revision	R0
Date	FEB. 2025

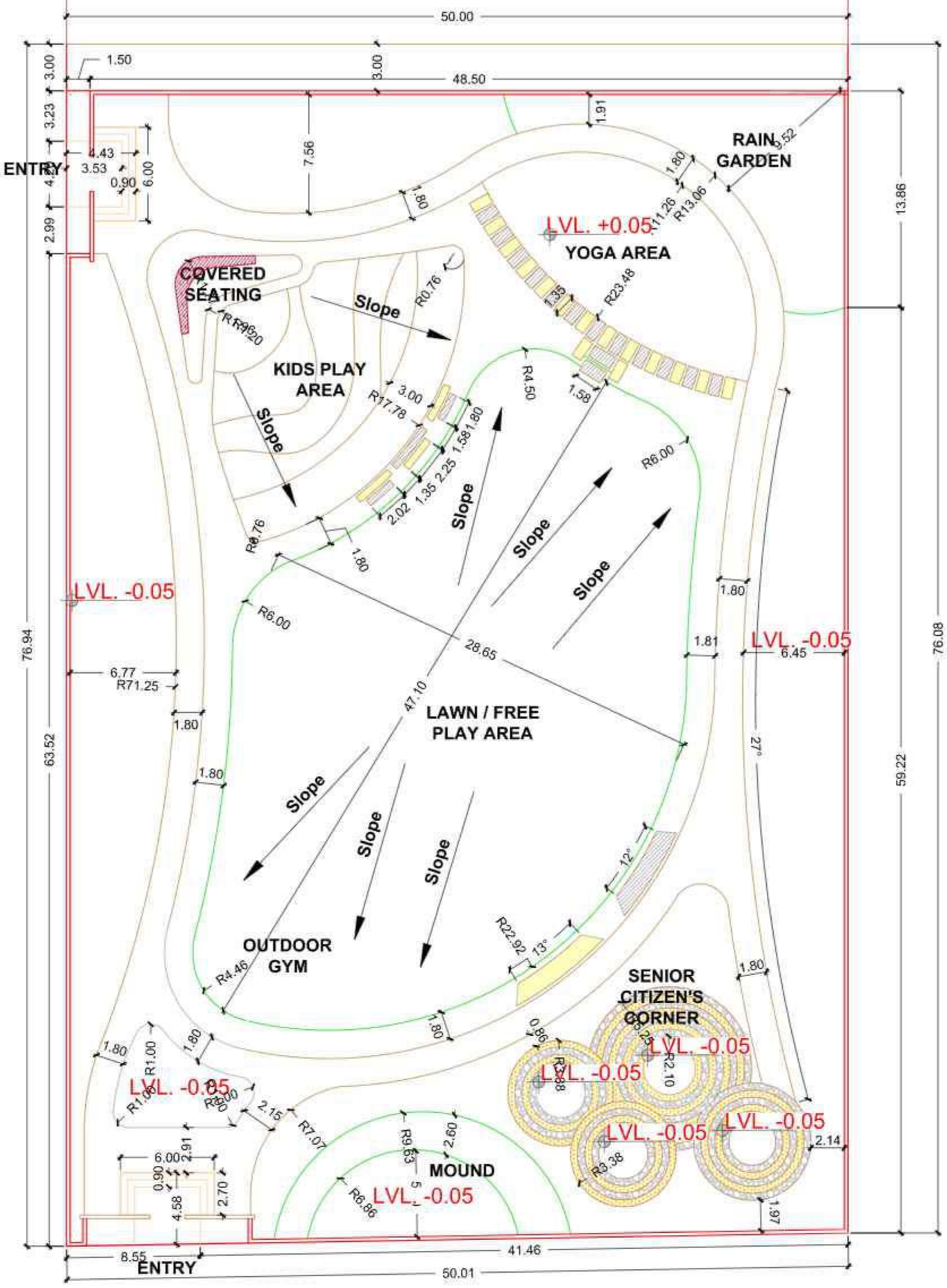
SHEET SIZE A2

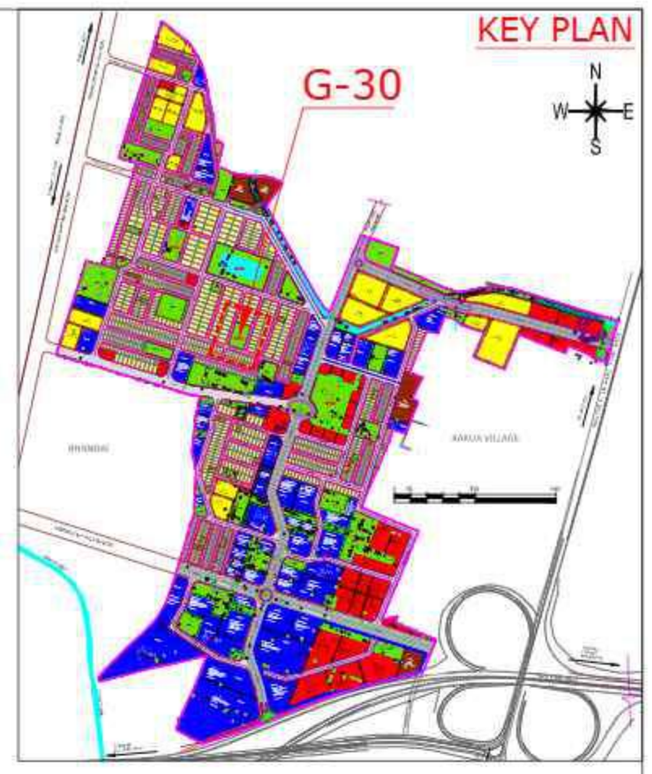




SYMBOL	TYPE OF FIXTURE	HEIGHT IN (M)
⊕	POST TOP LIGHT	6M

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :	PROJECT TITLE :	NOTE : ALL THE DIMENSIONS ARE IN METERS (M)
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010	PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.	
4								DRAWING TITLE : POCKET PARK (G-30) _LIGHTING PLAN	ISSUE RECORD / APPROVED FOR ISSUE
3									Concept /
2								DRAWING NO : VSPL/IPD/2324-066/DPR/LP/15	DPR/DPR /
1							CONSULTANT.		
0			S.H	S.H	P.S	S.S.R	Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.	GRAPHIC SCALE : 0 2 4 6 8 10 M	SHEET SIZE A2 / Tender Drawing ✓
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY			Revision R0 / Date FEB. 2025





REVISION BLOCK			QUALITY ASSURANCE			
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency			
4						
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REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

CLIENT :
Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

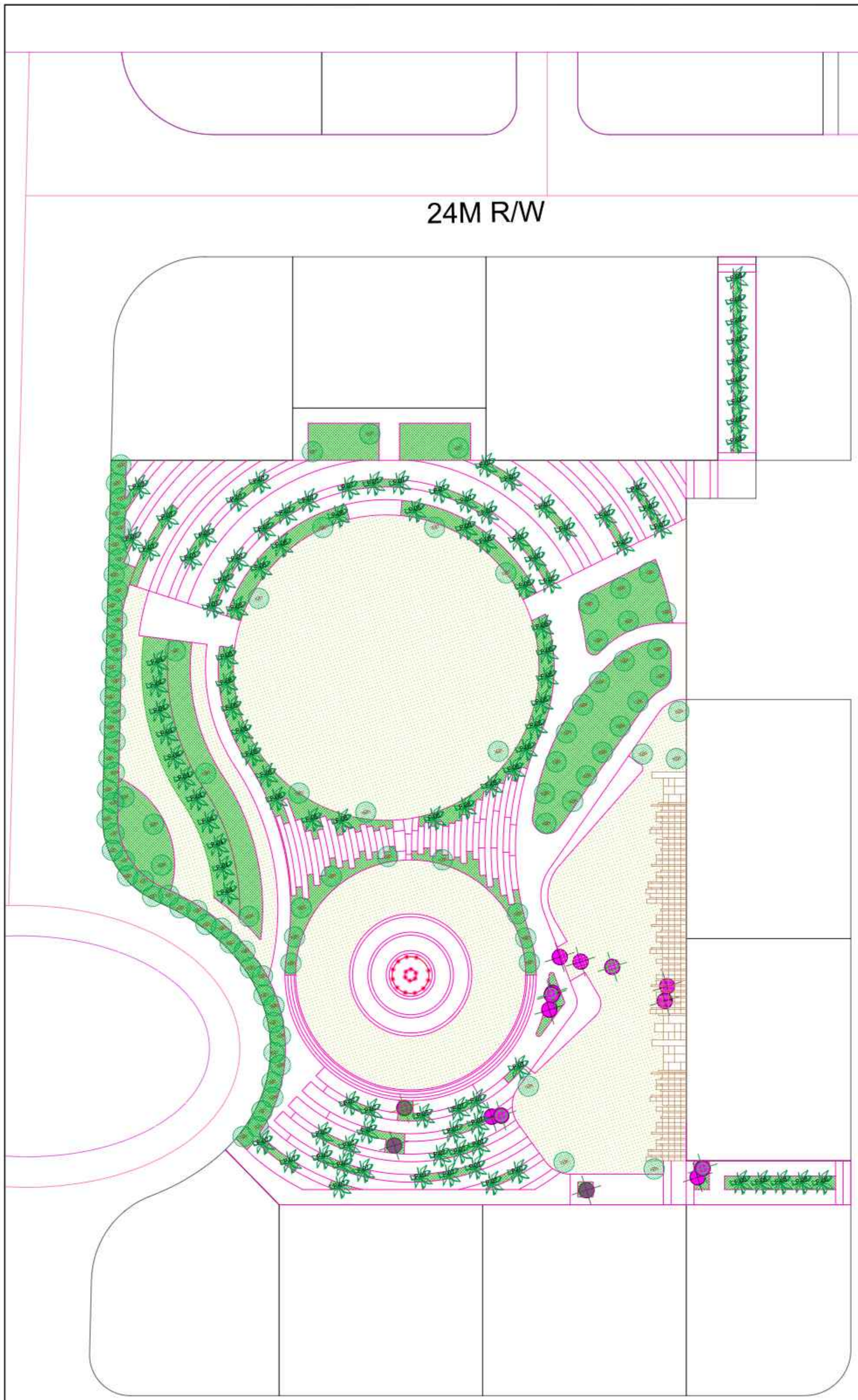
CONSULTANT.
Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

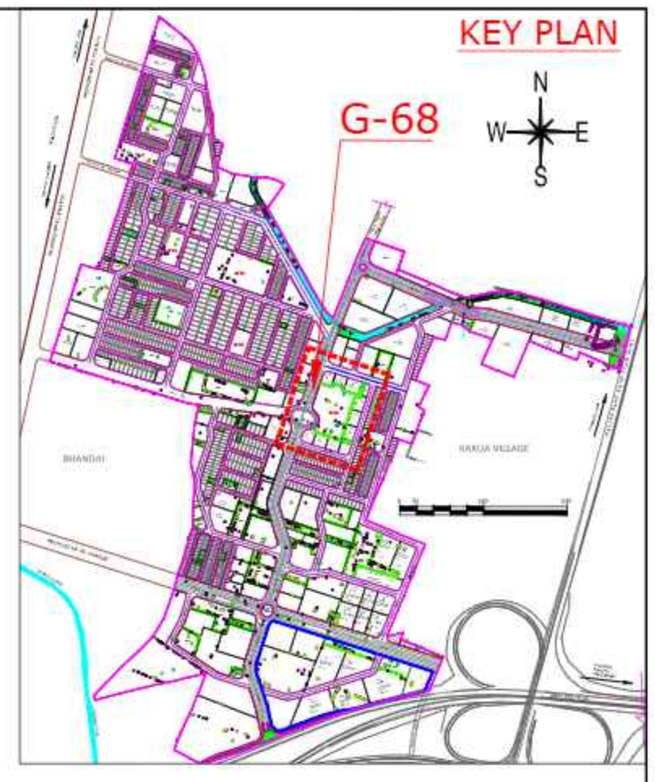
PROJECT TITLE :	PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.
DRAWING TITLE :	POCKET PARK (G-30) _GRADING AND SETTING OUT PLAN
DRAWING NO :	VSPL/IPD/2324-066/DPR/GSP/16
GRAPHIC SCALE :	0 2 4 6 8 10 M

NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DPR/DPR	
Tender Drawing	✓
Revision	R0
Date	FEB. 2025

SHEET SIZE : A2





LIST OF TREES :			
CODE	SYMBOL	SCIENTIFIC NAME	COMMON NAME
BIG TREES			
T-01	T-01	Terminalia mantaly	Saaj Tree
T-02	T-02	Peltophorum pterocarpum	Peela Gulmohar
T-03	T-03	Erythrina indica	Pangara
T-04	T-04	Thevetia peruviana	Pila kaner
T-05	T-05	Cordia sebestena	Bohari
T-06	T-06	Mimusops elengi	Bakul
T-07	T-07	Plumeria alba	White Champa
T-08	T-08	Cassia fistula	Amaltas
T-09	T-09	Tabebuia rosea	Basant rani
T-10	T-10	Polyalthia pendula	Ashok
T-11	T-11	Carissa carandas	Karand
T-12	T-12	Plumeria rubra	Red Champa
T-13	T-13	Spathodea campanulata	Rugtoora
T-14	T-14	Samanea saman	Rain tree
T-15	T-15	Delonix regia	Gulmohar
T-16	T-16	Jacaranda mimosifolia	Nili Gulmohar
T-17	T-17	Bauhinia blakeana	Kachnar
T-18	T-18	Lagerstroemia speciosa	Jarul
T-19	T-19	Callistemon lanceolatus	Bottlebrush
T-20	T-20	Cassia javanica	Pink shower
T-21	T-21	Pongamia pinnata	Karanj
T-22	T-22	Terminalia catappa	Badam
T-23	T-23	Schleichera oleosa	Kusum
T-24	T-24	Ficus benghalensis	Banyan
T-25	T-25	Grevillea robusta	Silver Oak
T-26	T-26	Bombax ceiba	Semal
T-27	T-27	Madhuca longifolia	Mahua
T-28	T-28	Ficus religiosa	Peepal

LIST OF PALMS :			
CODE	SYMBOL	SCIENTIFIC NAME	COMMON NAME
BIG TREES			
P-01	P-01	Areca catechu	Puga / Supari
P-02	P-02	Veitchia merrillii	Christmas palm
P-03	P-03	Caryota mitis	Fishtail palm
P-04	P-04	Bismarckia nobilis	Norvisnee
P-05	P-05	Cocos nucifera	Nariyal
P-06	P-06	Wodyetia bifurcata	Foxtail palm
P-07	P-07	Dictyosperma album	Hurricane Palm
P-08	P-08	Roystonea regia	Royal palm
P-09	P-09	Hyophorbe lagenicaulis	Bottle palm

REVISION BLOCK

REV.	DATE	DESCRIPTION
5		
4		
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QUALITY ASSURANCE

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DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY
S.M	S.M	P.S	S.S.R

CLIENT :

Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT.

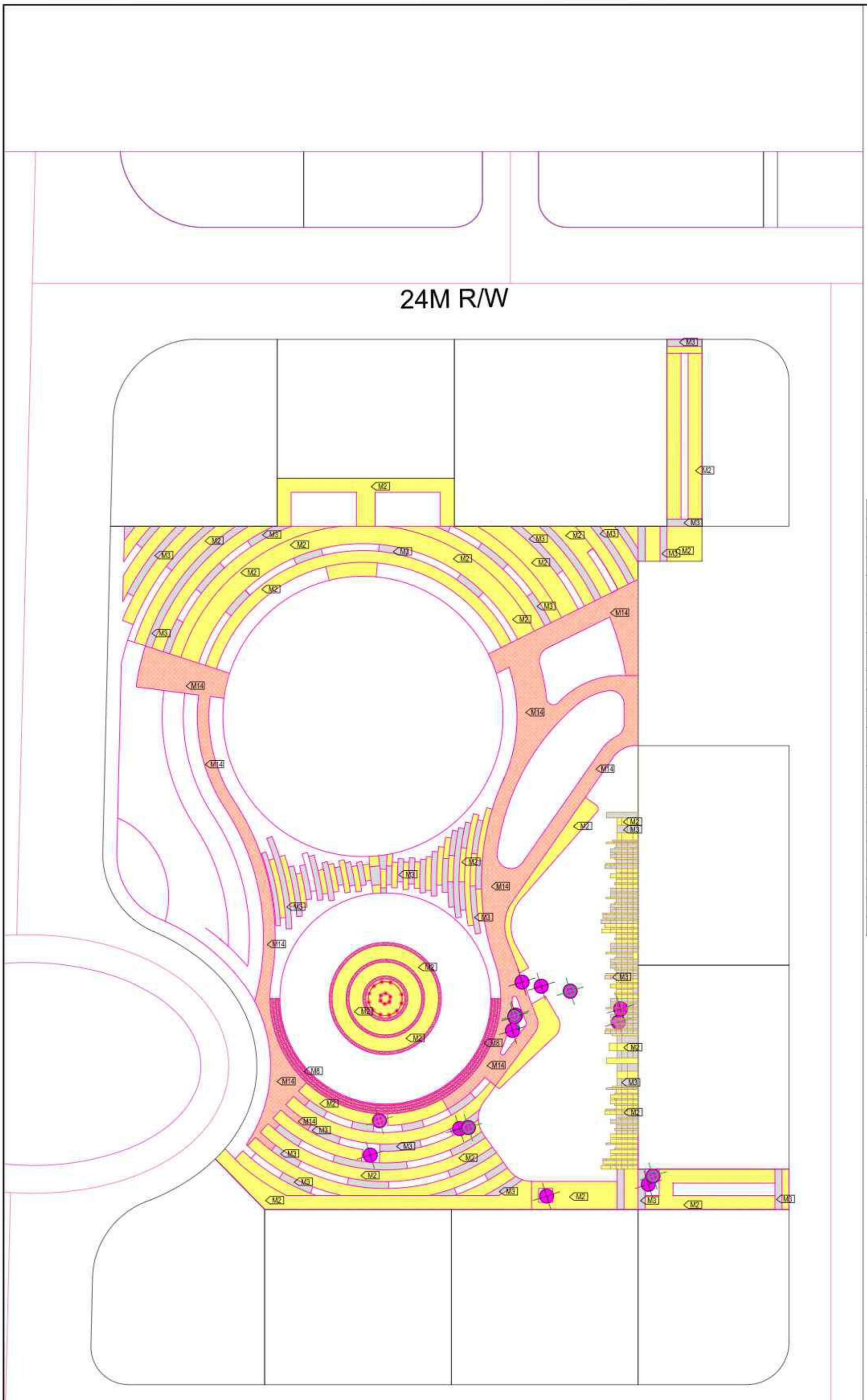
Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE :	PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.
DRAWING TITLE :	CENTRAL PLAZA_(G-68)_TREE PLAN
DRAWING NO :	VSPL/IPD/2324-066/DPR/TP/17
GRAPHIC SCALE :	0 3 15 30M

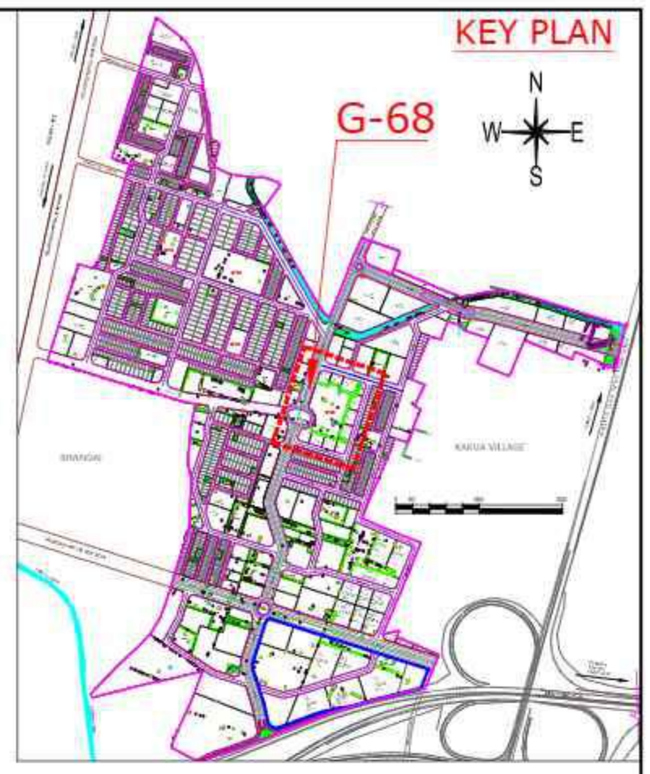
NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DPR/DPR	
Tender Drawing	✓
Revision	R0
Date	FEB. 2025

SHEET SIZE : A2



KEY PLAN



MATERIAL CHART

CODE	AREA	SYM.	MATERIAL	COLOUR	SIZE
DRIVEWAY					
M1			KERB STONE		
PATHWAY, STEPPING STONES & PARKING					
M2	PARKS / GARDEN		ROUGH KOTA STONE	HONEY	40MM THK.
M3	PARKS / GARDEN		PEARL GREY GRANITE	PEARL GREY	40MM THK.
M4	PATHWAY		CONCRETE GRASS PAVER		75MM THK.
M5	CYCLE TRACK		MURRAM		
SPORTS SEATING					
M6	COPING & CLADDING		RED SAND STONE	RED	40MM THK.
FOUNTAIN INTERNAL CLADDING					
M7			GLASS MOSAIC TILES AS/ SPEC		
COPING AND CLADDING					
M8	COPING		POLISHED STEEL GREY GRANITE	GREY	40MM THK.
SPORTS & CHILDREN'S PLAY AREA					
M9	SPORTS AREA		RUBBERISED FLOORING		A per Vendor
M10	FENCE		CHAINLIKE WIRE NETTING		
M11	CONCRETE FLOOR		PLAY COURT		
VIEWING DECK					
M12	Deck		WPC WOODEN DECK		A per Vendor
PEBBLE					
M13			1.5-2" DIA UNIFORMLY ROUND RIVER WASHED PEBBLES		
M14	PATHWAY THROU-GHOUT THE SITE		LIGHT GREY CONC. PAVERS	GREY	60MM THK.

REVISION BLOCK			QUALITY ASSURANCE			
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0			S.M	S.M	P.S	S.S.R
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

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Agra, Uttar Pradesh - 282010

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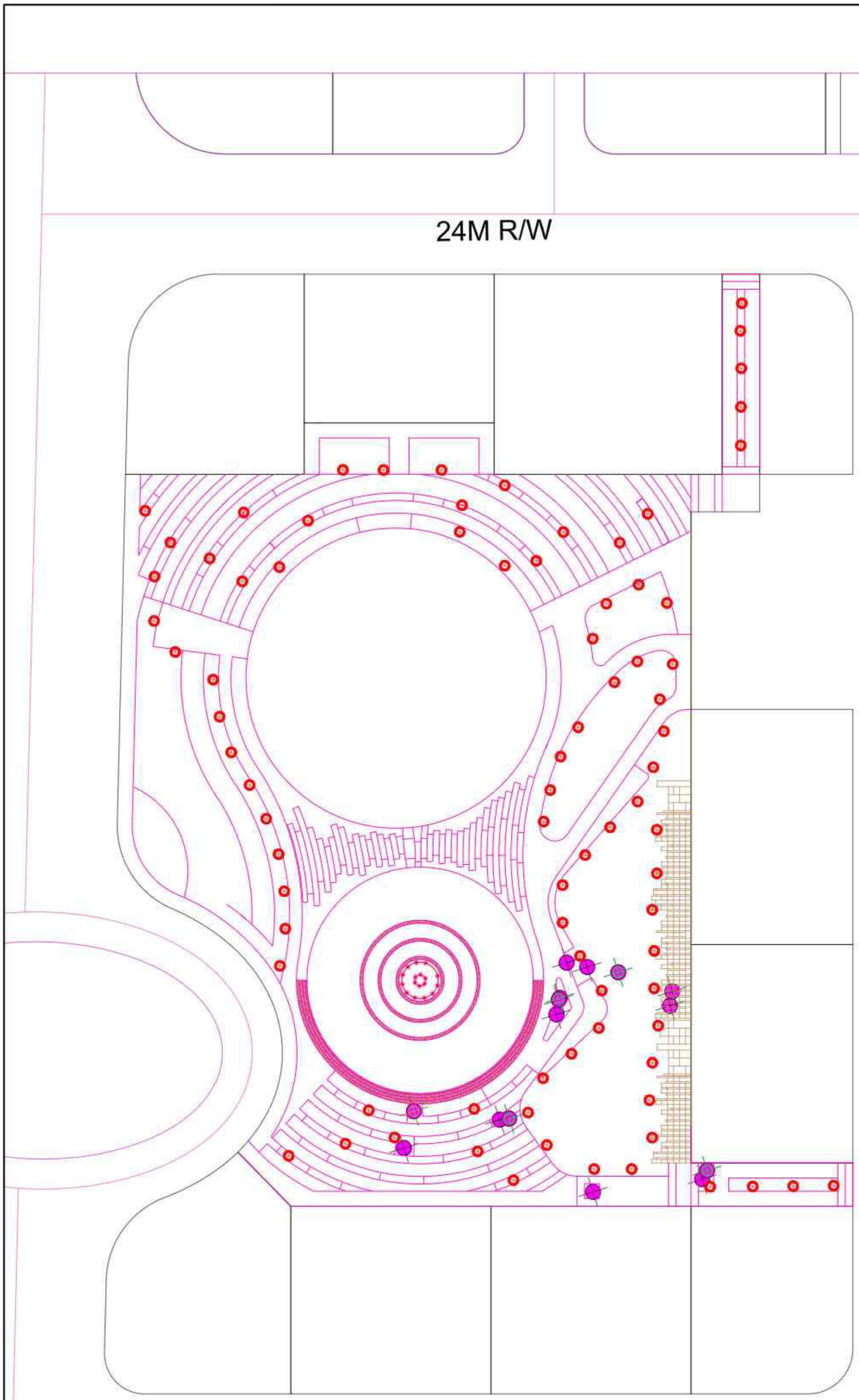
PROJECT TITLE :	PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.
DRAWING TITLE :	CENTRAL PLAZA (G-68)_MATERIAL PLAN
DRAWING NO :	VSPL/IPD/2324-066/DPR/MP/18
GRAPHIC SCALE :	0 5 15 30M

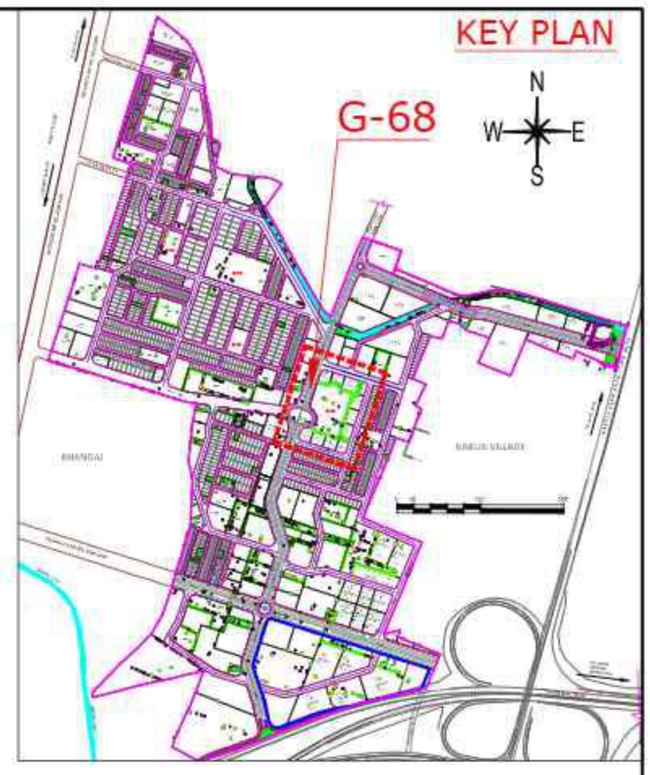
NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

SHEET SIZE : A2	ISSUE RECORD	APPROVED FOR ISSUE
	Concept	
	DPR/DPR	
	Tender Drawing	✓
	Revision	R0
	Date	FEB, 2025

24M R/W



18M R/W



SYMBOL	TYPE OF FIXTURE	HEIGHT IN (M)
	POST TOP LIGHT	7.5M

REVISION BLOCK			
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REV.	DATE	DESCRIPTION	

QUALITY ASSURANCE

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S.H	S.H	P.S	S.S.R
DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

CLIENT :

Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony,
Agra, Uttar Pradesh - 282010

CONSULTANT.

Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE :	PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.
DRAWING TITLE :	CENTRAL PLAZA (G-68)_LIGHTING PLAN
DRAWING NO :	VSPL/IPD/2324-066/DPR/LP/19
GRAPHIC SCALE :	0 5 15 30M

NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

SHEET SIZE	ISSUE RECORD	APPROVED FOR ISSUE
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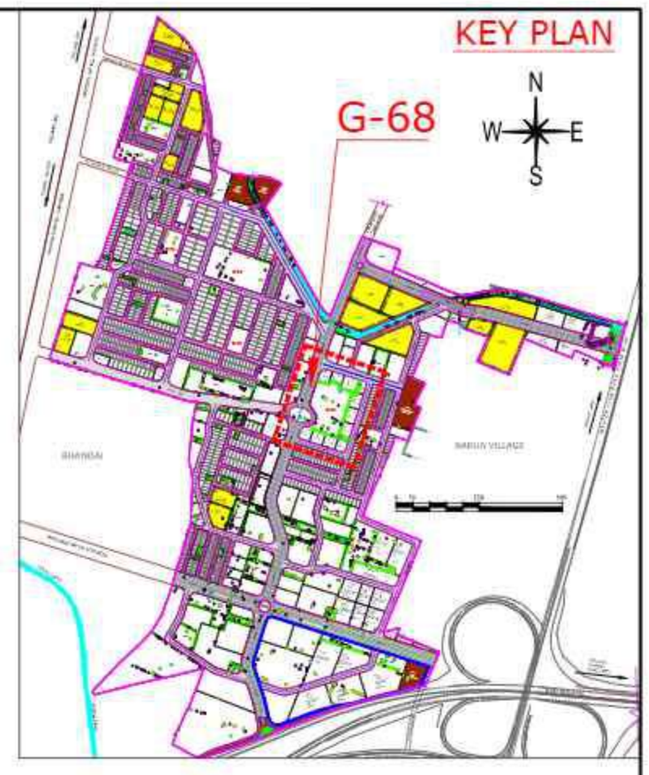
	DPR/DPR	
	Tender Drawing	✓
	Revision	R0
	Date	FEB. 2025



24M R/W

LAWN

Slope

Slope

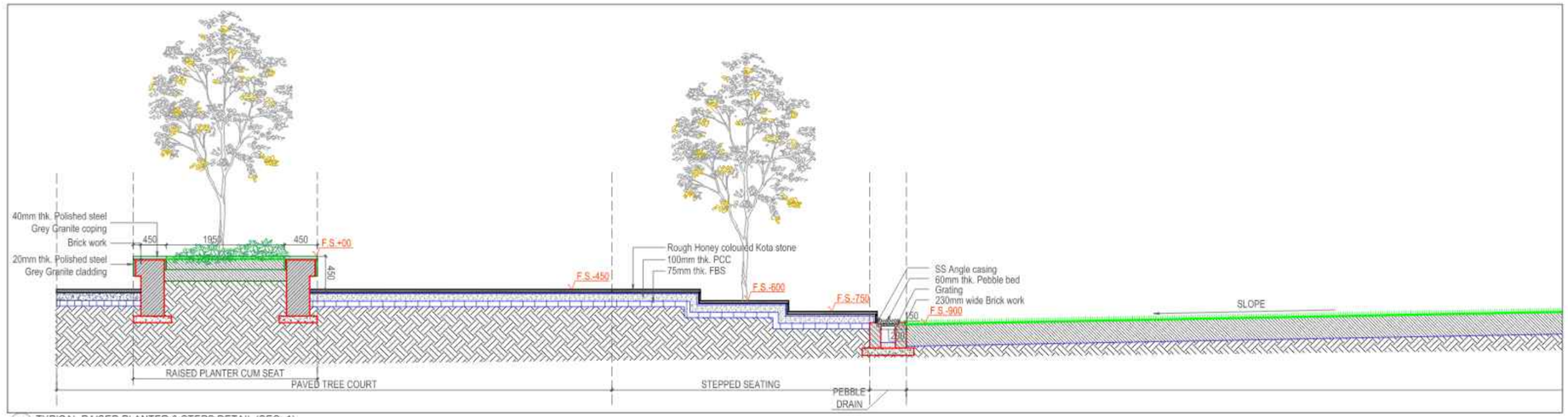
Slope

FOUNTAIN

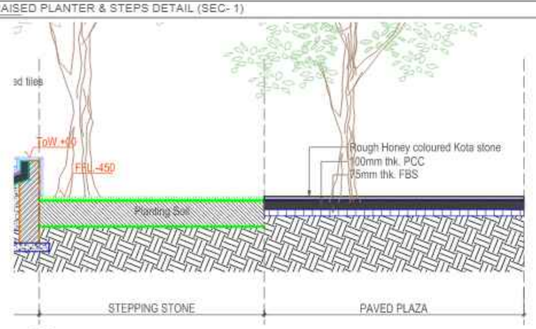
LAWN

18M R/W

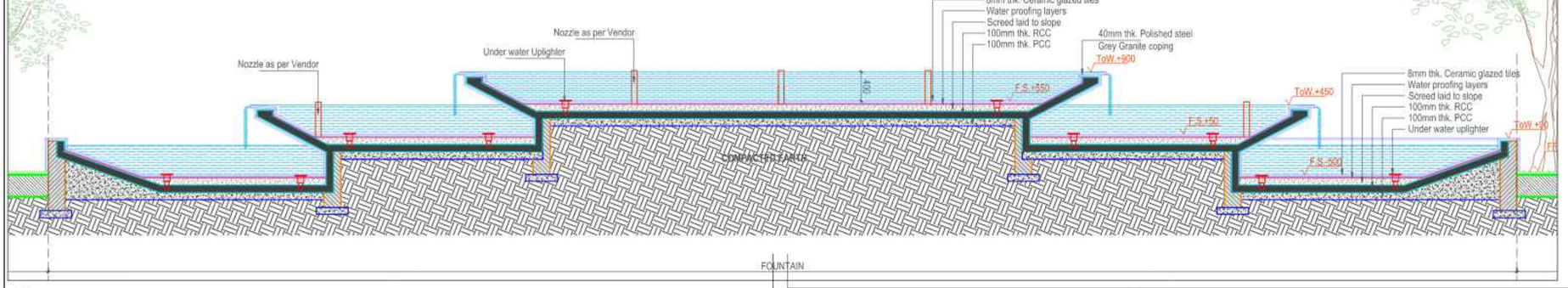
REVISION BLOCK			QUALITY ASSURANCE	CLIENT :	PROJECT TITLE :	PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.	NOTE : ALL THE DIMENSIONS ARE IN METERS (M)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency	Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010	DRAWING TITLE :	CENTRAL PLAZA (G-68)_GRADING AND SETTING OUT PLAN	Issue Record	APPROVED FOR ISSUE
4							Concept	
3				CONSULTANT. Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.	DRAWING NO :	VSPL/IPD/2324-066/DPR/GSP/20	DPR/DPR	
2							Tender Drawing	✓
1					GRAPHIC SCALE :	0 3 15 30M	Revision	R0
0			S.H	S.H	P.S	S.S.R	SHEET SIZE : A2	Date : FEB. 2025
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY		

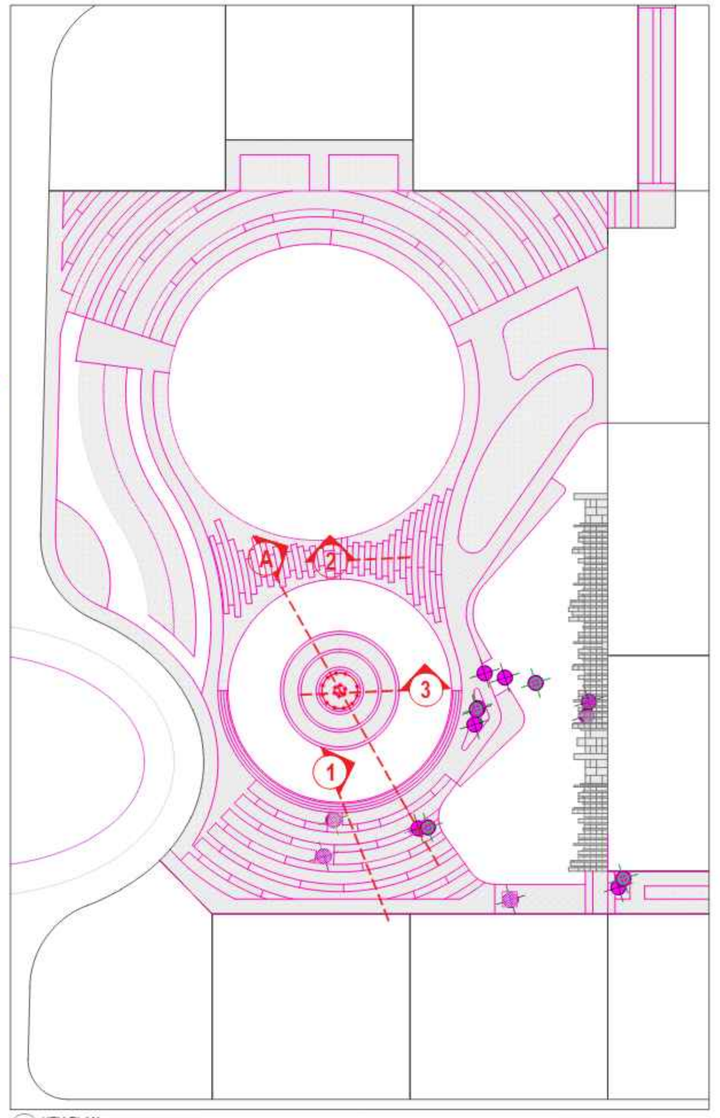


1 TYPICAL RAISED PLANTER & STEPS DETAIL (SEC- 1)
SCALE 1:50



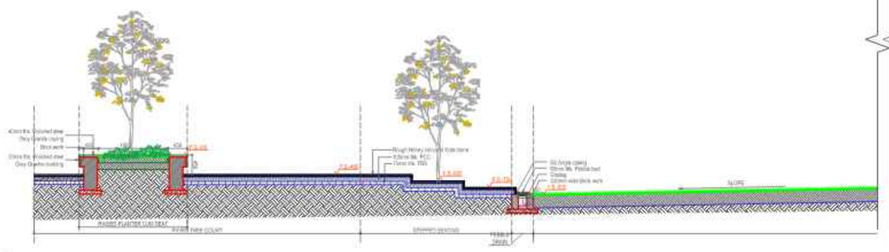
2 TYPICAL STEPPING STONE & PAVED DETAIL (SEC- 2)
SCALE 1:50

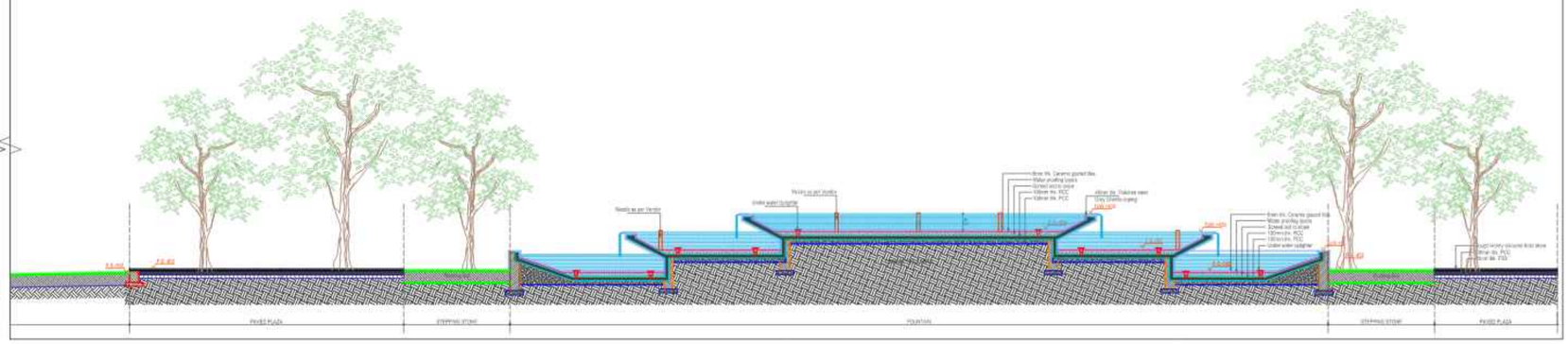




1 KEY PLAN
SCALE 1:1000

3 TYPICAL FOUNTAIN SECTION (SEC- 3)
SCALE 1:50





2 SECTION THROUGH A
SCALE 1:100

REVISION BLOCK

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QUALITY ASSURANCE

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S.H	S.H	P.S	S.S.R

CLIENT :
Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony,
Agra, Uttar Pradesh - 282010

CONSULTANT.
Voyants Solutions Pvt. Ltd.
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NH-8,Gurgaon - 122001,India.

PROJECT TITLE :	PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.
DRAWING TITLE :	CENTRAL PLAZA (G-68)_LANDSCAPE DETAIL
DRAWING NO :	VSPL/IPD/2324-066/DPR/LD/21
GRAPHIC SCALE :	AS SHOWN

NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

SHEET SIZE	ISSUE RECORD	APPROVED FOR ISSUE
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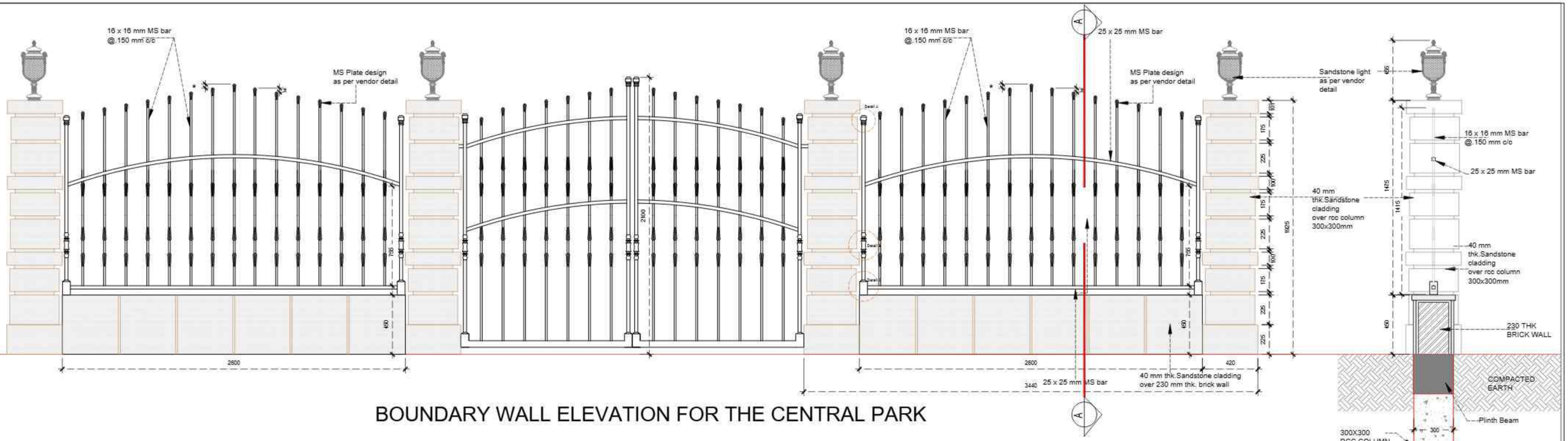
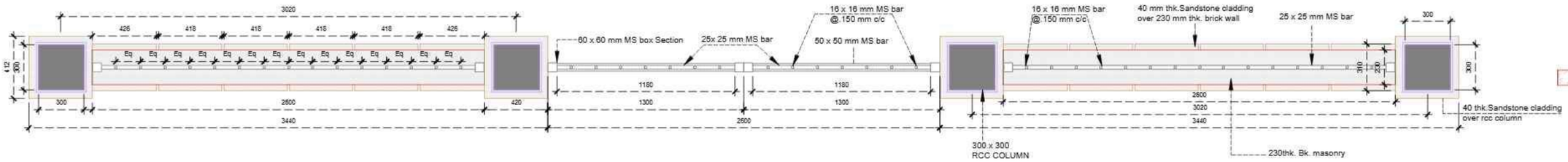
	DPR/DPR	
A2	Tender Drawing	✓
	Revision	R0

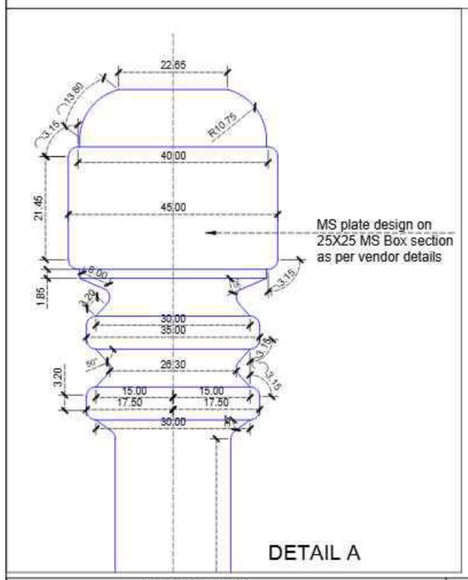


BOUNDARY WALL ELEVATION FOR THE CENTRAL PARK

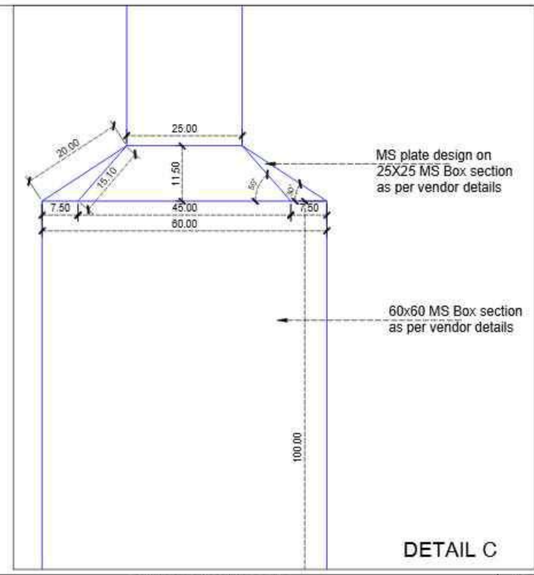
SECTION 'A'



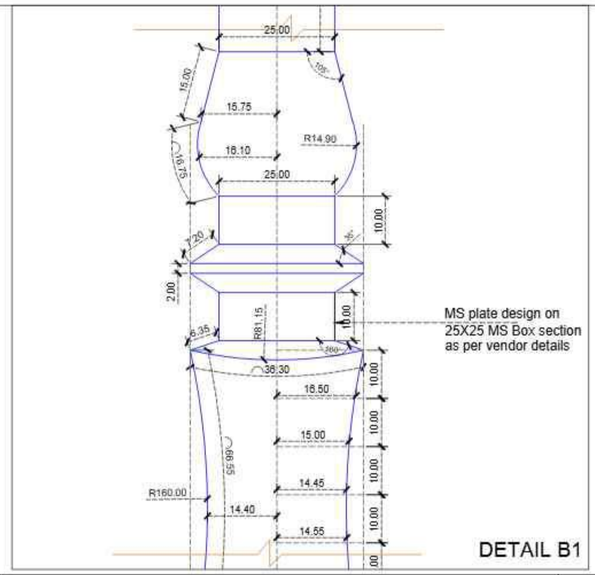
BOUNDARY WALL PLAN FOR THE CENTRAL PARK



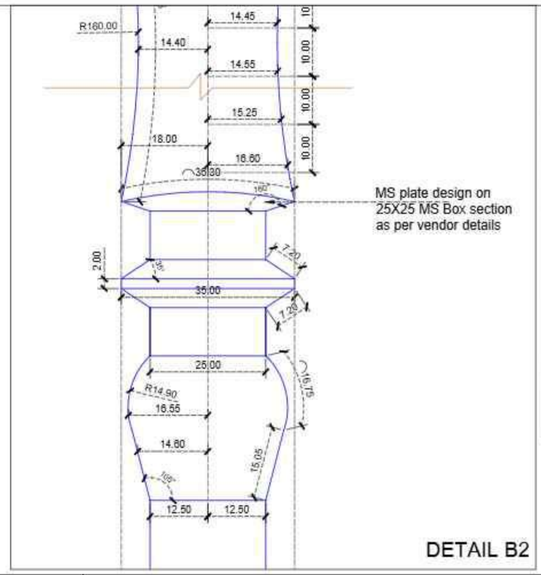
DETAIL A



DETAIL C



DETAIL B1



DETAIL B2

REFERENCE FOR SANDSTONE LIGHT

Note: Red and Yellow sandstone to be used

REVISION BLOCK		
5		
4		
3		
2		
1		
0		
REV.	DATE	DESCRIPTION

QUALITY ASSURANCE

The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency

DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY
S.M	S.M	P.B	S.B.R

CLIENT :

Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT :

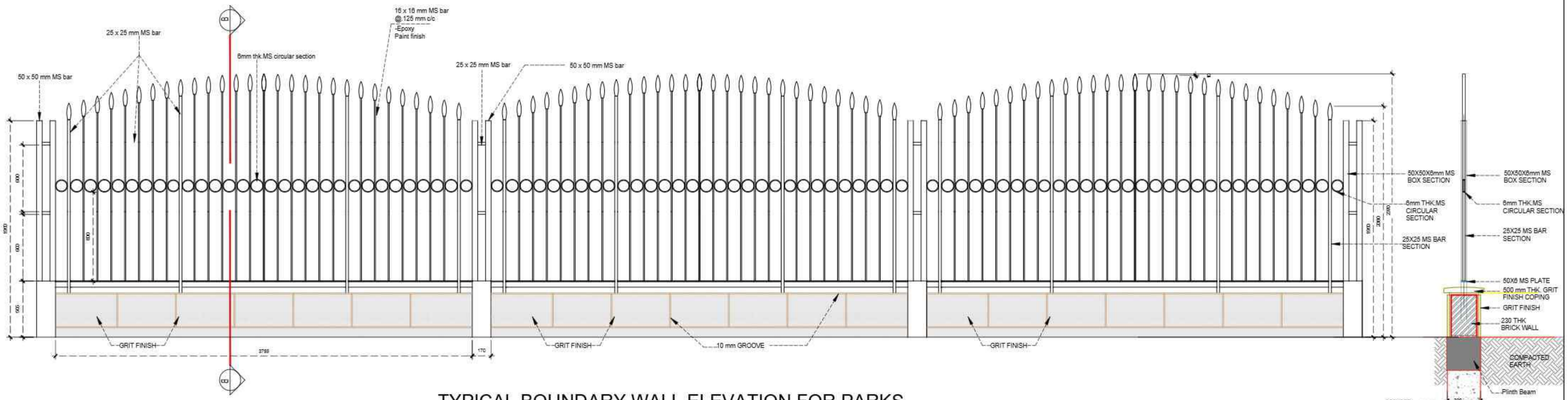
Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE :	**PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.**
DRAWING TITLE :	CENTRAL PARK BOUNDARY WALL- DETAILS
DRAWING NO :	**VSPL/IPD/2324-066/DPR/BWD/22**
GRAPHIC SCALE :	0 25 125 250

NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

ISSUE RECORD	APPROVED FOR ISSUE
Concept	
DFR/DPR	
Tender Drawing	✓
Revision	R0
Date	FEB. 2025

SHEET SIZE A2

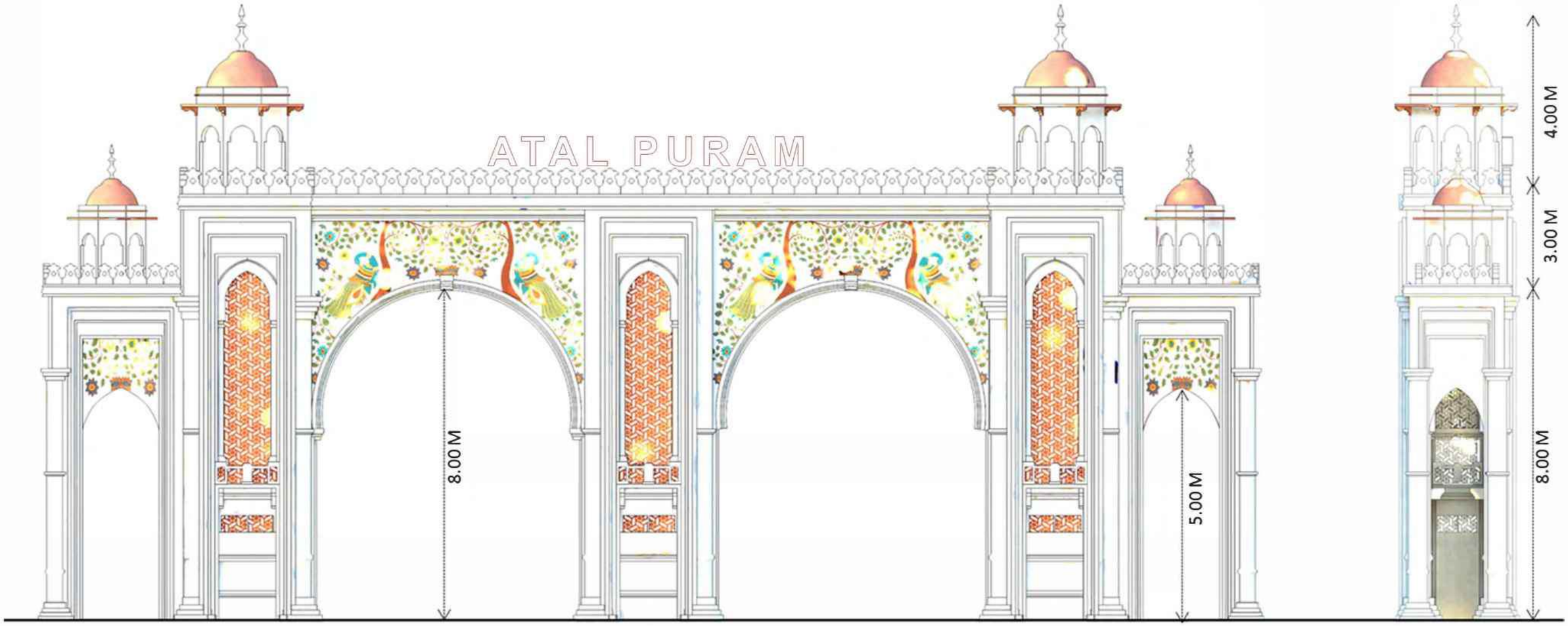


TYPICAL BOUNDARY WALL ELEVATION FOR PARKS

TYPICAL BOUNDARY WALL PLAN FOR PARKS

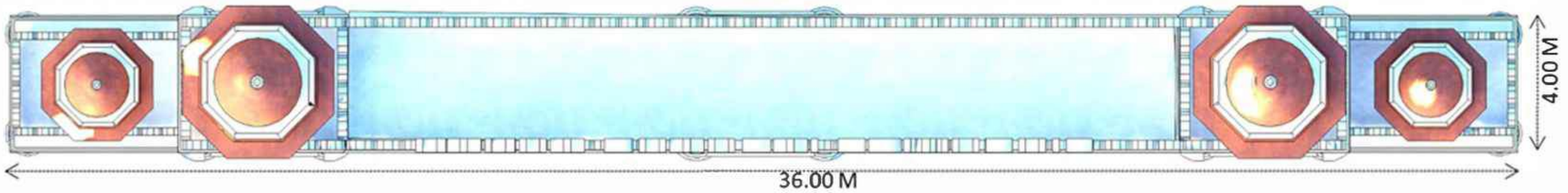
SECTION 'B'

REVISION BLOCK			QUALITY ASSURANCE				CLIENT :		PROJECT TITLE :		NOTE : ALL THE DIMENSIONS ARE IN METERS (M)	
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency				Agra Development Authority ADA Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010		PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA.			
4												
3												
2							CONSULTANT :		DRAWING TITLE :	TYPICAL POCKET PARK BOUNDARY WALL DETAIL		
1							Voyants Solutions Pvt. Ltd. 403, 4th Floor, Park Centra, Sec.-30 NH-8,Gurgaon - 122001,India.		DRAWING NO :	VSPL/IPD/2324-066/DPR/BWD/23		
0			S.M	S.M	P.B	S.B.R			GRAPHIC SCALE :	0 25 125 250	SHEET SIZE A2	
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY					ISSUE RECORD / APPROVED FOR ISSUE	
											Concept	
											DFR/DPR	
											Tender Drawing	✓
											Revision	R0
											Date	FEB. 2025



Front Elevation- Gate 1

Side Elevation



Plan - Gate 1

REVISION BLOCK			QUALITY ASSURANCE			
5			The responsibility of control, check and verification of accuracy, correctness, completeness, integration and full compliance of contract provisions in respect of design analysis and drawings rests with the approving agency			
4			Signature Not Verified			
3			Digitally signed by Rakesh Pratap			
2			Date: 2025.02.22 20:02:23 IST			
1			Location: Uttar Pradesh-UP			
0			S.M	S.M	P.B	S.B.R
REV.	DATE	DESCRIPTION	DRAWN BY	DESIGNED BY	CHECKED BY	APPROVED BY

CLIENT : Agra Development Authority ADA
Ratan Muni Road, Jaipur House, Jaipur House Colony, Agra, Uttar Pradesh - 282010

CONSULTANT : Voyants Solutions Pvt. Ltd.
403, 4th Floor, Park Centra, Sec.-30
NH-8,Gurgaon - 122001,India.

PROJECT TITLE : PREPARATION OF DETAILED LAYOUT PLAN, DETAILED DESIGN AND PROJECT MANAGEMENT OF ALL PROJECT COMPONENTS OF ATAL PURAM TOWNSHIP IN AGRA

DRAWING TITLE : ENTRY GATE 1- DETAIL

DRAWING NO : VSPL/IPD/2324-066/DPR/EG/24

GRAPHIC SCALE : 0 25 125 250

NOTE : ALL THE DIMENSIONS ARE IN METERS (M)

	ISSUE RECORD	APPROVED FOR ISSUE
	Concept	
	DFR/DPR	
SHEET SIZE	Tender Drawing	✓
A2	Revision	R0
	Date	FEB. 2025