



**Agra Smart City Limited
Agra (U.P)**

Tender Document For:-

**Providing 24x7 water supply to ABD area with water meter and SCADA system
under Smart city Mission**

**Agra Smart City Limited (ASCL), Office of Nagar Nigam,
Agra, UP-282001**

FOR THE WORK: Providing 24x7 water supply to ABD area with water meter and SCADA system under Smart city Mission

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**AGRA SMART CITY LIMITED
AGRA**

**COVER-1
TECHNICAL BID**

SECTION 1

**LIST OF IMPORTANT DATES
NOTICE INVITING TENDER**

SECTION I

List of Important Dates of Bids for Construction Related to Project under ASCL

1	Name of Work:	Providing 24x7 water supply to ABD area with water meter and SCADA system under Smart city Mission
2	Completion Period for construction:	AS PER NIT including rainy Season.
3	Date of Issue of Notice Inviting Bid.	26.10.2018
4	Period and Places of Availability of Bidding Documents From:	26.10.2018 To 22.11.2018 Till 17:30 Hrs On line on http://etender.up.nic.in
5	Time, and Date of Pre-bid meeting,	Date: 13.11.2018 Time – 04:00 P.M At Office of Agra Smart City Limited, Agra Nagar Nigam, Agra.
6	Deadline for Receiving Bids online only,	Date 22.11.2018 Time– 05:30 P.M.
7	Time and Date for opening Technical Bid/Bids online,	Date 26.11.2018 Time:- 04.00 PM onwards At Office of Agra Smart City Limited, ASCL, Agra.
8	Time and Date of opening Financial Bids online	Date to be notified after technical evaluation
9	Last Date of Bid Validity	90 days from date of submission of Bid
10	Officer inviting Bids	Office of the Chief Executive Officer, Agra Smart City Limited, Agra

Notice Inviting Tender

No- 03/ ASCL/Water Supply /Oct-18

Dated 27.10.2018

1. The **CEO, Agra Smart City Limited, Agra** on behalf of Government of Uttar Pradesh invites the Item rate bids online from the eligible and approved Contractors registered with UP PWD and other state government department, class 'A', **The Bidder may submit bids for any or all of the works. Bidders are advised to note the minimum qualification criteria specified in Clause 4 of the Instructions to Bidders to qualify for the award of the contract.**

2.

S N	Name of Work	Estimated cost (Rs)	EMD (Rs)	Cost of Document (in Rs.)	Address of the Executing the work
1	2	3	4	5	6
1.	Providing 24x7 water supply to ABD area with water meter and SCADA system under Smart city Mission	142,53,63,000.00	2,51,16,520.00	Rs.5,000 +18% GST	ABD area under Smart City Mission, Agra

3. **Time allowed for completion of Whole work is 24 Month, including rainy season.**
4. The bids shall remain valid for acceptance for a period of **THREE MONTHS** days from the last date of submission of Bids. Bids once submitted cannot be withdrawn.
5. Bids must be accompanied by non-refundable fee as indicated in Column 5 of the above table, in the form of **Demand Draft on any Schedule bank, for amount indicated in favour of "Chief Executive Officer, Agra Smart City Limited, Agra" payable at Agra. A set of bidding documents (SBD) will be available online on website <http://etender.up.nic.in>.**
6. Bids must be submitted online on or before **05:30 PM on dated 22.11.2018** and the technical bids will be opened online, dated **26.11.2018 at 04:00 PM**. If the office happens to be closed on the date of opening of the bids as specified, the bids will be opened online on the next working day, at the same time and validity of bid will be considered from the original date. The date and time of opening of the financial bid shall be notified on website. The Financial bids shall be accordingly opened online.
7. A pre-bid meeting shall be held in the **Agra Smart City Limited Agra, Conference Hall, Agra** for the work on date **12.11.2018 at 04.00 PM** corresponding to the respective package to clarify the issues and to answer questions on any matter that may be raised at that stage.
8. Bids must be accompanied with security of the amount specified for the work in the table. Bid security will have to be in any one of the forms as specified in the bidding document and shall be valid for 45 days beyond the validity of the bid. Bid security pledged in favour of **"Chief Executive Officer, Agra Smart City Limited, Agra.**
9. No Engineer of Gazetted rank or other Gazetted officer employed in Engineering or Administrative duties in an Engineering Department of the State / Central Government is allowed to work as a Contractor for a period of two years after his retirement from Government service, without Government permission. 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 as aforesaid before submission of the tender or engagement in the Contractor's service.

10. Bid documents and other details consisting of qualification information and eligibility criterion of bidders, plans, specifications, drawings, the schedule of quantities of the various classes of work to be done and the set of terms & conditions of contract to be complied with by the Contractor can be seen in the office of the CEO, Agra Smart City Ltd., Agra between hours of 11.00 am and 04.00 PM on any working day between **26.10.2018 & 12.11.2018**.
11. Any bidder who is having criminal record is not allowed to participate in the bidding process.
12. Any bidder who is registered with the state Bar Council is not allowed to participate in the bidding process.
13. Each bidder is required to furnish an affidavit online on a non-judicial stamp paper of Rs. 100/-giving all information on prescribed Performa required for evaluation of the bidding capacity of the bidder.
14. Bidder must submit scan copy of original information/document on prescribed Performa i.e., T4, T5, T6 with each bid original must be produced when asked for at the time of opening of the bid.
15. **Bidder's must comply with as per G.O. No. 3070/78-2-2018-42IT/2017 (22) date 03.01.2018 Non Compliance will be treated as failure. To the condition of the bid and as a valid reason to disqualify the bid's. And bid security should be submitted in the office of Chief Executive Officer, Agra Smart City Limited, Agra after opening Technical & Financial bid of participating work.**
16. 1% Labour Cess will be deducted from the Contractor Bill.
17. The Extra Security /Performance Guarantee will be accepted as per G.O. No. 622/23-12-202-2Audit/08TC-2Lucknow Dated 08.06.2012.
 - A. Up to 10 Percent below Rates on BOQ @ 0.50 % Per 1 % below Rate.
 - B. In case of Bidders Quote the Rate More Than 10% below on BOQ Then Bidder Has to Provide Extra Security @ 1% Per 1% Below Rate
18. Bidder have to quote all the rates inclusive of all taxes,levies and royalties if any but exclusive of G.S.T.GST Shall Be Applicable As Per G.O.No 1614/23-10-2017-12(Samanya)/2017 Date 09.11.2017.

Section 2: Instructions to Bidders
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Instructions to Bidders (ITB)

A. General

1. Scope of Bid

- 1.1. The Employer as defined in the Appendix to ITB invites bids for the construction of Works as described in these documents and referred to as “the works”. The name and identification number of the works is provided in the Appendix to ITB. The bidders have to submit the works detailed in the table given in the Notice Inviting Tender. Bid for each work should be submitted separately.
- a) Providing 24 x 7 Water Supply system to ABD area along with SCADA and metering system ensuring the terminal pressure of 17m at the consumer end. Work consists of the following
 - b) Construction of clear water Pumping Station at Geoni Mandi Water Works including Electro-Mechanical components
 - c) Laying of transmission main from Geoni Mandi headworks to Taj Ganj ZPS, 1200mm dia. M.S pipe for a length of 6 Km
 - d) Design and Construction of Clear Water Reservoir at Taj Ganj ZPS for 10 LL capacity
 - e) Construction of pumping station at Taj Ganj ZPS including Electro-Mechanical components
 - f) Laying of feeder main from Taj Ganj ZPS to Zonal OHTs diameter ranging from 150mm to 500mm DI-K9 pipe for a length of 5.55 Km
 - g) Design, plan and construction of OHT of following capacity and staging height

	Zone No	Capacity in KL	Staging Ht. in m	Quantity in Nos
	1	2500	25	1
	2A	2000	25	1
	2B	2000	25	1
	3	1500	15	1
	4	2700	15	1
	5	2500	25	1
	6	250	25	1

- h) Laying of distribution mains using HDPE pipe diameter ranging from 110mm to 225mm for a length of 140.05 Km and DI-K7 pipe diameter ranging from 200mm to 450mm for a length of 17.82 Km.
- i) Providing House Service Connections using HDPE PN 6 pipe and AMR water meters (17225 Nos.)

- 1.2. The successful Bidder will be expected to complete the Works by the Intended Completion Date specified in the Part I General Conditions of Contract.

- 1.3. Throughout these documents, the terms “bid” and “tender” and their derivatives (bidder/ tendered, bid/ tender, bidding/ tendering, etc.) are synonymous.
- 2. Source of Funds**
 - 2.1. The Government of the State U.P. and other states government departments as defined in the Appendix to ITB has decided to undertake the works of construction of Water Supplies
 - 2.2. The Government of the State has decided to provide funds for the construction of the Water Supplies.
- 3. Eligible Bidders**
 - 3.1. This Invitation for Bids is open to all bidders as defined in the Appendix to ITB.
 - 3.2. Bidders shall not be under a declaration of ineligibility for corrupt and fraudulent practices by the Central Government, the State Government or any public undertaking, autonomous body, authority by whatever name called under the Central or the State Government.
 - 3.3. Any bidders having **criminal record** is not allowed to participate in the online bidding process. Any person who is having criminal cases against him or involved in the **organized crime or gangster activities or Mafia or Goonda or Anti social activity** are strictly prohibited to participate in the bidding process. If it is established that any bidder has **criminal record, his bid shall be automatically cancelled.**
 - 3.4. The bidder has to produce attested true copies of the solvency & character certificates issued by the competent authority with the bid document along with an affidavit verifying that these two documents are valid. However, these original certificates should be produced by them at the time of opening the bids. If the competent authority is not satisfied after comparing attested copies with the originals, it may reject the bid as if the required documents were not produced all.
The bidder has also to produce self declaratory affidavit (on the attached prescribed proforma) in original with the bid documents.
 - 3.5. Any bidder who is an Advocate and Registered with any State Bar Council Shall not be allowed to participate in the bidding. If it is established that the contractor is registered with the state bar council, **his bid shall be automatically cancelled.**
- 4. Qualification of the Bidder**
 - 4.1. All bidders shall provide in Section 3, Forms of Bid and Qualification information, a preliminary description of the proposed work method and schedule, including drawings and charts, as necessary.
 - 4.2. All bidders shall include the following information and documents with their bids in Section 3, Qualification Information unless otherwise stated in the Appendix to ITB:
 - (a) 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 civil construction works performed for each of the last five years;
 - (c) Experience in works of a similar nature and size for each of the last five years, and details of works in progress or contractually committed with certificates from the concerned officer or equivalent;
 - (d) Evidence of ownership of major items of construction equipment named in Clause 4.4 B (b) (i) of ITB or evidence of arrangement of possessing them on hire/lease/buying as defined therein.
 - (e) Details of the technical personnel proposed to be employed for the Contract having the qualifications defined in Clause 4.4 (b) (ii) of ITB for the construction.
 - (f) Reports on the financial standing of the Bidder, such as profit and loss statements and auditor's reports for the past three years;

- (g) an undertaking that the bidder will be able to invest a minimum of cash up to the percentage (defined in the Appendix to ITB) of the contract price of works, during the implementation of the works;
- (h) Evidence of access to line(s) of credit and availability of other financial resources/ facilities (10 percent of the contract value) certified by banker (the certificate being not more than 3 months old.)
- (i) Authority to seek references from the Bidder's bankers;
- (j) information regarding any litigation or arbitration during the last five years in which the Bidder is involved, the parties concerned, the disputed amount, and the matter;
- (k) Proposal for subcontracting the components of the works for construction/ Up gradation aggregating not more than 25% of the contract price and
- (l) The proposed methodology and program of construction, backed with equipment and material planning and deployment, duly supported with broad calculations and Quality Management Plan proposed to be adopted, justifying their capability of execution and completion of the work as per technical specifications and within the stipulated period of completion. .

4.3. **Bids from joint venture with three consortiums are allowed.**

4.4. A To qualify for award of the Contract, each bidder should have in the last five years:

- a) Achieved in any one year a minimum financial turnover (in all cases of civil engineering construction works only) volume of construction work of at least the amount equal to the estimated cost of works(excluding maintenance cost for five years for which bid has been invited. The turnover will be indexed at the rate of 8 percent for a year.
- b) Satisfactorily completed, as prime Contractor, at least one similar work equal in value to one-third of the estimated cost of work (excluding maintenance cost for five years) for which the bid is invited, or such higher amount as may be specified in the Appendix to ITB.

4.4.B (a) Each bidder must attach:

- (i) The current income-tax clearance certificate;
- (ii) An affidavit that the information furnished with the bid documents is correct in all respects; and
- (iii) Such other certificates as defined in the Appendix to ITB. Failure to produce the certificates shall make the bid non-responsive.

(b) Each bidder must demonstrate:

- (i) Availability for construction work, of the owned, key equipment stated in the Appendix to ITB including equipment required for establishing field laboratory to perform mandatory tests, and those stated in the Appendix to ITB;
- (ii) Availability for construction work of technical personnel as stated in the Appendix to ITB.
- (iii) Liquid assets and /or credit facilities, net of other contractual commitments and exclusive of any advance payments which may be made under the Contract, of not less than the amount specified in the Appendix to ITB;

(c) The bidder must not have in his employment:

- (i) The near relations (defined as first blood relations, and their spouses, of the bidder or the bidder's spouse) of persons listed in the Appendix to ITB.
- (ii) Without Government permission, any person who retired as gazetted officer within the last two years of the rank and from the departments listed in the Appendix to ITB.

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

- 4.5. Sub contractors experience and resources shall not be taken into account in determining the bidder's compliance with the qualifying criteria except to the extent stated in 4.4 A above
- 4.6. Bidders who meet the minimum qualification criteria will be qualified only if their available bid capacity for construction work is equal to or more than the total bid value. The available bid capacity will be calculated as under:

$$\text{Assessed Available Bid capacity} = (A*N*M - B)$$

Where

A = Maximum value of civil engineering works executed in any one year during the last five years (updated to the price level of the last year at the rate of 8 percent a year) 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 (period up to 6 months to be taken as half-year and more than 6 months as one year).

M = M is taken 2.5

B = Value, at the current price level, of existing commitments and on-going works to be completed during the 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 stipulated 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.

- 4.7. Even though the bidders meet the above qualifying criteria, they are subject to be disqualified if they have:
 - (i) Made misleading or false representations in the forms, statements, affidavits and attachments submitted in proof of the qualification requirements; and/or
 - (ii) Record of poor performance such as abandoning the works, not properly completing the contract, inordinate delays in completion, litigation history, or financial failures etc.
 - (iii) Participated in the previous bidding for the same work and had quoted unreasonably high or low bid prices and could not furnish rational justification for it to the Employer.

5. One Bid per Bidder

- 5.1. Each Bidder shall submit only one Bid for one work. A Bidder who submits more than one Bid will cause the proposals with the Bidder's participation to be disqualified.

6. Cost of Bidding

- 6.1. The Bidder shall bear all costs associated with the preparation and submission of his Bid, and the Employer will, in no case, be responsible or liable for those costs.

7. Site Visit

- 7.1. The Bidder, at his own cost, responsibility and risk, is encouraged to visit, examine and familiarize himself with the Site of Works and its surroundings including source of earth, water, road aggregates etc. and obtain all information that may be necessary for preparing the Bid and entering into a contract for construction of the Works. The costs of visiting the Site shall be at the Bidder's own expense. He may contact the person whose contact details are given in the Appendix to ITB.

B. Bidding Documents

8. Content of Bidding Documents

8.1. The set of bidding documents comprises the documents listed below and addenda issued in accordance with Clause 10 of ITB.

1. Notice Inviting Tender
2. Instructions to Bidders
3. Qualification Information
4. Conditions of Contract

(Part I General Conditions of Contract, and Contract Data; Part II Special Conditions of Contract)

5. Specifications
6. Drawings
7. Bill of Quantities
8. Form of Bid
9. Form of Acceptance, Form of Agreement, Issue of Notice to Proceed with the Work, form of Unconditional Bank Guarantee.

8.2. Bidding document will be available online on the website <http://etender.up.nic.in>.

8.3. The bidder is expected to examine carefully all instructions, conditions of contract, contract data, forms, terms and specifications, bill of quantities, forms and drawings in the Bid Document. Failure to comply with the requirements of Bid Documents shall be at the bidder's own risk. Pursuant to clause 25 hereof, bids, which are not substantially responsive to the requirements of the Bid Documents, shall be rejected.

9. Clarification of Bidding Documents and Pre-bid Meeting

9.1. A prospective bidder requiring any clarification of the bidding document may notify the employer in writing or by cable ("cable" includes Telex and facsimile) at the employer address indicated in the Notice inviting tenders. The Employer will respond to any request for clarification received earlier than 10 Days prior to the dead line for submission of bid. Copies of the employer's response will be forwarded to all purchasers of the bidding documents, including a description of the enquiry, but without identifying its source

9.2. If a pre-bid meeting is to be held, the bidder or his authorized representative is invited to attend it. Its date, time and address are given in the Appendix to ITB.

9.2.1. The purpose of the meeting will be to clarify issues and to answer questions on any matter that may be raised at that stage.

9.2.2. The bidder is requested to submit any questions in writing or by cable so as to reach the Employer not later than one week before the meeting.

9.2.3. Minutes of the meeting, including the text of the questions raised (without identifying the source of the enquiry) and the responses given will be transmitted online (or otherwise). Any modifications of the bidding documents listed in Clause 8.1 of ITB, which may become necessary as a result of the pre-bid meeting shall be made by the Employer exclusively online through the issue of an Addendum pursuant to Clause 10 of ITB and not through the minutes of the pre-bid meeting.

9.2.4. Non-attendance at the pre-bid meeting will not be a cause for disqualification of a bidder.

10. Amendment of Bidding Documents

10.1. Before the deadline for submission of bids, the Employer may modify the bidding documents by issuing addenda online.

10.2. Any addendum thus issued shall be part of the bidding documents.

10.3. To give prospective bidders reasonable time in which to take an addendum into account in preparing their bids, the Employer shall extend, as necessary, the deadline for submission of bids, in accordance with Clause 20.2 of ITB.

C. Preparation of Bids

11. Language of Bid

- 11.1. All documents relating to the Bid shall be in the language specified in the Appendix to ITB.
- 12. Documents Comprising the Bid**
- 12.1. The Bid submitted by the Bidder shall be in two separate parts:
- Part I** This shall be named Technical Bid and shall comprise of:
- I. Earnest Money;
 - II. Qualification information, supporting documents, affidavit and undertaking as specified in Clause 4 of ITB.
 - III. Undertaking that the bid shall remain valid for the period specified in clause 15.1 of ITB.
 - IV. Any other information / documents required to be completed and submitted by bidders, as specified in the appendix to ITB, and
 - V. An affidavit affirming that information he has furnished in the bidding document is correct to the best of his knowledge and belief.
- Part II.** It shall be named Financial Bid and shall comprise of:
- i) Form of Bid as specified in Section 6;
 - ii) Priced bill of quantities for items specified in Section 7;
- 12.2. The following documents, which are not submitted with the bid, will be deemed to be bid is non responsive.
- | Section | particulars |
|---------|----------------------------|
| 1. | Notice inviting Tender |
| 2. | Instruction to the bidders |
| 3. | Conditions of Contract |
| 4. | Contract Data |
| 5. | Specifications |
| 6. | Drawings |
- 13. Bid Prices**
- 13.1. The Contract shall be for the whole Works, as described in Clause 1. 1 of ITB, based on the priced Bill of Quantities submitted by the Bidder.
- 13.2. The Bidder shall adopt the Item Rate Method as specified in the Appendix to ITB; only the same option is allowed to all the Bidders. Item Rate Method requires the bidder to quote a rates for each item specified in the Appendix to ITB.
- 13.3. All duties, taxes, royalties and other levies payable by the Contractor under the Contract, or for any other cause, shall be included in the rates, prices, and total Bid price submitted by the Bidder (except GST).
- 13.4. The rates and prices quoted by the Bidder shall be fixed for the duration of the Contract and shall not be subject to adjustment.
- 14. Currencies of Bid**
- 14.1. The unit rates and the prices shall be quoted by the bidder entirely in Indian Rupees.
- 15. Bid Validity**
- 15.1. Bids shall remain valid for a period of ninety days after the deadline date for bid submission specified in Clause 20 of ITB. A bid valid for a shorter period shall be rejected by the Employer as non-responsive.
- 15.2. In exceptional circumstances, prior to expiry of the original time limit, the Employer may request that the bidders may extend the period of validity for a specified additional period. The request and the bidders' responses shall be made in writing or by cable. A bidder may refuse the request without forfeiting his Earnest Money. A bidder agreeing

to the request will not be required or permitted to modify his bid, but will be required to extend the validity of his earnest money for a period of the extension, and in compliance with Clause 16 of ITB in all respects.

16. Earnest Money

- 16.1. The Bidder shall furnish, as part of the Bid, Earnest Money, in the amount specified in the Appendix to ITB.
- 16.2. The Earnest Money shall, at the Bidder's option, be in the form of Fixed Deposit Receipt of a scheduled commercial bank, NSC, Post office saving Bank issued in favor of the name given in the Appendix to ITB. The Fixed Deposit Receipt shall be valid for six months or more after the last date of receipt of bids. Other forms of Earnest Money acceptable to the Employer are stated in the Appendix to ITB. Earnest money will be deposited, physically, with officer calling tender, before last date of submission of tender. A scanned copy of earnest money document will be submitted along with the tender
- 16.3. Any bid not accompanied by an acceptable Earnest Money, unless exempted in terms given in the Appendix to ITB, shall be rejected by the Employer as non-responsive.
- 16.4. The Earnest Money of unsuccessful bidders will be returned within 28 days of the end of the Bid validity period specified in Clause 15.1 of ITB.
- 16.5. The Earnest Money of the successful Bidder will be discharged when the Bidder has signed the Agreement and furnished the required Performance Security.
- 16.6. **The Earnest Money may be forfeited:**
 - a) If the Bidder withdraws the Bid after bid opening (technical bid) during the period of Bid validity;
 - b) In the case of a successful Bidder, if the Bidder fails within the specified time limit to
 - i. Sign the Agreement; and/or
 - ii. Furnish the required Performance Security.

17. Alternative Proposals by Bidders

- 17.1. Bidders shall submit offers that comply with the requirements of the bidding documents, including the Bill of Quantities and the basic technical design as indicated in the drawings and specifications. Alternative proposals will be rejected as non-responsive.

18. Format and Signing of Bid

- 18.1. The Bidder shall submit one set of the bid comprising of the documents as described in Clause 12 of ITB.
- 18.2. The Bid shall be submitted on line and shall be digitally signed by a person or persons duly authorized to sign on behalf of the Bidder, pursuant to Clause 4.3(a) of ITB. The person or persons signing the Bid shall sign all pages of the Bid.

D. Submission of Bids

19. Sealing and Marking of Bids

- 19.1. The Bidder shall have to bid on line separately for Technical and financial bid .
Technical Bid: To be opened on AS PER NIT (Date and time of Technical Bid opening as per clause 22.1 of ITB.) Financial Bid: Not to be opened except with the approval of the Employer.

20. Deadline for Submission of Bids

- 20.1. Complete Bids (including Technical and Financial) must be received by the Employer in the Appendix to ITB not later than the date and time indicated in the Appendix to ITB.
- 20.2. The Employer may extend the deadline for submission of bids by issuing an amendment in accordance with Clause 10.3 of ITB, in which case all rights and obligations of the Employer and the bidders previously subject to the original deadline will then be subject to the new deadline.

21. Late Bids

21.1. No Provision/Consideration on Late Bid/Bids Submission.

E. Bid Opening and Evaluation

22. Bid Opening

- 22.1. The Employer will open the bids received, on line in the presence of the bidders/ bidder's representatives who choose to attend at the time, date and place specified in the Appendix to ITB. In the event of the specified date for the submission of bids being declared a holiday for the Employer, the Bids will be opened at the appointed time online on the next working day.
- 22.2. The technical bid shall be opened online.
- 22.3. The Employer will prepare minutes of the Bid opening, including the information disclosed to those present in accordance with Clause 22.3 of ITB.
- 22.4. Evaluation of the technical bids with respect to bid security, qualification information and other information furnished in Part I of the bid in pursuant to Clause 12.1 of ITB, shall be taken up and completed within Ten working days of the date of bid opening, and a list will be drawn up of the responsive bids whose financial bids are eligible for consideration.
- 22.5. The Employer shall inform, by E-mail (or otherwise the bidders, whose technical bids are found responsive, date, time and place of opening as stated in the Appendix ITB. In the event of the specified date being declared a holiday for the Employer, the bids will be opened at the appointed time online on the next working day through they or their representative, may attend the meeting of opening of financial bids.
- 22.6. At the time of the opening of the "Financial Bid", the names of the bidders whose bids were found responsive in accordance with clause 22.5 of ITB will be announced. The financial bids of only these bidders will be opened. The responsive bidder's names, the Bid prices, the total amount of each bid, and such other details as the Employer may consider appropriate will be announced by the Employer at the time of bid opening. Any Bid price, which is not read out and recorded, will not be taken into account in Bid Evaluation.
- 22.7. The Employer shall prepare the minutes of the opening of the Financial Bids.

23. Process to be Confidential

23.1. Information relating to the examination, clarification, evaluation, and comparison of bids and recommendations for the award of a contract shall not be disclosed to bidders or any other persons not officially concerned with such process until the award to the successful Bidder has been announced. Any attempt by a Bidder to influence the Employer's processing of bids or award decisions may result in the rejection of his Bid

24. Clarification of Bids and Contacting the Employer

- 24.1. No Bidder shall contact the Employer on any matter relating to its bid from the time of the bid opening to the time the contract is awarded.
- 24.2. Any attempt by the bidder to influence the Employer's bid evaluation, bid comparison or contract award decision may result in the rejection of his bid.

25. Examination of Bids and Determination of Responsiveness

- 25.1. During the detailed evaluation of "Technical Bids", the Employer will determine whether each Bid (a) meets the eligibility criteria defined in Clauses 3 and 4; (b) has been properly signed; (c) is accompanied by the required securities; and (d) is substantially responsive to the requirements of the bidding documents. During the detailed evaluation of the "Financial Bids", the responsiveness of the bids will be further determined with respect to the remaining bid conditions, i.e., priced bill of quantities, technical specifications and drawings.
- 25.2. A substantially responsive "Financial Bid" is one that conforms to all the terms, conditions, and specifications of the bidding documents, without material deviation or reservation. A material deviation or reservation is one (a) which affects in any

substantial way the scope, quality, or performance of the Works; (b) which limits in any substantial way, inconsistent with the bidding documents, the Employer's rights or the Bidder's obligations under the Contract; or (c) whose rectification would affect unfairly the competitive position of other Bidders presenting substantially responsive bids.

- 25.3. If a "Financial Bid" is not substantially responsive, it will be rejected by the Employer, and may not subsequently be made responsive by correction or withdrawal of the nonconforming deviation or reservation

26. Correction of Errors

- 26.1. Bids determined to be substantially responsive will be checked by the Employer for any arithmetic errors. Errors will be corrected by the Employer as follows:

- a) Where there is a discrepancy between the rates in figures and in words, the rate in words will govern; and
- b) Where there is a discrepancy between the unit rate and the line item total resulting from multiplying the unit rate by the quantity, the unit rate as quoted will govern.

- 26.2. The amount stated in the Bid will be adjusted by the Employer in accordance with the above procedure for the correction of errors and shall be considered as binding upon the Bidder. If the Bidder does not accept the corrected amount, the Bid will be rejected, and the Earnest money shall be forfeited in accordance with Clause 16.6(b) of ITB.

27. Evaluation and Comparison of Bids

- 27.1. The Employer will evaluate and compare only the bids determined to be substantially responsive in accordance with Clause 25 of ITB.
- 27.2. In evaluating the bids, the Employer will determine for each Bid the evaluated Bid price by adjusting the Bid price by making correction, if any, for errors pursuant to Clause 26 of ITB
- 27.3. If the Bid of the successful Bidder is seriously unbalanced in relation to the Engineer's estimate of the cost of work to be performed under the contract, the Employer may require the Bidder to produce detailed price analyses for any or all items of the Bill of Quantities, to demonstrate the internal consistency of those prices with the construction methods and schedule proposed. After evaluation of the price analyses, the Employer may require that the amount of the performance security set forth in Clause 32 of ITB be increased at the expense of the successful Bidder to a level sufficient to protect the Employer against financial loss in the event of default of the successful Bidder under the Contract. The amount of the increased performance security shall be decided at the sole discretion of the Employer, which shall be final, binding and conclusive on the bidder.
- 27.4. If the Bid of the successful Bidder is seriously unbalanced in relation to the Engineer's estimate of the cost of routine maintenance of works to be performed for five years under the contract, the Employer may require the Bidder to produce detailed price analyses for routine maintenance. After its evaluation, the Employer may require that the amount of the performance security set forth in Clause 32 be increased at the expense of the successful Bidder to a level sufficient to protect the Employer against financial loss in the event of default of the successful Bidder under the Contract. The amount of the increased performance security shall be decided at the sole discretion of the Employer, which shall be final, binding and conclusive on the bidder.

28. Price Preference

- 28.1. There will be no price preference to any bidder.

F. Award of Contract

29. Award Criteria

- 29.1. Subject to Clause 31 of ITB, the Employer will award the Contract to the Bidder whose Bid has been determined:
- i. to be substantially responsive to the bidding documents and who has offered the lowest evaluated Bid price, provided that such Bidder has been determined to be (a) eligible in accordance with the provisions of Clause 3 of ITB, and (b) qualified in accordance with the provisions of Clause 4 of ITB; and
 - ii. To be within the available bid capacity adjusted to account for his bid price which is evaluated the lowest in any of the packages opened earlier than the one under consideration.
- 30. Employer's Right to accept any Bid and to Reject any or all Bids**
- 30.1. Notwithstanding Clause 29 above, the Employer reserves the right to accept or reject any Bid, and to cancel the bidding process and reject all bids, at any time prior to the award of Contract, without thereby incurring any liability to the affected Bidder or bidders or any obligation to inform the affected Bidder or bidders of the grounds for the Employer's action.
- 31. Notification of Award and Signing of Agreement.**
- 31.1.1. The bidder whose Bid has been accepted will be notified of the award by the Employer prior to expiration of the Bid validity period by cable, telex or facsimile confirmed by registered letter. This letter (hereinafter and in the Part I *General Conditions of Contract* called the "Letter of Acceptance") will state the sum that the Employer will pay to the Contractor in consideration of the execution, completion by the Contractor as prescribed by the Contract (hereinafter and in the Contract called the "Contract Price").
- 31.2. The notification of award will constitute the formation of the Contract, subject only to the furnishing of a performance security in accordance with the provisions of Clause 32.
- 31.3. The Agreement will incorporate all agreements between the Employer and the successful Bidder. It will be signed by the Employer and the successful Bidder after the performance security is furnished.
- 31.4. Upon the furnishing by the successful Bidder of the Performance Security, the Employer will promptly notify the other Bidders that their Bids have been unsuccessful.
- 32. Performance Security**
- 32.1. Within 10 (ten) days after receipt of the Letter of Acceptance, the successful Bidder shall deliver to the Employer a Performance Security of five percent of the Contract Price, for the period of one years and the time for completion of works plus additional security for unbalanced Bids in accordance with Clauses 27.3 and 27.4 of ITB and Clause 46 Part I General Conditions of Contract and sign the contract.
- 32.2. The performance security shall be either in the form of a Bank Guarantee or fixed deposit Receipts, in favour of "Chief Executive Officer, Agra Smart City Limited Payable at Agra, U.P., from a Scheduled Commercial Bank.
- 32.3. Failure of the successful Bidder to comply with the requirements of Clause 32.1 shall constitutes sufficient grounds for cancellation of the award and forfeiture of the Earnest Money. He will also be debarred from participating future bids under U.P. P.W.D. for one year.
- 33. Advances:**
- 33.1. The employer will provide mobilization advances and advance against security of equipment as provided in Part I General Condition of Contract.
- 34. Corrupt or Fraudulent Practices**
- The Employer requires the bidders/Contractors to strictly observe the laws against fraud and corruption in force in India, namely, Prevention of Corruption Act, 1988.
- 35. Return of Security Deposit & Retention Money:**

Security Deposit shall be returned only after issuance of Virtual Completion Certificate by Engineer in charge / Project Management Consultant for the project. The schedule for returning the Security Deposit & Retention Money shall be as specified hereunder.

1. The return of SD shall start after 1 year of operation and maintenance (from date of issuance of Completion Certificate) of the Water Supply as specified in Detailed Tender Notice.
2. The SD shall be released on successful completion of operation and maintenance of the Water Supply during that period as specified in Detailed Tender Notice.
3. Starting from completion of year 1 of O&M, the SD shall be returned at the rate of 1% every year (Total 5 % in 5 years) after submission of equivalent Bank Guarantee by the contractor for balance period of operation and maintenance.

36. Completion Certificate:

It is obligatory for the contractor to obtain the completion certificate within 01 (one) months of completion of time period or valid extension period. Only 90 % payment for the work shall be released to the contractor upon 100 % physical work completion. Upon completion of 90 % physical work, the contractor shall apply for Completion Certificate and balance amount of 10 % shall be released along with Completion Certificate and Final Bill. The completion certificate will depend upon achieving NRW, if 30 % NRW achieved then 5 % will be released and 20 % will be achieved 2.5 % will be released and balance 2.5 % will be released after achieving 15 %. It shall be mandatory on the contractor to receive completion certificate from ASCL / Consultant within 01 months of completion of Tender Period or Valid Extension Period failing which suitable amount shall be deducted from his Security Deposit as directed by the Engineer- in – Charge.

If during any period the contractor fails to complete the operation and maintenance of the work as specified in the Detailed Tender Notice, the cost of this work shall be deducted from the balance SD payable to the contractor.

Appendix to Invitation to Bidders (ITB)

Instructions to Bidders

Clause Reference

(1.1) The Employer is CEO, Agra Smart City Limited Represented by: **CEO, Agra Smart City Limited Agra.**

(1.1) The Works is Construction of following Water Supply with allied works as shown below
FOR THE WORK: Providing 24x7 water supply to ABD area with water meter and SCADA system under Smart city Mission.

(2.1) The State is Uttar Pradesh

(3.1) Eligible Bidders Are: contractors registered with CPWD or Public Works Department in class A or any Uttar Pradesh Govt. department or Other State Govt. department certificate.

(4.2) The information required from bidders in Clause 4.2 is modified as follows:
NONE

4.2 (g) The percentage is Ten

(4.4 A) (b) One Third of the estimated cost of works

(4.4 B) (a) (iii) Other certificates required with the bid are: As per ITB

(4.4. B) (b) (i) The key equipment for Water Supply works and field testing laboratory Water Supply Works are:

SI	Name of Equipment (Documents to be attached)	Cost Of Work Up To 2 Crores	Quantity /No Cost Of Work More Then 2 Crores
1	R.M.C. plant	-	1
2	Transport Miller	-	4
3	Tar Boiler	2	-
4	Mixture/Mixol	1	1
5	Concrete Mixture	1	1
6	Water Tanker	8	8
7	Diesel Road Roller (8-10 Ton Capacity)	4	-
8	Vibratory Roller	-	-
9	Tractor	-	2
10	Truck	-	2
11	Hot mix plant with sensor paver	-	-
12	Air compressor	1	-
13	Mechanical Broom	1	-
14	Bitumen Distributor/ mechanical sprayer	1	-
15	Tipper	-	4
16	J.C.B.	-	2
17	Pockland	-	-
18	Wet Mix Macadam Plant with paver	-	-
19	Pin vibrator	2	-
20	Generator 250 KVA	1	1

21	Grader	-	-
22	Soil Compactor	1	1
23	Concrete Vibrator with niddle	1	1
24	Field Laboratoy	1	1
25	Hydra (CAPACITY 8 TON)	-	As per requirement
26	Mastic Cooker	-	-
27	Trolly	-	As per requirement
28	Barrier	-	-
29	Cone	-	-
30	Reflective Tape	-	As per requirement
31	Pressure pump for testing of pipeline	-	As per requirement
32	Dumpy level	2 Nos.	2 Nos.
33	Total Station	1 No.	1 No.

For field testing Laboratory:

- Contractor will have to establish one Laboratories in between of stretch of working site fully equipped and consumable as per SP-20-2002 Jal Nigam Uatter Pradesh
 - Contractor will have to provide 2 Jeeps in good condition with driver and POL etc. exclusively to departmental officers for checking and inspection execution of work free of cost.
- Note: (a) The bidder must produce the following documentary evidence in support of his owning the above equipment: Documents showing proof of ownership.

(4.4 B) (b)(ii) The Number of Technical personnel, Qualifications and Experience will be as follows:

A. The technical Personal are

Technical Personnel	Number	Experience in water Supply Works
A. Degree Holder in Civil / Mechanical/ Electrical Engineering	1	Minimum 20 years of Experience out of which five years of experience of having handled/executed independently large water supply work project.
B. Degree Holder in Civil Engineering	1	Minimum 5 years of Experience
C. Degree Holder in Mechanical Engineering	1	Minimum 5 years of Experience
D. Degree Holder in Electrical/ Electronic Engineering	1	Minimum 5 years of Experience
E. Diploma holder in Civil Engineering	2	Minimum 2 years of Experience
F. Diploma holder in Mechanical / Electrical Engineering	2	Minimum 2 years of Experience in Maintenance of plant & machinery
G. Surveyor	3	Minimum 2 years of Experience
H. ITI Certified Plumber/ Electrician/ Welder/ Fitter	10	Minimum 2 years of Experience

To ensure employment of Technical Personnel, the contractor would require giving the proof of payment of their salaries/ Wages by Cheque/ Demand Draft.

B. For field testing laboratory:

Technical Personnel	Number	Experience in Water Supply Works
A. Degree Holder in Civil / Mechanical/ Electrical Engineering	2	Minimum 5 years of Experience in Testing and Quality control in Water Supply Work.
B. Lab Assistant/Technical (ITI/B.Sc)	2	Minimum 2 years of Experience in maintenance of plant & machinery.
SCADA Operator	10	Minimum 2 years of Experience in maintenance of SCADA
E. Surveyor	1	Minimum 2 years of Experience in testing

- (4.4 B) (b)(iii) The minimum amount of liquid assets and/or credit facilities net of other contractual commitments of the successful Bidder shall be 10% of the contract value
- (4.4 B) (c) (i) The bidder must produce an affidavit stating that the near relations of the following departmental officers are not in his employment: J.E.'s, A.E.'s, E.E.'s, S.E.'s, and other staff of equivalent rank
- (4.4 B) (c) (ii) The bidder must produce an affidavit stating the names of retired gazetted officer (if any) in his employment who retired within the last two years with the following ranks from the departments listed below: U.P.P.W.D., R.E.S. and. U.P. Irrigation. (Assistant Engineer, Executive Engineer, Superintending Engineer, Chief Engineer, Director cum Chief Engineer, Engineer-in-Chief) In case there is no such person in his employment, his affidavit should clearly state this fact.
- (4.6) M = 2.5
- (7.1) The contact person is:
Designation: Chief Executive Officer,
Office of Agra Smart City Limited, Agra
Ph No-0562-2520615
- (9.2.1) Place, Time and Date for pre-bid meeting are:
As per NIT
- (11.1) Language of the bid is: *English*
- (12.1) Part I (v) The other documents required are: NONE
T-4,T-5,T6
- (13.2.) Bids may be submitted only in Item Rate Method
- (16.1) **The amount of Earnest Money shall be as per NIT**
- (16.2) Fixed Deposit Receipt must be drawn in favour of:
Chief Executive Officer, Agra Smart City Limited, Agra.
- (16.2) Other acceptable forms of Bid Security pledged in favour of : **Chief Executive Officer, Agra Smart City Limited, Agra** National savings certificate issued by P&T Deptt., Post Office Saving account Pass book .
- (16.3) Exemption from Earnest Money is granted to: As per N.I.T/G.O.
- (20.1) The Employer's address for the purpose of Bid submission is online submission
- (20.1)1. The deadline for submission of bids shall be:
As per NIT
- (22.1) & (22.6) The date, and time for opening of the Technical Bids online are:
(A) Technical Bid
As per NIT

- (32.1) The amount and validity period of the performance guarantee is: Amount as BID SECURITY of the contract price Validity Period: -As per SBD
- (i) Performance security shall be valid until a date 45 days after the expiry of Defect Liability Period of 2 years after intended completion date.
- (ii) Additional Performance Security for unbalanced Bid shall be valid for 45 days plus intended completion period.

Signature of Employer/ Authorized Signatory

Date :

Section 3 Qualification Information

(Following information's shall be furnished by the contractor on a non-judicial stamp paper of Rs. 100/- only)

Notes on Form of Qualification Information

The information to be filled in by bidders in the following pages will be used for Purposed of post-qualification as provided for in clause 4 of the Instructions to Bidders. This Information will not be incorporated in the Contract. Attach additional pages as necessary

1. Individual Bidders

1.1	Constitution or legal status of Bidder Place of registration: Principal place of business Power of attorney of signatory of Bid	[Attach copy] <hr/> <hr/> [Attach]
1.2	Total annual volume of civil engineering construction work executed and payments received in the last five years preceding the year in which bids are invited. (Attach certificate from Chartered Accountant)	(Rs in Lacs)

1.3.1	Work performed as prime Contractor (in the same name and style) on construction works of a similar nature and volume over the last five years. Attach certificate from the Engineer-in-charge
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Project Name	Name of Employer	Description of work	Value of contract	Contract No.	Date of Issue of work order	Stipulated Date of Completion	Actual Date of Completion	Remarks explaining reasons for Delay. if any

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1.3.2. Information on Bid capacity (works for which bids have been submitted and works which are yet to be completed) as on the date of this

(A) Existing commitments and on-going construction works:

Description of Work	Place & State	Contract No & Date	Name & Address of Employer	Value of Contract (Rs. In lakhs)	Stipulated period of completion	Value of works remaining to be completed (Rs. Lakhs) *	Anticipated Date of completion
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)

** Enclose certificate(s) from Engineer(s)-in-charge for value of work remaining to be completed.*

(B) Works for which bids already submitted:

Descripti on of Work	Place & State	Name & Address of Employer	Estimated Value of Works (Rs. Lakhs)	Stipulated period of completion	Date when decision is expected	Remarks, if any
(1)	(2)	(3)	(4)	(5)	(6)	(7)

1.4. Availability of Major items of Contractor's Equipment proposed for carrying out the Works. List all information requested below. Refer also to Clause 4.2(d) and Clause 4.4 b (b) of the Instructions to Bidders.

Item of Equipment	Description, make, and age (Years), and capacity	Condition (new, good, poor) and number available	Owned, leased (from whom?), or to be purchased

- 1.5. Qualifications of technical personnel proposed for the Contract. Refer also to Clause 4.2(e) of the Instructions to Bidders and Clause 9.1 of Part-1 General Conditions of Contract

Position	Name	Qualification	Years of experience		
			Road Works	Building Works	Other

- 1.6. Proposed sub-contractors and firms involved for construction. Refer to Clause 7 of Part I General Conditions of Contract.

Sections of the Works	Value of subcontract	Sub-contractor (name and address)	Experience in similar work

- 1.7. Note: The capability of the sub-Contractor will also be assessed (on the same lines as for the main Contractor) before according approval to him.

- 1.8. Financial reports for the last five years: balance sheets, profit and loss statements, auditors' reports, etc.
List below and attach copies.

- 1.9. Name, address, and telephone, telex, and facsimile numbers of banks that may provide references if contacted by the Employer.

- 1.10. a. Information on current litigation in which the Bidder is involved.

Name of Other party(s)	Cause of dispute	Litigation where (Court/arbitration)	Amount involved
1.11.			
1.12.			
1.13.			

1.14.

- 1.11. Proposed Program (work method and schedule). Descriptions, drawings, and charts as necessary, to comply with the requirements of the bidding documents.

SAMPLE FORMAT FOR EVIDENCE OF ACCESS TO OR AVAILABILITY OF CREDIT FACILITIES

BANK CERTIFICATE

This is to certify that M/S -----is a reputed company with a good financial standing.

If the contract for the work, namely, ____ _____ is awarded to the above firm, we shall be able to provide overdraft/credit facilities to the extent of Rs. ____ _____ to meet their working capital requirements for executing the above contract.

Signature of Senior Bank Manager
Name of the senior Bank Manager
Address of the
Bank.....

Stamp of the Bank

Note: Certificate should be on the letterhead of the bank.

Under taking From bidders to Invest minimum 10% of the Value of the work.

FOR THE WORK: : Providing 24x7 water supply to ABD area with water meter and SCADA system under Smart city Mission

It is to be certified that I have Rs. In Cash, Rs. in Bank and Rs..... by other sources with proceed with the proposed work.

Date :-
Place :-

Signature of Contractor.

Section 4 Conditions of Contract

Part – I General Conditions of Contract

These conditions are subject to the variations and additions set out in Part II Special Conditions of Contract

Notes on Conditions of Contract

The Conditions of Contract, read in conjunction with Part II Special Conditions of Contract and the Contract Data and other documents listed therein, should be a complete document expressing fairly the rights and obligations of both parties.

The form of Conditions of Contract that follows has been developed for smaller admeasurements contracts for construction on the basis of international practice and the practice of the Government of India, Jal Nigam Uatter Pradesh, and considerable experience in different States in India in the drafting and management of contracts, bearing in mind a trend in the construction industry towards simpler, more straightforward language.

The Conditions of Contract also incorporate the concept of performance-based payments for routine maintenance of Water Supply

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Section 4

Part I General Conditions of Contract

A. General

1. Definitions

1.1. Terms, which are defined in the Contract Data, are not also defined in the Conditions of Contract but keep their defined meanings. Capital initials are used to identify defined terms.

Bill of Quantities means the priced and completed Bill of Quantities forming part of the Bid.

Compensation Events are those defined in Clause 40 hereunder.

The Completion Date is the date of completion of the Works as certified by the Engineer, in accordance with Clause 48.1.

The Contract is the Contract between the Employer and the Contractor to execute, complete, and maintain the Works. It consists of the documents listed in Clause 2.3.

The Contract Data defines the documents and other information, which comprise the Contract.

The Contractor is a person or corporate body who's Bid to carry out the Works, including routine maintenance, has been accepted by the Employer.

The Contractor's Bid is the completed bidding document submitted by the Contractor to the Employer.

The Contract Price is the price stated in the Letter of Acceptance and thereafter as adjusted in accordance with the provisions of the Contract.

Days are calendar days; months are calendar months.

A Defect is any part of the Works not completed in accordance with the Contract.

The Defects Liability Certificate is the certificate issued by Engineer, after the Defect Liability Period has ended and upon correction of Defects by the Contractor.

The Defects Liability Period is Two years calculated from the Completion Date.

Drawings include calculations and other information provided or approved by the Engineer for the execution of the Contract.

The Employer is the party as defined in the Contract Data, who employs the Contractor to carry out the Works, including Routine maintenance,. The Employer may delegate any or all functions to a person or body nominated by him for specified Functions.

The Engineer is the person named in the Contract Data (or any other competent person appointed by the Employer and notified to the Contractor, to act in replacement of the Engineer) who is responsible for supervising the execution of the Works and administering the Contract.

Equipment is the Contractor's machinery and vehicles brought temporarily to the Site to construct the Works.

The Initial Contract Price is the Contract Price listed in the Employer's Letter of Acceptance.

The Intended Completion Date is the date on which it is intended that the Contractor shall complete the Works.

The Intended Completion Date is specified in the Contract Data. The Intended Completion Date may be revised only by the Engineer by issuing an extension of time.

Materials are all supplies, including consumables, used by the Contractor for incorporation in the Works.

Plant is any integral part of the Works that shall have a mechanical, electrical, electronic, chemical, or biological function.

The Site is the area defined as such in the Contract Data.

Site Investigation Reports are those that were included in the bidding documents and are reports about the surface and subsurface conditions at the Site.

Specification means the Specification of the Works included in the Contract and any modification or addition made or approved by the Engineer.

The Start Date is given in the Contract Data. It is the date when the Contractor shall commence execution of the Works. It does not necessarily coincide with any of the Site Possession Dates.

A Sub-Contractor is a person or corporate body who has a Contract with the Contractor to carry out a part of the construction work in the Contract, which includes work on the Site.

Temporary Works are works designed, constructed, installed, and removed by the Contractor that are needed for construction or installation of the Works.

A. Variation is an instruction given by the Engineer, which varies the Works.

The Works, as defined in the Contract Data, are what the Contract requires the Contractor to construct, install, maintain, and turn over to the Employer. Routine maintenance is defined separately.

2. Interpretation

In interpreting these Conditions of Contract, singular also means plural, male also means female or neuter, and the other way around. Headings have no significance. Words have their normal meaning under the language of the Contract unless specifically defined. The Engineer will provide instructions clarifying queries about these Conditions of Contract.

If sectional completion is specified in the Contract Data, references in the Conditions of Contract to the Works, the Completion Date, and the Intended Completion Date apply to any Section of the Works (other than references to the Completion Date and Intended Completion Date for the whole of the Works).

The documents forming the Contract shall be interpreted in the following order of priority:

- (1) Agreement,
- (2) Notice to Proceed with the Work,
- (3) Letter of Acceptance,
- (4) Contractor's Bid
- (5) Contract Data,
- (6) Special Conditions of Contract Part II,
- (7) General Conditions of Contract Part I,
- (8) Specifications,
- (9) Drawings,
- (10) Bill of Quantities, and
- (11) Any other document listed in the Contract Data.

3. Language and Law.

The language of the Contract and the law governing the Contract are stated in the Contract Data.

4. Engineer's Decisions

Except where otherwise specifically stated, the Engineer will decide contractual matters between the Employer and the Contractor in the role representing the Employer. However, if the Engineer is required under the rules and regulations and orders of the Employer to obtain approval of some other authorities for specific actions, he will so obtain the approval.

Except as expressly stated in the Contract, the Engineer shall not have any authority to relieve the Contractor of any of his obligations under the contract.

5. Delegation

The Engineer, with the approval of the Employer, may delegate any of his duties and responsibilities to other people, after notifying the Contractor, and may cancel any delegation after notifying the Contractor.

6. Communications

All Certificate, notices or instructions to be given to the contractor by Employer / Engineer shall be sent on the address or contact details given by the contractor in Section 6- Form of Bid. The address and contact details for communication with the Employer/ Engineer shall be as per the details given Contract Data to GCC. Communications between parties that are referred to in the conditions shall be in writing. The Notice sent by Facsimile (fax) or other electronic means shall be effective on confirmation of the transmission. The Notice sent by Registered post or Speed post shall be effective on delivery or at the expiry of the normal delivery period as undertaken by the postal service.

7. Subcontracting

7.1- The contractor may subcontract part of the construction work with the approval of the Employer in writing, up to 25% of the contract price but will not assign the Contract. Subcontracting shall not alter the contractor's obligations.

Beyond what has been stated in clauses 7.1, if the contractor proposes subcontracting any part of the work during execution of the works, because of some unforeseen

circumstances to enable him to complete the work as per terms of the contract, the Employer will consider the following before according approval:

- a. The Contractor shall not sub-contract the whole of the works.
- b. The Contractor shall not sub-contract any part of the work without prior consent of the Employer. Any such consent shall not relieve the contractor from any liability or obligation under the contract and he shall be responsible for the acts, defaults and neglects of any his sub-contractor, his agents or workmen as fully as if they were the acts, defaults or neglects of the Contractor, his agents and workmen.

The Engineer should satisfy himself before recommending to the Employer whether

- a. The circumstances warrant such sub-contracting: and
- b. The sub-contractor so proposed for the work possess the experience, qualification and equipment necessary for the job proposed to be entrusted to him in proportion of the Quantum of works to be sub-contracted.

8. Other Contractors

The contractor shall co-operate and share the site with other contractors. Public authority's utilities and the employer between the dates given in the schedule of other contractors, as referred to in the contract data. The contractor shall also provide facilities and services for them as described in the schedule. The employer may modify the schedule of other contractor, and shall notify the contractor of any such modification.

The contractor should take up the work in convenient reaches as decided by the Engineer to ensure there is least hindrance to the smooth flow of traffic including movement of vehicles and equipment of other contractors till the completion of the works.

Work related with Water supply and Sewerage Contracting agency must do the work in Co ordination with each other.

9. Personnel

The Contractor shall employ for the construction work and routine maintenance the technical personnel named in the Contract Data or other technical persons approved by the Engineer. The Engineer will approve any proposed replacement of technical personnel only if their relevant qualifications and abilities are substantially equal to or better than those of the personnel stated in the Contract Data.

If the Engineer asks the Contractor to remove a person who is a member of the Contractor's staff or work force, stating the reasons, the Contractor shall ensure that the person leaves the Site within seven days and has no further connection with the Works in the Contract.

The Contractor shall not employ any retired Gazetted officer who has worked in the Engineering Department of the State Government and has either not completed two years after the date of retirement or has not obtained State Government's permission to employment with the Contractor.

10. Employer's and Contractor's Risks

The Employer carries the risks which this Contract states are Employer's risks, and the Contractor carries the risks that this Contract states are Contractor's risks

11. Employer's Risks

The Employer is responsible for the excepted risks which are (a) in so far as they directly affect the execution of the Works in the Employer's country, the risks of war, invasion, act of foreign enemies, rebellion, revolution, insurrection or military or usurped power, civil war, riot commotion or disorder (unless restricted to the Contractor's employees), natural calamities and contamination from any nuclear fuel or nuclear waste or radioactive toxic explosive, or (b) a cause due solely to the design of the Works, other than the Contractor's design.

12. Contractor's Risks

All risks of loss of or damage to physical property and of personal injury and death which arise during and in consequence of the performance of the Contract other than the excepted risks, referred to in clause 11.1, are the responsibility of the Contractor.

13. Insurance

The Contractor at his cost shall provide, in the joint names of the Employer and the Contractor, insurance cover from the Start Date to the date of completion, in the amounts and deductibles stated in the Contract Data for the following events which are due to the Contractor's risks:

- a) loss of or damage to the Works, Plant and Materials;
- b) loss of or damage to equipment;
- c) loss of or damage to property (except the Works, Plant, Materials, and equipment) in connection with the Contract; and
- d) Personal injury or death.

Insurance policies and certificates for insurance shall be delivered by the Contractor to the Engineer for the Engineer's approval before the completion date/ Start Date. All such insurance shall provide for compensation to be payable in Indian Rupees to rectify the loss or damage incurred.

(a) The Contractor at his cost shall also provide, in the joint names of the Employer and the Contractor, insurance cover from the date of completion to the end of defect liability period, in the amounts and deductibles stated in the Contract Data for the following events which are due to the Contractor's risks:

(a) Personal injury or death.

(b) Insurance policies and certificates for insurance shall be delivered by the Contractor to the Engineer for the Engineer's approval before the completion date/ start date. All such insurance shall provide for compensation to be payable in Indian Rupees. Alterations to the terms of insurance shall not be made without the approval of the Engineer.

Both parties shall comply with any conditions of the insurance policies.

14. Site Investigation Reports

The Contractor, in preparing the Bid, may rely on any Site Investigation Reports referred to in the Contract Data, supplemented by any other information available to him, before submitting the bid.

15. Queries about the Contract Data

The Engineer will clarify queries on the Contract Data.

16. Contractor to Construct the Works

The Contractor shall construct, and install and maintain the Works in accordance with the Specifications and Drawings.

The contractor shall construct the works with intermediate technology, i.e., by manual means with medium input of machinery required to ensure the quality of works as per specifications. The contractor shall deploy the equipment and machinery as given in Contract Data.

1. The Works to Be Completed by the Intended Completion Date

The Contractor may commence execution of the Works on the Start Date and shall carry out the Works in accordance with the Programme submitted by the Contractor, as updated with the approval of the Engineer, and complete them by the Intended Completion Date.

2. Approval by the Engineer

The Contractor shall submit Specifications and Drawings showing the proposed Temporary Works to the Engineer, who is to approve them.

The Contractor shall be responsible for design of Temporary Works.

The Engineer's approval shall not alter the Contractor's responsibility for design of the Temporary Works.

The Contractor shall obtain approval of third parties to the design of the Temporary Works, where required.

All Drawings prepared by the Contractor for the execution of the temporary or permanent Works, are subject to prior approval by the Engineer before their use.

3. Safety

The Contractor shall be responsible for the safety of all activities on the Site.

4. Discoveries

Anything of historical or other interest or of significant value unexpectedly discovered on the Site shall be the property of the Employer. The Contractor shall notify the Engineer of such discoveries and carry out the Engineer's instructions for dealing with them.

21. Possession of the Site

The Employer shall handover complete or part possession of the site to the Contractor 7 days in advance of construction program. At the start of the work, the employer shall handover the possession of at-least 75% of the site.

22. Access to the Site

The Contractor shall allow access to the Site and to any place where work in connection with the Contract is being carried out, or is intended to be carried out to the engineer and any person/persons/agency authorized by:

- a. The Engineer
- b. The Employer
- c. The Ministry of Rural Development, Government of India.
- d. Jal Nigam Uatter Pradesh

23. Instructions

The Contractor shall carry out all instructions of the Engineer, which comply with the applicable laws where the Site is located.

24. Dispute Redressal System

If any dispute or difference of any kind what-so-ever shall arises in connection with or arising out of this Contract or the execution of Works or maintenance of the Works there under, whether before its commencement or during the progress of Works or after the termination, abandonment or breach of the Contract, it shall, in the first instance, be referred for settlement to the competent authority, described along with their powers in the Contract Data, above the rank of the Engineer, The competent authority shall, within a period of forty-five days after being requested in writing by the Contractor to do so, convey his decision to the Contractor. Such decision in respect of every matter so referred shall, subject to review as hereinafter provided, be final and binding upon the Contractor. In case the Works is already in progress, the Contractor shall proceed with the execution of the Works, including maintenance thereof, pending receipt of the decision of the competent authority as aforesaid, with all due diligence.

Either party will have the right of appeal, against the decision of the competent authority, to the arbitration if the amount appealed exceeds rupees one lakh.

25. Procedure for Resolution of Disputes

- 25.0.1. The Competent Authority mentioned in clause 24.1 shall give a decision in writing within 45 days of receipt of a notification of a dispute.
- 25.0.2. Either party may refer a decision of the Competent Authority to Arbitration within 28 days of the Competent Authority's written decision. Arbitration shall be under the Arbitration and Conciliation Act 1996. If neither party refers the dispute to Arbitration within the above 28 days, the Competent Authority's decision will be final and binding.
- 25.0.3. The Arbitration shall be conducted in accordance with the following procedure, in case Initial Contract Price is more than Rs. 5 Crore or the Contractor is a Foreign Contractor, who has bid under ICB:-
 - a) In case of a decision of the Competent Authority in a dispute or difference arising between the Employer and a Contractor relating to any matter arising out of or connected with this Agreement, the matter will be referred to an Arbitral Tribunal. The Arbitral Tribunal shall consist of three Arbitrators, one each to be appointed by the Employer and the contractor. The third Arbitrator shall be chosen by the two Arbitrators so appointed by the parties and shall act as presiding Arbitrator. In case of failure of the two Arbitrators appointed by the parties to reach upon a consensus within a period of 30 days from the appointment of the Arbitrator appointed subsequently, the presiding Arbitrator shall be appointed by Jal Nigam Uatter Pradesh
 - b) If one of the parties fails to appoint its arbitrator in pursuance of sub-clause (a) above within 30 days after receipt of the notice of the appointment of its arbitrator by the other party, then the Jal Nigam Uatter Pradesh shall appoint the arbitrator.
A certified copy of the order of the Chairman of the Jal Nigam Uatter Pradesh, making such an appointment shall be furnished to each of the parties.
 - c) The decision of the majority of arbitrators shall be final and binding upon both parties. The cost and expenses of Arbitration proceedings will be paid as determined by the Arbitral Tribunal. However, the expenses incurred by each party in connection with the preparation, presentation etc. of its proceedings as also the fees and expenses paid to the arbitrator appointed by such party or on its behalf shall be borne by each party itself.
Where the Initial Contract Price as mentioned in the Acceptance Letter is Rs. 5 Crore and below, disputes and differences in which an Adjudicator has given a decision shall be referred to a sole Arbitrator. The sole Arbitrator would be appointed by the agreement between the parties; failing such agreement within 15 days of the reference to arbitration, by the appointing authority, namely the Jal Nigam Uatter Pradesh.

Arbitration proceedings shall be held at Agra (U.P.) , India, and the language of the arbitration proceedings and that of all documents and communications between the parties shall be English.

Performance under the contract shall continue even after reference to the arbitration and payments due to the contractor by the Employer shall not be withheld, unless they are the subject matter of the arbitration proceedings.

B. TIME CONTROL

26. Programme

Within the time stated in the Contract Data, the Contractor shall submit to the Engineer for approval a Program showing the general methods, arrangements, order, and timing for all the activities in the Works, along with monthly cash flow forecasts for the construction of works.

The Contractor shall submit the list of equipment and machinery being brought to site, the list of key personnel being deployed, the list of machinery/ equipments being placed in field laboratory and the location of field laboratory along with the Program. The Engineer shall cause these details to be verified at each appropriate stage of the program.

An update of the Program shall be a program showing the actual progress achieved on each activity and the effect of the progress achieved on the timing of the remaining Works, including any changes to the sequence of the activities.

The Contractor shall submit to the Engineer for approval an updated Program at intervals of *60 Days* no longer than the period stated in the Contract Data. If the Contractor does not submit an updated Program within this period, the Engineer may withhold the amount stated in the Contract Data from the next payment certificate and continue to withhold this amount until the next payment after the date on which the overdue Program has been submitted.

The Engineer's approval of the Program shall not alter the Contractor's obligations. The Contractor may revise the Program and submit it to the Engineer again at any time. A revised Program shall show the effect of Variations and Compensation Events.

27. Extension of the Intended Completion Date

The Engineer shall extend the Intended Completion Date if a Compensation Event occurs or a Variation is issued which makes it impossible for Completion to be achieved by the Intended Completion Date without the Contractor taking steps to accelerate the remaining Works, which would cause the Contractor to incur additional cost

The Engineer shall decide whether and by how much time to extend the Intended Completion Date within 21 days of the Contractor asking the Engineer for a decision upon the effect of a Compensation Event or Variation and submitting full supporting information. If the Contractor has failed to cooperate in dealing with a delay, the delay by this failure shall not be considered in assessing the new Intended Completion Date.

28. Delays Ordered by the Engineer

The Superintending Engineer may instruct the Contractor to delay the start or progress of any activity within the Works. Delay/delays totaling more than 30 days will require prior written approval of the Employer.

29. Management Meetings

The Engineer may require the Contractor to attend a management meeting. The business of a management meeting shall be to review the plans for the Works.

29.1.1. The Engineer shall record the business of management meetings and provide copies of the record to those attending the meeting. The responsibility of the parties for actions to

be taken shall be decided by the Engineer either at the management meeting or after the management meeting and stated in writing to all those who attended the meeting.

C. *Quality Control*

30. Identifying Defects

The Engineer shall check the Contractor's work and notify the Contractor of any Defects that are found. Such checking shall not affect the Contractor's responsibilities. The Engineer may instruct the Contractor to search for a Defect and to uncover and test any work that the Engineer considers may have a Defect.

31. Tests

For Carrying out mandatory tests as prescribed in the specification. The Contractor shall establish field laboratory at the location decided by Engineer. The field laboratory will have minimum equipment as specified in the Contract Data. The contractor shall be solely responsible for :

- a. Carrying out the mandatory tests prescribed in the Specifications, and
- b. For the correctness of the test results, whether performed in his laboratory or elsewhere.

If the Engineer instructs the Contractor to carry out a test not specified in the Specification/ Water Supply Manual to check whether any work has a Defect and the test shows that it does, the Contractor shall pay for the test and any samples.

32. Correction of Defects noticed during the Defect Liability Period for two year.

32.0.1. The Engineer shall give notice to the Contractor of any Defects before the end of the Defects Liability Period, which begins at Completion of work. The Defects Liability Period shall be extended for as long as Defects remain to be corrected.

32.0.2. Every time notice of Defect/Defects is given, the Contractor shall correct the notified Defect/Defects within the duration of time specified by the Engineer's notice.

The RFI system will be followed for execution of work.

33. Uncorrected Defects

If the Contractor has not corrected a Defect pertaining to the Defect Liability Period under clause 32.1.1 and of these Conditions of Contract, to the satisfaction of the Engineer, within the time specified in the Engineer's notice, the Engineer will assess the cost of having the Defect corrected, and the Contractor will pay this amount, on correction of the Defect.

D. *Cost Control*

34. Bill of Quantities

The Bill of Quantities shall contain items for the construction, installation, testing, and commissioning, maintaining works, and lump sum figures for yearly routine maintenance for each of the five years separately, to be done by the Contractor. The Bill of Quantities is used to calculate the Contract Price. The Contractor is paid for the quantity of the work done at the rate in the Bill of Quantities for each item for the

construction of Water Supply. The payment to the Contractor is performance based for routine maintenance of Water Supply.

35. Variations

The Engineer shall, having regard to the scope of the Works and the sanctioned estimated cost, have power to order, in writing, Variations within the scope of the Works he considers necessary or advisable during the progress of the Works. Such Variations shall form part of the Contract and the Contractor shall carry them out and include them in updated Programs produced by the Contractor. Oral orders of the Engineer for Variations, unless followed by written confirmation, shall not be taken into account.

36. Payments for Variations

If rates for variation items are specified in Bill of Quantity, the contractor shall carry out such work at the same rate. This shall apply for variation only up to the limit prescribed in the contract data. If the variation exceeds this limit, the rates shall be derived under the provision of clause 36.3 for quantities (higher or lower) exceeding the deviation limit.

If the rates for Variation are not specified in the Bill of Quantities, the Engineer shall derive the rate from similar items in the Bill of Quantities.

If the rate for Variation item cannot be determined in the manner specified in Clause 36.1 or 36.2, the Contractor shall, within 14 days of the issue of order of variation work, inform the Engineer the rate which he proposes to claim, supported by analysis of the rates. The Engineer shall assess the quotation and determine the rate based on prevailing market rates within one month of the submission of the claim by the Contractor. As far as possible, the rate analysis shall be based on the standard data book and the current schedule of rates of the district public works division. The decision of the Engineer on the rate so determined shall be final and binding on the Contractor.

37. Cash Flow Forecasts

When the Program is updated, the Contractor shall provide the Engineer with an updated cash flow forecast.

38. Payment Certificates

The payment to the contractor will be as follows for construction work:

- a) The Contractor shall submit to the Engineer fortnightly/ monthly statements of the value of the work executed less the cumulative amount certified previously supported with detailed measurement of the items of work executed in measurement books authorized by Project Engineer ASCL.
- b) The Engineer shall check the Contractor's fortnightly/monthly statement within 14 days and certify the amount to be paid to the Contractor.
- c) The value of work executed shall be determined, based on measurements by the Engineer.
- d) The value of work executed shall comprise the value of the quantities of the items in the Bill of Quantities completed.
- e) The value of work executed shall also include the valuation of Variations and Compensation Events.

- f) The Engineer may exclude any item certified in a previous certificate or reduce the proportion of any item previously certified in any certificate in the light of later information.
- g) The Payment of final bill shall be governed by the provisions of clause 50 of GCC.

39. Payments

Payments shall be adjusted for deductions for advance payments security deposit, other recoveries in terms of the Contract and taxes at source, as applicable under the law. The Engineer shall pay the Contractor the amounts he had certified within 15 days of the date of each certificate.

The Employer may appoint another authority, as specified in the Contract Data (or any other competent person appointed by the Employer and notified to the contractor) to make payment certified by the Engineer.

Items of the Works for which no rate or price has been entered in the Bill of Quantities, will not be paid for by the Employer and shall be deemed covered by other rates and prices in the Contract.

40. Compensation Events

The following shall be Compensation Events unless they are caused by the Contractor

- a) The Engineer orders a delay or delays exceeding a total of 30 days.
 - b) The effects on the Contractor of any of the Employer's Risks.
- If a Compensation Event would prevent the Works being completed before the Intended Completion Date, the Intended Completion Date shall be extended. The Engineer shall decide whether and by how much the Intended Completion Date shall be extended.

41. Tax

The rates quoted by the Contractor shall be deemed to be inclusive of the sales and other levies, duties, royalties, cess, toll, taxes of Central and State Governments, local bodies and authorities that the Contractor will have to pay for the performance of this Contract. The Employer will perform such duties in regard to the deduction of such taxes at source as per applicable law.

42. Currencies

All payments will be made in Indian Rupees.

43. Security Deposit/ Retention and Release of Performance Security and Security Deposit/ Retention.

The Employer shall retain security deposit of 5% of the amount from each payment due to the Contractor until completion of the whole of the construction Work. No. security deposit/ retention shall be retained from the payments for Routine maintenance of Works.

On the completion of the whole of the construction Work half the total amount retained as Security Deposit is repaid to the contractor and half when the defect liability period has passed and the Engineer has certified that all defects notified by the Engineer to the contractor before the end of his period have been corrected.

The additional performance security for unbalanced bids as detailed in Clause 51 of Conditions of Contract is repaid to the contractor when the construction work is complete.

The performance security equal to the five percent of the contract price in Clause 51 of Conditions of contract is repaid to the contractor when the period of two years finished or defect liability period is over and the Engineer has certified that the contractor has satisfactorily carried out the Works.

If the contractor so desires then the Security Deposit can be converted into any interest bearing security of schedule commercial bank in the name of the Employer or National Saving Certificates duly pledged in favor of the Employer for Defect Liability Period.

44. Liquidated Damages

The Contractor shall pay liquidated damages to the Employer at the rate per week or part thereof stated in the Contract Data for the period that the Completion Date is later than the Intended Completion Date. Liquidated damages at the same rate shall be withheld if the Contractor fails to achieve the milestones prescribed in the Contract Data. However, in case the Contractor achieves next milestone the amount of the liquidated damages already withheld shall be restored to the Contractor by adjustment in the next payment certificate. The total amount of liquidated damages shall not exceed the amount defined in the Contract Data. The Employer may deduct liquidated damages from payments due to the Contractor. Payment of liquidated damages shall not affect the Contractor's other liabilities.

If the Intended Completion Date is extended after liquidated damages have been paid, the Engineer shall correct any overpayment of liquidated damages by the Contractor by adjusting the next payment certificate.

45. Advance Payment

The Employer will make the following advance payment to the contractor against provision by the Contractor of an Unconditional Bank Guarantee in a form and by a Commercial bank acceptable to the Employer in amounts equal to the advance payment:

- a) Mobilization advance up to 5 percent of the contract price.
- b) equipment advance up to ninety percent of the cost of the new equipment brought to the site, subjects to a maximum of 10 percent of the contract price.

The guarantee shall remain effective until the advance payment has been repaid, but the amount of the guarantee shall be progressively reduced by the amounts repaid by the Contractor. Interest will not be charged on advance payment.

The Contractor is to use the advance payment only to pay for equipment, plant and mobilization expenses required specifically for execution of works. The Contractor shall demonstrate the advance payment as been used in this way by supplying copies of invoices or other documents to the Engineer.

The advance payment shall be repaid by deducting proportionate amounts from payments otherwise due to the Contractor for the construction work, following the schedule of completed percentage of the work on payment basis. No account shall be taken of the advance payment or the repayment in assessing valuation of work done. Variations, price adjustments, Compensation events or liquidated damages.

46. Securities

The Performance Security equal to five percent of the contract price and additional security for unbalanced bids shall be provided to the Employer no later than the date specified in the Letter of Acceptance and shall be issued in the form given in the Contract Data and by a scheduled commercial bank. The Performance Security shall be valid until a date 45 days from the date of expiry of Defect Liability Period and the

additional security for unbalanced bids shall be valid until a date 45 days from the date of issue of the certificate of completion.

47. Cost of Repairs

Loss or damage to the Works or Materials to be incorporated in the Works between the Start Date and the end of the Defects Correction periods shall be remedied by the Contractor at his cost if the loss or damage arises from the Contractor's acts or omissions.

E. *Finishing the Contract*

48. Completion of Construction and Maintenance

The contractor shall request the Engineer to issue a certificate of completion of the construction of the works, and the Engineer will do so upon deciding that the works is completed.

49. Taking Over

The Employer shall take over the works within seven days of the Engineer issuing a certificate of completion of works.

50. Final Account

The contractor shall supply the Engineer with a detailed account of the total amount that the Contractor considers payable for works under the contract within 21 days of issue of certificate of completion of construction of works. The Engineer shall issue a defect liability certificate and certify any payment that is due to the correct and complete. If the account is not correct or complete, the engineer shall issue within 42 days a schedule that states the scope of the corrections or additions that are necessary. If the account is still unsatisfactory after it has been resubmitted, the Engineer shall decide on the amount payable to the contractor and issue a payment certificate within 28 days of receiving the Contractor's revised account. The payment of final bill for construction of works will be made within 14 days thereafter.

In case the account is not received within 21 days of issue of Certificate of Completion as provided in clause 50. I above, the engineer shall proceed to finalize the account and issue a payment certificate within 28 days. The payment of final bill for construction of works will be made within 14 days thereafter.

51. Operating and Maintenance Manuals

If "as built" Drawings and/or operating and maintenance manuals are required, the Contractor shall supply them by the dates stated in the Contract Data.

If the Contractor does not supply the Drawings and/or manuals by the dates stated in the Contract Data, or they do not receive the Engineer's approval, the Engineer shall withhold the amount stated in the Contract Data from payments due to the Contractor. The entire water supply system will be monitored by full SCADA system compatible to link to master control centre. A period of 60 months shall be provided to the contractor to construct the water supply system. Thereafter the Contractor shall operate and maintain the water supply system thus constructed for a period of next 5 years. All the functions of operations, repair & maintenance, providing new connections and disconnections, if any, metering billing and collection of revenue etc will be carried out by the contractor on behalf of the Agra Smart City Limited.

The water supply project proposed for Agra has objective to achieve ultimate goals of continuous water supply system, sustainability, imparting energy efficiency, control on

NRW, and Introducing (SCADA) automation for efficient management of water supply system

Deign period is 30 years, taking base year as 2020.

Projection of population

To review the existing water supply system in ABD area

Creation of new raw water storage at the existing headworks

By abandoning existing infrastructure wherever the same is uneconomical when undertaken for rehabilitation

Design and Provide transmission main

Design and provide new raw water and clear water pumping plants

Design and provide new OHTs of required quantity and staging height

Replacement of old & inefficient pumping machinery installed at various places serving ABD area with new & energy efficient pumping machinery

Abandoning the existing old distribution system by a newly designed distribution network

Reduction in NRW in pilot zones with the objective of attaining continuous water supply with minimum residual pressure of 12m

system automation (SCADA)

52. Termination

The Employer may terminate the Contract if the Contractor causes a fundamental breach of the Contract.

Fundamental breaches of Contract shall include, but shall not be limited to, the following:

- a) the Contractor stops work for 28 days when no stoppage of work is shown on the current Program and the stoppage has not been authorized by the Engineer;
- b) the Contractor is declared as bankrupt or goes into liquidation other than for approved reconstruction or amalgamation;
- c) the Engineer gives Notice that failure to correct a particular Defect is a fundamental breach of Contract and the Contractor fails to correct it within a reasonable period of time determined by the Engineer;
- d) the Contractor does not maintain a Security, which is required;
- e) the Contractor has delayed the completion of the Works by the number of days for which the maximum amount of liquidated damages can be paid, as defined in clause 44.1;
- f) the Contractor fails to provide insurance cover as required under clause 13;
- g) if the Contractor, in the judgment of the Employer, has engaged in the corrupt or fraudulent practice in competing for or in executing the Contract. For the purpose of this clause, "corrupt practice" means the offering, giving, receiving, or soliciting of anything of value to influence the action of a public official in the procurement process or in Contract execution. "Fraudulent Practice" means a misrepresentation of facts in order to influence a procurement process or the execution of a contract to the detriment of the Employer and includes collusive practice among Bidders (prior to or after bid submission) designed to establish bid process at artificial non-competitive levels and to deprive the Employer of the benefits of free and open competition.

- h) if the Contractor has not completed at least thirty percent of the value of construction Work required to be completed after half of the completion period has elapsed;
- i) if the Contractor fails to set up a field laboratory with the prescribed equipment, within the period specified in the Contract Data; and
- j) Any other fundamental breaches as specified in the Contract Data.
- k) if the Contractor fails to deploy machinery and equipment or personnel as specified in the contract Data at the
Appropriate time.

Notwithstanding the above, the Employer may terminate the Contract for convenience. If the Contract is terminated, the Contractor shall stop work immediately, make the Site safe and secure, and leave the Site as soon as reasonably possible.

53. Payment upon Termination

If the Contract is terminated because of a fundamental breach of Contract by the Contractor, the Engineer shall issue a certificate for the value of the work done and Materials ordered less liquidated damages, if any less advance payments received up to the date of the issue of the certificate and less the percentage to apply to the value of the work not completed, as indicated in the Contract Data. If the total amount due to the Employer exceeds any payment due to the Contractor, the difference shall be recovered from the security deposit, and performance security. If any amount is still left unrecovered it will be a debt payable to the Employer.

If the Contract is terminated at the Employer's convenience, the Engineer shall issue a certificate for the value of the work done, the reasonable cost of removal of equipment, repatriation of the Contractor's personnel employed solely on the Works, and the Contractor's costs of protecting and securing the Works and less advance payments received up to the date of the certificate, less other recoveries due in terms of the Contract, and less taxes due to be deducted at source as per applicable law.

54. . Property

All Materials on the Site, Plant, equipment, Temporary Works, and Works shall be deemed to be the property of the Employer for use for completing balance construction work if the Contract is terminated because of the Contractor's default, till the Works is completed after which it will be transferred to the Contractor and credit, if any, given for its use.

55. Releases from Performance

If the Contract is frustrated by the outbreak of war or by any other event entirely outside the control of the Employer or the Contractor, the Engineer shall certify that the Contract has been frustrated. The Contractor shall make the Site safe and stop work as quickly as possible after receiving this certificate and shall be paid for all work carried out before receiving it and for any work carried out afterwards to which a commitment was made.

F. Other Conditions of Contract

56. Labor

The Contractor shall, unless otherwise provided in the Contract, make his own arrangements for the engagement of all staff and labor, local or other, and for their payment, housing, feeding and transport.

The Contractor shall, if required by the Engineer, deliver to the Engineer a return in detail, in such form and at such intervals as the Engineer may prescribe, showing the

staff and the numbers of the several classes of labor from time to time employed by the Contractor on the Site and such other information as the Engineer may require.

57. COMPLIANCE WITH LABOUR REGULATIONS

During continuance of the Contract, the Contractor and his sub Contractors shall abide at all times by all existing labor enactments and rules made there under, regulations, notifications and bye laws of the State or Central Government or local authority and any other labor law (including rules), regulations, bye laws that may be passed or notification that may be issued under any labor law in future either by the State or the Central Government or the local authority. Salient features of some of the major labor laws that are applicable to construction industry are given in Appendix to Part I General Condition of Contract. The Contractor shall keep the Employer indemnified in case any action is taken against the Employer by the competent authority on account of contravention of any of the provisions of any Act or rules made there under, regulations or notifications including amendments. If the Employer is caused to pay or reimburse, such amounts as may be necessary to cause or observe, or for non-observance of the provisions stipulated in the notifications/bye laws/Acts/Rules/regulations including amendments, if any, on the part of the Contractor, the Engineer/Employer shall have the right to deduct any money due to the Contractor including his amount of performance security. The Employer/Engineer shall also have right to recover from the Contractor any sum required or estimated to be required for making good the loss or damage suffered by the Employer.

The employees of the Contractor and the Sub-Contractor in no case shall be treated as the employees of the Employer at any point of time.

58. Drawings and Photographs of the Works

The contractor shall do photography/video photography of the site firstly before the start of the work, secondly mid-way in the execution of different stages of work and lastly after the completion of the work. No separate payment will be made to the contractor for this.

The Contractor shall not disclose details of Drawings furnished to him and works on which he is engaged without the prior approval of the Engineer in writing. No photograph of the works or any part thereof or plant employed thereon, except those permitted under clause 58.1, shall be taken or permitted by the Contractor to be taken by any of his employees or any employees of his sub-Contractors without the prior approval of the Engineer in writing. No photographs/ Video photography shall be published or otherwise circulated without the approval of the Engineer in writing.

59. The Apprentices Act 1961

The Contractor shall duly comply with the provisions of the Apprentices Act 1961 (III of 1961), the rules made there under and the orders that may be issued from time to time under the said Act and the said Rules and on his failure or neglect to do so he shall be subject to all liabilities and penalties provided by the said Act and said Rules.

60. Criminals are prohibited from bidding

Any bidders having **criminal record** is not allowed to participate in the bidding process. Any person who is having criminal cases against him or involved in the **organized crime or gangster activities or Mafia or Goonda or Anti social activity** are strictly prohibited to participate in the bidding process. If it is established that any bidder has **criminal record, his bid shall be automatically cancelled.**

The bidder has to produced character certificate, Solvency certificate, self declared affidavit (on the prescribed Performa which is attached with the bid document) etc., issued by the competent authority in original with bid document.

- 61.** Any bidder who is an Advocate and Registered with any State Bar Council Shall not be allowed to participate in the bidding. If it is established that the contractor is registered with the state bar council, **his bid shall be automatically cancelled.**

Contract Data to General Conditions of Contract

Except where otherwise indicated, the Employer prior to issuance of the bidding documents should fill in all Contract Data. Schedules and reports to be provided by the Employer should be annexed

Clause Reference

Items marked “N/A” do not apply in this Contract.

1. The Employer is: [Cl.1.1]
 Designation: **Chief Executive officer, ASCL Agra**
 E-mail ID :gm@agrasmartcity.in
2. The Intended Completion Date for the whole of the Works is **AS PER NIT** [Cl.1.1, 17&27] after start of work.
3. **The Site is located : Agra U.P.**
4. The Start Date shall be Same days after the date of issue of the Notice to proceed with the work. [Cl.1.1]
5. The works shall, inter-alia, include the following, as specified or as directed.
 - a) Laying of transmission main 1200mm dia. M.S pipe for a length of 2.00 Km
 - b) Laying of feeder main diameter ranging from 150mm to 500mm DI pipe for a length of 2.00 Km
 - c) Laying of distribution mains using HDPE pipe diameter ranging from 110mm to 225mm for a length of 100.0 Km
 - d) Construction of pumping station including Electro-Mechanical components
 - e) Design, plan and construction of OHT of staging height 20 meter 2 Nos
 - f) Providing House Service Connections using HDPE pipe and AMR water meters (10,000 Nos.)
 - g) SCADA system for entire water supply system
 - h) Bidder shall have successfully operated and maintained at least one drinking water supply system for a minimum period of two years in the last five (5) years.
6. Section completion is [Cl 2.2]
7. The following documents also form part of the Contract: [Cl.2.3(11)]
8. (a) The law which applies to the Contract is the law of Union of India. [Cl.3.1]
 (b) The language of the Contract documents is English. [Cl.3.1]
9. The Schedule of Other Contractors is attached. [Cl. 8.1]
10. A. The Technical Personnel for construction work are: [Cl. 9.1]

Technical Personnel	Number	Experience in water Supply Works
A. Degree Holder in Civil / Mechanical/ Electrical Engineering	1	Minimum 20 years of Experience out of which five years of experience of having handled/executed independently large water supply work project.
B. Degree Holder in Civil Engineering	1	Minimum 5 years of Experience
C. Degree Holder in Mechanical Engineering	1	Minimum 5 years of Experience
D. Degree Holder in Electrical/ Electronic Engineering	1	Minimum 5 years of Experience
E. Diploma holder in Civil Engineering	2	Minimum 2 years of Experience

F. Diploma holder in Mechanical / Electrical Engineering	2	Minimum 2 years of Experience in Maintenance of plant & machinery
G. Surveyor	3	Minimum 2 years of Experience
I. ITI Certified Plumber/ Electrician/ Welder/ Fitter	10	Minimum 2 years of Experience

For field testing laboratory

Technical Personnel	Number	Experience in Water Supply Works
A. Degree Holder in Civil / Mechanical/ Electrical Engineering	2	Minimum 5 years of Experience in Testing and Quality control in Water Supply Work.
B. Lab Assistant/Technical (ITI/B.Sc)	2	Minimum 2 years of Experience in maintenance of plant & machinery.
E. Surveyor	1	Minimum 2 years of Experience in testing

B. For routine maintenance

Technical Personnel	Number	Experience in Water Supply Works
A. Degree Holder in Civil / Mechanical/ Electrical Engineering	1	At least 2 Years
A. Diploma Holder in Mechanical/ Electrical Engineering	1	At least 2 Years
SCADA Operator	10	At least 2 Years
B. Lab Assistant/Technical (ITI/B.Sc)	1	At least 2 Years

To start with, the scheme may be introduced in one zone as a pilot study. After observing the results and rectifying the problems encountered, the scheme may gradually be introduced in all other zones. Pilot DMAs are created and unauthorized connections are legitimized.

- The DMAs are converted to continuous pressurised supply and are operated for at least 12 months in a sustainable way.
- Volumetric charging is introduced.
- The changes in customer attitudes and behavior (including coping strategies) are monitored.
- The staff must be trained in modern operational techniques like leak detection and pressure management
- Once these first set of DMAs have successfully supplied water continuously and effectively reduced water losses, then the next set of DMAs can be established for conversion to 24-hour supply

13(a) Amount and deductible for insurance are:

[cl.13.1]

Item		Amount to be insured		Deductibles
A.	Loss of or damage to the works, Plants and materials	10 % of contract value		Deductibles for insurance shall be as per latest tariff of General Insurance Company of India plus 20% of premium amount for items A, B, C & D
B.	Loss of or damage to equipments	2.5 % of contract value		
C	Loss of or damage to property (except the works, plant, Materials, and Equipments) in Connection with the contract:	1 % of contract value		
D	Personal injury or death	Up to contract value Rs. 2 Crores	Rs. 2 lacs per occurrences for maximum three occurrences	
		For contract value more than Rs. 2 Crores	Rs. 2 lacs per occurrences for maximum three occurrences	

13(a) Amount and deductible for insurance are:

[cl.13.3(a)]

Item		Amount to be insured	Deductibles
A.	Personal injury or death	Rs. 2 Lacs for one occurrence per year	Deductibles shall be as per latest tariff of General Insurance Company of India plus 20% of the premium amount.

14. Site investigation report

[cl.14.1]

15. The key equipments/machinery for construction of works shall be:

Sl.	Name of the Equipments	Cost Of Work Up To 2 Crores	Quantity /No Cost Of Work More Than 2 Crores
1	R.M.C. plant	-	1
2	Transport Miller	-	-
3	Tar Boiler	2	-
4	Mixture/Mixer	1	4
5	Concrete Mixture	1	4
6	Water Tanker	8	8
7	Diesel Road Roller (8-10 Ton Capacity)	4	-
8	Vibratory Roller	-	-
9	Tractor	-	2
10	Truck	-	4
11	Hot mix plant with sensor paver	-	-
12	Air compressor	1	-
13	Mechanical Broom	1	-
14	Bitumen Distributor/ mechanical sprayer	1	-
15	Tipper	-	4
16	J.C.B.	-	2
17	Pockland	-	1
18	Wet Mix Macadam Plant with paver	-	-
19	Pin vibrator	2	-
20	Generator 250 KVA	1	3
21	Grader	-	-
22	Soil Compactor	1	-
23	Concrete Vibrator with niddle	1	-

24	Field Laboratoy	1	2
25	Hydra (CAPACITY 8 TON)	-	As per requirement
26	Mastic Cooker	-	-
27	Trolley	-	As per requirement
28	Barrier	-	As per requirement
29	Cone	-	-
30	Reflective Tape	-	-
31	Dumpy level	2 Nos.	2 Nos.
32	Total station	1 No.	1 No.

[Cl 16.2]

16. Competent authorities are: [Cl. 24.1]

Chief Executive Officer

17. (a) The period for submission of the program for approval of Engineer shall be TEN days from the issue of Letter of Acceptance. [Cl.26.1]

(b) The updated program shall be submitted at interval of 60 days. [Cl. 26.3]

(c) The amount to be withheld for late submission of an updated program shall be Rs. 10,000=00 per day for contract value up to 2 Crore and Rs. 20,000=00 per day for contract value above Rs. 2 Crores. [Cl. 26.3]

18. The key equipment for field laboratory shall be : As per mentioned in specification for relevant Items

19. *No increase in rates of any items specified in Bill Of Quantity is allowed due to variation in quantities* [Cl 36.1]

20. The authorized person to make payments is **CEO, Agra Smart City Limited, Agra.**
[Cl 39.2]

21. (a) Milestone to be achieved during the contract period.

(1) 1/8th of the value of entire contract work up to 1/4th of the period allowed for completion of construction.

(2) 3/8th of the value of entire contract work up to 1/2nd of the period allowed for completion of construction.

(3) 3/4th of the value of entire contract work up to 3/4th of the period allowed for completion of construction.

(b)

Amount of liquidated damages for delay in completion of works	For whole of work 1 percent of the initial contract price, rounded off to the nearest thousand, per week
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(c)

Maximum limit of liquidated damages for delay in completion of work.	10 percent of the initial contract price rounded off to the nearest thousand
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[CI 44.10]

22. The standard form of performance security acceptable to the employer shall be an unconditional Bank Guarantee of the type as presented in the Bidding Documents.

[CI 46.1]

23. (a) The Schedule of operating and maintenance manuals N.A

[CI 51.1]

(b) The date by which “as-built” drawings (in scale as directed) in 2 sets are required is within 28 days of issue of certificate of completion of whole or section of the work, as the case may be (including L-section and cross section of the road)

[CI 51.1]

24. The amount to be withheld for failing to supply “as-built” drawings by the date required is Rs. One Lac.

[CI 51.2]

25. (a) The Period for setting up a field laboratory with the prescribe equipment is 7 (Seven)

Days from the days from the date of notice to start work

[CI 51.2.(i)]

(b) The following events shall be fundamental breach of contract: “The Contractor has contravened Clause 7.1 and Clause 9 Of Part I General Condition Of Contract”

[CI 51.2.(j)]

26. The Percentage to apply to the value of the work not completed representing the Employer’s additional cost for the completing the works shall be 20%

[CI 53.1]

Appendix to Part I -General Condition of Contract

SALIENT FEATURES OF SOME MAJOR LABOUR LAWS APPLICABLE TO ESTABLISHMENTS ENGAGED IN BUILDING AND OTHER CONSTRUCTION WORK.

- a) Workmen Compensation Act 1923: - The Act provides for compensation in case of injury by accident arising out of and during the course of employment.
- b) Payment of Gratuity Act 1972: - Gratuity is payable to an employee under the Act on satisfaction of certain conditions on separation if an employee has completed the prescribed minimum years (say, five years) of service or more or on death the rate of prescribed minimum days (say, 15 days) wages for every completed year of service. The Act is applicable to all establishments employing the prescribed minimum number (say, 10) or more employees.
- c) Employees P.F. and Miscellaneous Provision Act 1952: The Act Provides for monthly contributions by the Employer plus workers at the rate prescribed (say, 10% or 8.33%). The benefits payable under the Act are:
 - i. Pension or family pension on retirement or death as the case may be.
 - ii. Deposit linked insurance on the death in harness of the worker.
 - iii. Payment of P.F. accumulation on retirement/death etc.
- d) Maternity Benefit Act 1951: - The Act provides for leave and some other benefits to women employees in case of confinement or miscarriage etc.
- e) Contract Labor (Regulation & Abolition) Act 1970: - The Act provides for certain welfare measures to be provided by the Contractor to contract labor and in case the Contractor fails to provide, the same are required to be provided, by the Principal Employer by Law. The principal Employer is required to take Certificate of Registration and the Contractor is required to take license from the designated Officer. The Act is applicable to the establishments or Contractor of Principal Employer if they employ prescribed minimum (say 20) or more contract labor.
- f) Minimum Wages Act 1948: - The Employer is to pay not less than the Minimum Wages fixed by appropriate Government as per provisions of the Act if the employment is a scheduled employment. Constructions of buildings, roads, runways are scheduled employment.
- g) Payment of Wages Act 1936: - It lays down as to by what date the wages are to be paid, when it will be paid and what deductions can be made from the wages of the workers.
- h) Equal Remuneration Act 1979: - The Act provides for payment of equal wages for work of equal nature to male and female workers and for not making discrimination against female employees in the matters of transfers, training and promotions etc.
- i) Payment of Bonus Act 1965: - The Act is applicable to all establishments employing prescribed minimum (say, 20) or more workmen. The Act provides for payments of annual bonus within the prescribed range of percentage of wages to employees drawing up to the prescribed amount of wages, calculated in the prescribed manner. The Act does not apply to certain establishments. The newly set-up establishments are exempted for five years in certain circumstances. States may have different number of employment size.
- j) Industrial Disputes Act 1947: - The Act lays down the machinery and procedure for resolution of industrial disputes, in what situations a strike or lock-out becomes illegal and what are the requirements for laying off or retrenching the employees or closing down the establishment.
- k) Industrial Employment (Standing Orders) Act 1946: - It is applicable to all establishments employing prescribed minimum (say, 100, or 50). The Act provides for laying down rules governing the conditions of employment by the Employer on matters provided in the Act and get these certified by the designated Authority.
- l) Trade Unions Act 1926: - The Act lays down the procedure for registration of trade unions of workmen and Employers. The Trade Unions registered under the Act have been given certain immunities from civil and criminal liabilities.

- m) Child Labor (Prohibition & Regulation) Act 1986: - The Act prohibits employment of children below 14 years of age in certain occupations and processes and provides for regulations of employment of children in all other occupations and processes. Employment of child labor is prohibited in building and construction industry.
- n) Inter-State Migrant Workmen's (Regulation of Employment & Conditions of Service) Act 1979: - The Act is applicable to an establishment which employs prescribed minimum (say, five) or more inter-state migrant workmen through an intermediary (who has recruited workmen in one state for employment in the establishment situated in another state). The Inter-State migrant workmen, in an establishment to which this Act becomes applicable, are required to be provided certain facilities such as Housing, Medical-Aid, Traveling expenses from home up to the establishment and back etc.
- o) The Building and Other Construction workers (Regulation of Employment and Conditions of Service) Act 1996 and the Cess Act of 1996: - All the establishments who carry on any building or other construction work and employs the prescribed minimum (say, 10) or more workers are covered under this Act. All such establishments are required to pay cess at the rate not exceeding 2% of the cost of construction as may be modified by the Government. The Employer of the establishment is required to provide safety measures at the building or construction work and other welfare measures, such as canteens, first-aid facilities, ambulance, housing accommodations for workers near the work place etc. The Employer to whom the Act applies has to obtain a registration certificate from the Registering Officer appointed by the Government.
- p) Factories Act 1948: - The Act lays down the procedure for approval of plans before setting up a factory, health and safety provisions, welfare provisions, working hours, annual earned leave and rendering information regarding accidents or dangerous occurrences to designated authorities. It is applicable to premises employing the prescribed minimum (say, 10) persons Or more with aid of power or another prescribed minimum (say, 20) or more persons without The aid of power engaged in manufacturing process.
- q) Arbitration and Conciliation Act, 1996: - The Act lays down the procedure for appointment of Arbitrator, Arbitration and conciliation, Jurisdiction of Arbitral Tribunals, Recourse against Arbitral award appeals.

Section- 4.

Conditions of Contract

Part – II Special Conditions of Contract

1. Contractors are advised to inspect the site of work before tendering.
2. All the works shall be carried out as per Jal Nigam Uttar Pradesh specifications/PWD detailed specification and instruction of Engineer-in-charge.
3. The conditional tender shall be liable to rejected.
4. Hiding of any information by contractor will result in rejection of his tender.
5. The quantities are liable to vary on either side to any extent as per actual requirement of work for which no claim whatsoever by the contractor shall be entertained.
6. Any recovery imposed by Technical Audit cell or by higher authority will be deducted from contractors running final bills during execution of works and will be adjusted from performance security if final bill is processed during defect liability period.
7. All the defects appeared' during execution of work will have to be rectified as directed by Engineer in charge within shortest possible time. During defect liability period contractor will be deploy sufficient technical staff as mention in contract document for, proper maintenance of work. If contractor fails to attend the defects. Within reasonable time period, the same will be attended by department and all expenses so incurred will be adjusted from performance security of contractors.
8. The contractor will adopt PERT to complete the project in time. A detailed program and weekly working program will have to be submitted by contractor regularly.
9. For earth work, each borrow pit will have get to be approved from competent authority by furnishing all physical/chemical characteristic of earth of each borrow pit before start of work. The contractors are advised to survey the area to ascertain the availability of earth before tendering.
10. Project Management Consultancy:

OBJECTIVE The objective of this Consultancy (the “Objective”) is to assist the ASCL in implementation of the Project till the successful completion and handing over of all works to the ASCL and comprehensively supervise the works and activities carried out by the Bidder(s) as Engineer’s Representative” under the respective contract(s) in a manner that would ensure:

- a. Total compliance of technical specifications and various other requirements contained in the respective contracts by the Bidder(s);
- b. High standards of quality assurance system in the Consultancy as well as the works and activities of the Bidder(s);
- c. Comprehensive and documented reporting to the ASCL of Consultant’s own activities, progress of the Project(s) and compliances/ non-compliances by the Bidder(s);
- e. Proper verification of measurements and bills submitted by the Bidder(s) so that payments made by the ASCL against these bills truly reflect the actual work done at site complying with the requirements of the respective contract(s);
- f. proper interface and coordination among the ASCL, Bidder(s), other Bidders/ Bidders and local bodies/ state government; and
- g. Full documentation of the completed works including applications for various approvals.

The objectives of the PMC is not limited to the above, CEO of ASCL have discretion implement other objectives or the completion of the project.

CONDITIONS OF CONTRACT	
Security Deposit	<p>Clause 1:The person / persons whose tender may be accepted(hereinafter called the Contractor, which expression shall unless excluded by or repugnant to the context include his heirs, executors, administrators and assigns) shall (A) within 10 days (which may be extended by the Chief Executive Officer, ASCL concerned up to 15 days, if the Chief Executive Officer ASCL thinks fit to do so) of the receipt by him of the notification of the acceptance of his tender deposit with the Chief Executive Officer ASCL in F.D.R. (if deposited for more than 12 months of sum as will amount to 5 percent of all moneys so payable such deductions to be held by ASCL by way of security Deposit). Provided always that in the event of the Contractor depositing a lump sum by way of security deposit as contemplated at (A) above then and in such case if the sum so deposited shall not amount to 5 percent of the total estimated cost of the work, it shall be lawful, for ASCL at the time of making any payment to the Contractor for work done under the contract C to Y make up the full amount of 5 percent by deducting a sufficient sum from every such payment as last aforesaid until the full amount of the security deposit is made up. All compensation or other sums of money payable by the Contractor to ASCL under the terms of his contract may be deducted from, or paid by the sale of sufficient part of the security deposit or from the interest arising there from, or from any sums which may be due or may become due by Corporation to the contractor under any other contract or transaction of any nature on any account whatsoever and in the event of his Security Deposit being reduced by a reason of ten days thereafter, make good in cash or F.D.R. pledged to Chief Executive Officer ASCL as aforesaid 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 referred to when paid in cash, at the cost of the depositor, be converted and interest-bearing securities provided that the depositor has expressly desired this in writing.</p> <p>If the amount of the security deposit to be paid in a lump sum within the period specified at (A) above is not paid the tender/ contract already accepted shall be considered as cancelled any legal steps taken against the contract for recover of amounts, the amount of the security deposit lodged by a contractor shall be refunded after a date up to which the contract has agreed to maintain the work in good order is over. In the event of the contractor failing or neglecting to complete rectification work within the period up to which the contractor has agreed to maintain the work in good order, then, subject to provisions of clause 17 and 20 hereof the amount of security deposit retained by ASCL shall be forfeited without any notice.</p>
Compensation for delay	<p>Clause-2: The time allowed to carry out the work as entered in the tender shall be strictly observed by the contractor and shall be reckoned from the date on which the order to commence work is given to the Contractor. The work shall through the stipulated period of the contract be proceeded with, all due diligence (time being deemed to be of the essence of the contract on the part of the Contractor) and the Contractor shall pay as compensation and amount equal to one percent as Board ASCL (whose decision in writing shall be final) may decide of the amount of estimated cost of the whole work as shown by the tenderer of everyday the work remains un commenced or unfinished after the proper dates.And further to ensure good progress during execution of the work, the contractor shall be bound, in all cases in which the time allowed for any work exceeds one month to complete.</p> <p> $\frac{1}{4}$ of the working $\frac{1}{3}$ of the time $\frac{1}{4}$ of the working $\frac{1}{2}$ of the time $\frac{1}{4}$ of the working $\frac{3}{4}$ of the working </p>

	<p style="text-align: center;">$\frac{1}{4}$ $\frac{3}{4}$ of the time</p> <p style="text-align: center;">and full work should be completed in (27 Calendar months)</p> <p>NOTE: The quantity of the work to be done within a particular time to be specified above shall be fixed and inserted in the blank space kept for the purpose of the officer competent to accept the contracts after taking into consideration the circumstances of each case and abide by the program of detailed progress laid down by the Project Engineer. In the event of the Contractor failing to comply with these conditions he shall be liable to pay as compensation, an amount an equal to one percent as the Board ASCL(whose decision in shall be final) may decide of the said estimated cost of the whole work for everyday that the due quantity of work remains incomplete provided always that the total amount of compensation to be paid under the provisions of this clause shall not exceed 10 percent of the estimated cost of the work as shown in the tender. Chief Executive Officer, ASCL, should be the final authority in the respect.</p>
<p>Action when whole of security Deposit is forfeited</p>	<p>Clause-3 :In any case in which under any clause of this contract the Contractor shall have rendered himself liable to pay compensation amounting to the whole of his security deposit whether paid in one sum or deducted by the installments or in the case of abandonment of the work owing to serious illness or death of the Contractor or any other cause the Chief Executive officer, on behalf of the ASCL, shall have the power to adopt any of the following courses, as he may deem best suited to the interest of the ASCL.</p> <p>(a) To rescind the contract (for which rescission notice in writing to the Contractor under the hand of Chief Executive officer shall be conclusive evidence) and in that case the security deposit of the Contractor shall stand forfeited and be absolutely at the disposal of the ASCL.</p> <p>(b) To carry out the work or any part of the work departmentally debiting the Contractor with the cost of the work, expenditure incurred on the tools and plant, and charges on additional supervisory staff including the cost of the work-charged establishment employed for getting the un-executed part of the work completed and crediting him with the value of the work done departmentally in all respect in the same manner and at the same rates as if it had been carried out by the Contractor under terms of his contract. The certificate of the Chief executive officer as to the costs and other allied expense so incurred and as to the value of the work so done departmentally shall be final and conclusive against the Contractor.</p> <p>(c) i) To order that the work of the Contractor be measured up and to take such part thereof as shall be un-executed out of his hands, and to give it to another Contractor to complete, in which case all expenses incurred on advertisement for fixing a new contracting agency ,additional supervisory staff including the cost of the work charged establishment and the cost of the work executed by the new Contractor agency will be debited to the Contractor and the value of the work done or executed through the new Contractor in all respects and in the same manner and at the same rates as if it had been carried out by the Contractor under the terms of his contract. The certificate of the Chief executive officer as to the costs and other allied expense so incurred and as to the value of the work so done departmentally shall be final and conclusive against the contractor.</p> <p>ii)In case the contract shall be rescinded under clause (a) above the Contractor shall not be entitled to recover or be paid, any sum for any work thereof actually performed by him under this contract unless and until the Chief Executive officer shall have certified in writing the performance of the such work and the amount payable to him in respect thereof and he shall only be entitled to be paid the amount so certified. In the event of either of courses referred to clause (b) or</p>

	<p>(c) being adopted and the cost of the work executed departmentally or through new contractor and other allied expense exceeding the value of such work credited to the Contractor the amount of excess shall be deducted from any money due to the Contractor, by ASCL under the contractor or otherwise howsoever or from his security deposit or the sale proceeds thereof provided; however that Contractor shall have no claim against ASCL</p> <p>even if the certified value of the work done departmentally or through a new Contractor exceeds the certified cost of such work and allied expenses, provided always that whichever of the three courses mentioned in clause (a), (b) or (c) is adopted by the Chief Executive Officer ASCL, the Contractor shall have no claim to compensation for any loss sustained by him by reason of his having purchased or procured any materials, or entered into any engagements, or made any advance on account of or with a view to the execution of the work or the performance of the contract</p>
<p>Action when the progress of any particular portion of the work is unsatisfactory</p>	<p>Clause – 4: If the progress of any particular portion of the work is unsatisfactory, the Chief Executive Officer ASCL shall notwithstanding that the general progress of the work is in accordance with the conditions mentioned in clause 2 be entitled to take action under clause 3 (b) after giving the Contractor 10 days’ notice in writing. The contractor will have no claim for compensation, for any loss sustained by him owing to such action</p>
<p>Contractor remains liable to pay compensation if action not taken under clause 3 and 4</p>	<p>Clause – 5 :In any case in which any of the powers conferred upon the Project Engineer by clause 3 and 4 shall have become exercisable and the same shall not have been exercised the non-exercise thereof shall not constitute a waiving of any of the condition here of the such power shall notwithstanding be exercisable in the event of any future case of default by the Contractor for which under any clause hereof he is declared liable to pay compensation amounting to the whole of his security deposit and the liability of the Contractor for past and future compensation shall remain unaffected,. In the event of the Project Engineer taking action under sub-clause (a) or (c) of clause 3, he may, if he so desires, take possession of all or any tools and plant, materials and stores in or upon the work of the site thereof belonging to the Contractor, or procured by him 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 contract rates not being applicable at current market rates to be certified by the Chief Executive officer whose certificate thereof shall be final. In the alternative, the Chief Executive officer may, after giving notice in writing to the Contractor or his duly authorized representative, foreman or other authorized agent required him to remove such tools and plant, materials, or stores from the premises within a time to be specified in such notice, and in the event of the Contractor failing to comply with any such requisition, the Project Engineer may remove them at the Contractor’s expenses or sell them by auction or private sale on account of the Contractor and at his risk in all respects, and the certificate of Project Engineer 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</p>
<p>Extension of time limit</p>	<p>Clause – 6: If the Contractor shall desire an extension of the time for completion of work on the ground of his having been unavoidably hindered in its execution or on any other ground he shall apply in writing to the Chief Executive officer before the expiration of the period stipulated in the tender or before the expiration of 30 days from the date on which he was hindered as aforesaid or on which the clause for asking for extension occurred, whichever is earlier and the chief executive officer with the approval of Chairman ASCL, if there were reasonable ground for granting an</p>

	extension, grant such extension as he thinks necessary or proper, the decision of the Chief Executive Officer ASCL in this matter shall be final.
Final Certificate	Clause – 7 : On the completion of the work the Contractor shall be furnished with a certificate by the Project Engineer of such completion; but no such certificate shall be given nor shall the work be considered to be complete until the Contractor shall have removed from the premises on which the work shall have been executed, all scaffolding, surplus materials and rubbish, and shall have cleaned off, the dirt from all wood work, doors, windows, wall, floor or other parts of any building in or upon which the work has been executed, or of which he may have had possession for the purpose of executing the work, nor until the work shall have been measured by the Project Engineer or where the measurements have been taken by his subordinates until they have received approval of the Project Engineer, the said measurements being binding and conclusive against Contractor. If the contractor shall fail to comply with the requirements of this clause as to the removal of scaffolding surplus materials and rubbish and cleaning of dirt on or before the date fixed for the completion of the work the Project Engineer may at the expense of the Contractor, removal such scaffolding, surplus material and rubbish, and dispose of the same as he thinks fit and clean off as such dirt as aforesaid and the Contractor shall from with pay the amount of the all expenses so incurred, but shall have no claim in respect of any such scaffolding or surplus materials as aforesaid except for any sum actually realized by the sale thereof
Payment on intermediate certificate to be regarded as advances	Clause-8: No payment shall be made for any work, estimated to cost less than rupees one thousand till after the whole of work shall have been completed and a certificate of completion given. But in the case of works estimated to cost more than rupees one thousand the Contractor shall on submitting a monthly bill therefore be entitled to receive payment proportionate to the part of the work than approved and passed by the Project Engineer, whose certificate of such approval and passing of the sum so payable shall be final and conclusive against the Contractor. All such intermediate payments shall be regarded as payment by way of advance against the final payment only and not as payment for work actually done and completed and shall not preclude the Project Engineer from requiring any bad, unsound imperfect or unskillful work to be removed or taken away and reconstructed, or re-erected nor shall any such payment be considered as an admission of the due performance of the contract or any part thereof in any respect or the occurring of any claim nor shall it conclude, determine or effect in any other way powers of the Project Engineer as to the final settlement and adjustment of the accounts or otherwise, or in any other way vary or effect the contract. The final bill shall be submitted by the Contractor within one month of the date fixed for the completion of the work, otherwise the Project Engineer certificate of the measurements and of the total amount payable for the work shall be final and binding on all parties
Payment on reduced rates on account of items of work not accepted as completion discretion of Engineer-in-Charge	Clause-9: The rates of several items of work estimated to cost more than Rs. 1000/- agreed to within, shall be valid only when the item concerned is accepted as having been completed fully in accordance with the sanctioned specifications. In case where the item of work are not accepted as so completed by the Board ASCL may make payment on account of such item at such reduced rates as he may consider reasonable in the preparation of final or on account bills.
Bill to be submitted	Clause –10: A bill shall be submitted by the Contractor in each month on or before the date fixed by the Project Engineer for all work executed in the previous month and the Project Engineer shall take or cause to be taken the requisite measurement for the purpose of having the same verified and the claim, so far as it is admissible, shall be adjusted, if possible, within 10 days from the presentation of the bill. If the contractor does not submit the bill within the time fixed as aforesaid, the Project Engineer may

	depute a subordinate to measure up the said work in the presence of the contractor or his duly authorized agent whose counter signature to the measurement list shall be sufficient warrant, and the Project Engineer may prepare a bill from such a list which shall be binding on the contractor in all respects
Bill to be on printed forms	Clause-11: The contractor shall submit all bills on the printed forms to be had in the application at the office of the Project Engineer. The charges to be made in the bill shall always be entered at the rates specified in the tender or in the case of any extra work ordered in pursuance of these conditions, and not mentioned or provided for in the tender at the rates hereinafter provided for such work
Stores supplied by ASCL	<p>Clause-12: If the specification or estimate of the work provides for the use of any special description of materials to be supplied from the store of the Engineering departmental store or if it is required that the contractor shall use certain stores to be provided by the Project Engineer (such materials and stores and the prices to be charged therefore as hereinafter mentioned being so far as practicable for the convenience of the contractor but not so far as in any way to control the meaning or effect to this contract specified in the schedule or memorandum hereto annexed) the contractor shall be supplied with such materials and stored as may be required from time to time to be used only by him for the purpose of the contract only, and the value of the full quantity of the materials and stores so supplied shall be set off or deducted from any sums then due, or thereafter to become due to contractor under the contract, or otherwise, or from the security deposit or the proceeds of the sale thereof if the security deposit is held in pledged securities, the same or a sufficient portion thereof shall in that case be sold for the purpose. All materials supplied to the contractor shall remain the absolute property of ASCL and shall on no account be removed from the site of the work, and shall at all times be open for inspection by the engineer in charge. Any such materials unused and in perfectly good conditions at the time of completion or determination of the contract shall be returned by the engineering departmental store if the Project engineer so requires by a notice in writing given under his hand but the contractor shall not be entitled to return any such materials except with consent of the Project Engineer and shall have no claim for compensation on account of any such material supplied to him as foresaid but remaining unused by him or any wastage in or damage to any such materials</p> <p>Clause-12 (A): All stores of controlled materials such as cement, steel etc., supplied to the contractor by the ASCL should be kept by the contractor under lock and key and will be accessible for inspection by the Project Engineer or his agents all the time</p>
Work to be executed in accordance to specifications, drawings, orders etc.	Clause-13: The contractor shall execute whole and every part of the work in the most substantial and workman like manner, and both as regards materials and every other respect in strict accordance with specifications. The contractor shall also conform exactly, fully, and faithfully to the designs, drawings and instructions in writing relating to the work signed by the Project Engineer and lodged in his office and to which the contractor shall be entitled to have access for the purpose of inspection at such office, or at the site of the work during office hours. The contractor will be entitled to receive three sets of contract drawings and working drawing as well as one certified copy of the accepted tender along with work order free of cost. Further copies of the contract drawings and working drawings if required by him, shall be supplied at the rate of Rs.200/- per set of contract drawings and Rs.100/- per working drawing except where otherwise specified
Alterations in specifications and designs not invalidate	Clause-14: The Project Engineer shall have the power to make any alterations in or additions to original specifications, drawings, designs, and the instructions that may appear to him to be necessary or advisable during the progress of the work, and the contractor shall be bound to carry out the work in accordance with any instructions in

<p>Rates for works not entered in estimate or schedule of rate of the PWD</p>	<p>this connection which may be given to him in the writing signed by the Project Engineer and such alterations shall not invalidate the contract, and any additional work which the contractor may be directed to do in the manner above specified as part of the work shall be carried out by the contractor on the same conditions in all respects on which he agreed to do the main work, and if the additional and altered work includes any class of work for which no rate is specified in the contract, then such work or class shall be carried out at the rates entered in the Schedule of rates of the PWD or the ASCL or at the rates mutually agreed upon between the Project Engineer or altered work for which no rate is entered in the rates agreed upon then the contractor shall within seven days of the date of receipt by him the order to carry out the work, inform the Project Engineer of the rate which it is his intention to charge for such class of work, and if the Project Engineer does not agree to this rate he shall by notice in writing be at liberty to cancel his order to carry out such class of work and arrange to carry out in such manner as he may consider advisable provided always that if the contractor shall commence work or incurred any expenditure in regard thereto before the rates shall have been determined as lastly herein before mentioned, then in such case he shall only be entitled to be paid in respect of the work carried out or expenditure incurred by him prior to the date of determination of the rate as aforesaid according to such rate or rates as shall be fixed by the Project Engineer in the event of a dispute, the decision of the Board ASCL will be final. Where, however, the work is to be executed according to the designs, drawings and specifications recommended by the contractor and accepted by the competent authority the alterations above referred to shall be within the scope of such designs, drawings and specifications appended to the tender. The time limit for the completion of the work shall be extended in the proportion that the increase in its cost occasioned by alterations, or additions bears to the cost of the original contract work, and the certificate of the Project Engineer as to such proportion shall be conclusive</p>
<p>Extension of time in consequence of additions or alterations</p> <p>No claim to any payment or compensation for alteration in or restriction of work</p> <p>No claim to compensation on account of loss due to delay in supply of material by Corporation</p>	<p>Clause 15-:</p> <ol style="list-style-type: none"> 1) If at any time after the execution of the contract documents the Engineer shall for any reason whatsoever (other than default on the part of the contractor for which the ASCL is entitled to rescind the contract) desires that the whole or the part of the work specified in the tender should be suspended for any period or that the whole or part of the work should not be carried out, at all he shall give to the contractor a notice in writing of such desire and upon the receipt of such notice the contractor shall forthwith suspend or stop the work wholly or in part as required, after having due regard to the appropriate stage at which the work should be stopped or suspended so as not to cause any damage or injury to the work already done or endanger the safety thereof provided that the design of the Engineer as to the stage at which the work or any part of it could be or could have been safely stopped or suspended shall be final and conclusive against the contractor. The contractor shall have no claim to any payment or compensation whatsoever by reason of or suspension, stoppage or curtailment except to the extent specified therein after. 2) Where the total suspension of work ordered as aforesaid continued for a continuous period exceeding 90 days the contractor shall be at liberty to withdraw from the contractual obligations under the contract so far as it pertains to the unexecuted part of the work by giving a 10 days prior notice in writing to the Engineer, within 30 days of the expiry of the said period of 90 days, of such intention and requiring the Engineer to record the final measurements of the work already done to pay the final bill. Upon giving such notice the contractor shall be deemed to have been discharged from his obligation to complete the remaining un-executed work under his contract. On receipt of such notice the Engineer shall proceed to complete the measurement and make such payment as may be finally due to the contractor within the period of 90 days from the receipt of such notice in respect of the work

<p>No claim to compensation on account of loss due to delay in supply of material by Corporation</p>	<p>already done by the contractor. Such payment shall not in any manner prejudice the right of the contractor to any further compensation under the remaining provisions of this clause</p> <p>3) Where the Engineer required the contractor to suspend the work for a period in excess of 30 days at any time or 60 days in the aggregate, the contractor shall be entitled to apply to the Engineer within 30 days of the resumption of the work after such suspension for payment of compensation to the extent of pecuniary loss suffered by him in respect of working machinery remained idle on the site or on the account of his having and to pay the salary or wages of labor engaged by him during the said period of suspension provided always that the contract shall be not entitled to any claim in respect of any working machinery, salary or wages for the first 30 days whether consecutive or in the aggregate or such suspension in respect of any suspension whatsoever occasioned by unsatisfactory work or any other default on his part. The decision of the Engineer in this regard shall be final and conclusive against the contractor.</p> <p>(4) In the event of-</p> <ul style="list-style-type: none"> (i) Any total stoppage of work on notice from the Engineer under Sub clause (1) in that behalf. (ii) Withdrawal from the contractor from the contractual obligation completes the remaining un-expected work under the sub-clause (2) on account of continued suspension of work for a period exceeding 90days (iii) Curtailment in the quantity of item or items originally tendered on account of any alteration, omission or substitution in the specification, drawings, designs, or instructions under clause 15(1) where such curtailment exceeds 25 % in quantity and the value of quantity curtailed beyond 25 % at the rates for the items specified in the tender is more than Rs.50000/- .It shall be open to the contractor, within 90 days from the service of (i) the notice of stoppage of work or (ii) the notice of withdrawal from the contractual obligations under the contract on account of continued suspension of work or (iii) notice under clause 15(1) resulting in such curtailment, to produce to the Engineer satisfactory documentary evidence that he had purchased or agreed to purchase material for use in the contracted work, before receipt by him of the notice of stoppage, suspension or curtailment and require the ASCL to take over on payment such material at the rates determined by the Board ASCL, provided, however such rates shall in no case exceed the rates at which the same was required by the contractor. The contractor shall thereafter take over the materials so offered, provided the quantities offered, are not in excess of the requirements of the unexecuted work as specified in the accepted tender and are of quality and specifications approved by the Project Engineer
	<p>Clause-15 (A): The contractor shall not be entitled to claim any compensation from the ASCL for the loss suffered by him on account of delay by ASCL in the supply of materials entered in Schedule „A“ where such delay is caused by-</p> <ul style="list-style-type: none"> (i) Difficulties related to the supply of railway wagons, (ii) Force Majeure, (iii) Act of God, (iv) Act of enemies of the State or any other reasonable cause beyond the control of ASCL. <p>In the case of such delay in the supply of materials, ASCL shall grant such extension of time for the completion of the works as shall appear to the Project Engineer to be reasonable in accordance with the circumstances of the case. The contractor shall accept the decision of the Board ASCL as to the extension of time as final</p>

Time limit for unforeseen claims	Clause-16: Under no circumstances whatever shall the contractor be entitled to any compensation from the ASCL on any account unless the contractor shall have submitted a claim in writing to the Project Engineer within one month of the case of such claim occurring the contractor shall accept the decision of the Board ASCL as to the extension for time as final.
Action and compensation payable in case of bad work	Clause-17: If any time before the security deposit or any part thereof is refunded to the contractor, it shall appear to the Project Engineer or his subordinate in charge of work, that any work has been executed with unsound, imperfect or unskillful workmanship or with the materials of inferior quality, or that any materials or articles provided by him for the execution of the work are unsound, or of a quality inferior to that contracted for or are otherwise not in accordance with the contract it shall be lawful for the Project Engineer to intimate this fact in writing to the contractor and then notwithstanding the fact that the work, materials or articles complained of any have been inadvertently passed, certified and paid for the contractor shall be bound forthwith, to rectify, or remove and reconstruct the work so specified in whole or in part, as the case may require, or if so required, shall remove the materials or articles so specified and provide other proper and suitable materials or articles at his own charge and cost, and in the event of his failing to do so, within a period to be specified by the Project Engineer in the written intimation aforesaid, the contractor shall be liable to pay compensation at the rate of 1 % on the amount of the estimate for every day not exceeding 10 days during which the failure so continues and in the case of any such failure the Project Engineer may rectify and remove, and re-execute the work or remove and replace the material or articles complained of as the case may be at the risk and expense in all respects of the contractor. Should the Project Engineer consider that no such inferior work or materials as described above maybe accepted or made use of it shall be within his discretion to accept the same at such reduced rates as he may fix therefore
Work to be open for Contractor or responsible agent to be present	Clause-18: All work under or in course of execution or executed in pursuance of the contract shall at all times be open to the inspection and supervision of the Project Engineer and his subordinates, and the contractor shall at all times during the usual working hours, and at all other times at which his subordinates to visit the work shall have been given to the contractor, either himself be present to receive orders and instructions or have responsible agent duly authorized in writing present for that purpose. Orders given to the contractors duly authorized agent shall be considered to have the same force and affect as if they had been given to the contractor himself
Notice to be given before work is covered up	Clause-19: The Contractor shall give not less than 5 days' notice in writing to the Project Engineer or his subordinate in charge of the work before measurement any work in order that the same may be measured and correct dimensions thereof taken before the same is so covered up or place beyond the reach of measurement and shall not cover up or place beyond the reach of measurement any work without the consent in writing of Project Engineer or his subordinate in charge of the work and if any work shall be covered up or placed beyond the reach of measurement, without such notice having been given or consent obtained the same shall be uncovered at the contractors expense and in default thereof no payment or allowance shall be made for such work or for the materials with which the same was executed
Contractor liable for damage done	Clause- 20: If during the period of 12 months from the date of completion as certified by the Project Engineer pursuant to Clause 7 of the contract for 12 months after commissioning the work, whichever is earlier in the opinion of the Project Engineer, said work is defective in any manner whatsoever, the contractor shall forthwith on receipt of notice in that behalf from the Project Engineer, duly commence execution and completely carry out at his cost in every respect or the work that may be necessary for rectifying and setting right the defects specified therein including dismantling and reconstruction of unsafe portion strictly in accordance with and in the manner

	<p>prescribed and under the supervision of the Project Engineer. In the event of the contractor failing or neglecting to commence execution of the said rectification work within the period prescribed thereof in the said notice and/or to complete the same as aforesaid as required by the said notice, the Project Engineer shall get the same executed and carried out departmentally or by any other agency at the risk on account and at the cost of the contractor. The contractor shall forthwith on demand pay to the ASCL the amount of such cost, charges and expenses sustained or incurred by the ASCL of which the certificate of the Project Engineer shall be final and binding on the contractor. Such cost, charges and expenses shall be deemed to be arrears of land revenue and in the event of the contractor failing or neglecting to pay the same on demand as aforesaid without prejudice to any other rights and aforesaid remedies of the corporation the same may be recovered from the contractor as arrears of land revenue. The ASCL shall also be entitled to deduct the same from any amount, which may then be payable or which may thereafter become payable by the ASCL to the contractor either in respect of the said work or any other work whatsoever or from the amount of security deposit retained by ASCL.</p>
<p>Contractor to supply, Plant, Ladder etc.</p>	<p>Clause-21: The contractor shall supply at his own cost all materials (except such special material, if any as many in accordance with the contract, be supplied from the Engineering Departmental Stores), plant tools appliances implements, ladders, cordage, tackle scaffolding and temporary works requisite or proper for the proper execution of the work, whether, in the original, altered or substituted from and whether including in the specification or other documents forming part of the contract or referred to in these conditions or not and which may be necessary for the purpose of satisfying or complying with the requirement of the Project Engineer as to any matter as to which these conditions, he is entitled to be satisfied, or which he is entitled to require together with the carriage therefore to and from the work. The contractor shall also supply without charge the requisite number of persons with the means and materials necessary for the purpose of setting out works and counting, weighing and assisting in the measurement or examination at any time and from time to time of the work or the material, failing which the same may be provided by the Engineer-in-Charge at the expenses of the contractor and the expenses may be deducted from any money due to the contractor under the contract or from his security deposit or the proceeds of sale thereof, or of a sufficient portion thereof. The contractor shall provide all necessary fencing and lights required to protect the public from accidents, and shall also be bound to bare the expenses of defense of every suit, action or other legal proceedings, that may be brought by any person for injuries sustained obeying to neglect of the above precautions, and to pay any damages and costs which may be avoided in any such suit actions or proceedings to any such person, or which may with consent of the contractor to be paid for compromising any claim by any such person.</p> <p>List of machinery in contractor's possession and which they propose to use on the work should be submitted along with the tender</p>
	<p>Clause-21 (A): the contractor shall provide suitable scaffolds and working platforms gangways and stairways and shall comply with the following regulations in connection therewith</p> <ol style="list-style-type: none"> a) Suitable scaffolds shall be provided for workmen for all works that cannot be safely done from a ladder or by other means b) A scaffold shall not be constructed, taken down or substantially altered except- <ol style="list-style-type: none"> i) Under the supervision of a competent and responsible person: and ii) As far as possible by competent workers possessing adequate experience in this kind of work

	<p>c) All scaffolds and appliances connected therewith and ladders shall-</p> <ul style="list-style-type: none"> i) Be sound of material, ii) Be of adequate strength having regards to the loads and strains to which they will be subjects, and iii) Be maintained in proper condition d) Scaffolds shall be so constructed that no part thereof can be displaced in consequence of normal use e) Scaffolds shall not be overloaded and so far as practicable the load shall be evenly distributed f) Before installing lifting gear on scaffolds special precautions shall be taken to ensure the strength and stability of the Scaffolds g) Scaffolds shall be periodically inspected by a competent person h) Before allowing a scaffold to be used by his workmen the contractor shall, whether the scaffold has been erected by his workmen or not, take steps to ensure that it complies fully with the regulation herein in specified. <ul style="list-style-type: none"> i) Working platform, gangways, stairways shall ii) Be so constructed that no part of thereof can sag unduly or unequally. iii) Be so constructed and maintained having regard to the prevailing conditions as to reduce as far as practicable risks of persons tripping or slipping, and <ul style="list-style-type: none"> i) Be kept free from any unnecessary obstruction j) In case of working platform, gangway, working places and stairways at a height exceeding three Members. Every working platform and every gangway shall be closely boarded unless other adequate measures are taken to ensure safety. <ul style="list-style-type: none"> i) Every working platform and gangway shall have adequate width and ii) Every working platform, gangway, working place and <ul style="list-style-type: none"> a) stairway shall be suitable fenced. k) Every opening in the floor of a building or in a working platform shall accept for the time and to the extent required to allow the excess of persons for the transport for shifting of materials to be provided with suitable means to prevent the fall of persons or materials l) When persons are employed on roof where there is a danger of falling from a height exceeding 3 meters. Suitable precautions shall be taken to prevent the fall of persons or material m) Suitable precautions shall be taken to prevent persons being struck by articles, which might fall from scaffolds or other working places n) Safe means of access shall be provided to all working platforms and other working places o) The contractor(s) will have to make payments to the laborers as per minimum wages Act
	<p>Clause-21 (B): The contractor shall comply with the following regulations as regards the hoisting appliances to be used by him.</p> <ul style="list-style-type: none"> (a) Hoisting machine and tackle, including the attachments anchorages and supports shall, <ul style="list-style-type: none"> (i) Be of good mechanical construction, sound material and adequate strength and free from patent defect and (ii) Be kept in good repair and in working order. (b) Every rope used in hoisting or lowering materials or as a mean of suspension

	<p>shall be of suitable quality and adequate strength and free from patent defect.</p> <p>(c) Hoisting machines and tackle shall be examined and adequately tested after erection on the site and before used and be reexamined in position at intervals to be prescribed by the ASCL.</p> <p>(d) Every chain, ring, hook, shackle swivel and pulley block used in hoisting and lowering materials or as a mean of suspension shall be periodically examined.</p> <p>(e) Every crane driver or hoisting appliance operator shall be properly qualified.</p> <p>(f) No person who is below the age of 18 years shall be control of any hoisting machine, including any scaffold which, or give signals to the operator.</p> <p>(g) In case of every hoisting machine and of every chain, ring, hook, shackle, swivel pulley block used in hoisting or lowering or as a mean of suspension, the safe working load shall be as ascertained by adequate means.</p> <p>(h) Every hoisting machine and all gear referred to in preceding regulation shall be plainly marked with the safe working load.</p> <p>(i) In the 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.</p> <p>(j) No part of any hoisting machine or of any geared referred to in regulation (g) above shall be loaded beyond the safe working load except for the purpose of testing.</p> <p>(k) Motors, gearing transmissions, electric wiring and other dangerous part of hoisting appliances shall be provided with efficient safeguards.</p> <p>(l) Hoisting appliances shall be provided with such means as will reduce to minimum, and the risk of the accidental descent of a load</p> <p>(m) Adequate precautions shall be taken to reduce to a minimum the risk of any part of a suspended load becoming accidentally displaced</p>
Measure prevention of fire	<p>Clause-22: The contractor shall not set fire to any standing jungle, trees, bush woods or grass without a written permit from the Project Engineer.</p> <p>When such permit is given, and also in all cases when destroying cut or dug up trees bush wood, grass etc. by fire; the contractor shall take necessary measure to prevent such fire spreading to or otherwise damaging surrounding property.</p> <p>The contractor shall make his own arrangements for drinking water for the labors employed by him</p>
Liability of contractor for any damage done in or outside work	<p>Clause-23: Compensation for all damages done intentionally or unintentionally by the contractor's labor whether in or beyond the limits of ASCL property including any damage caused by the spreading of fire mentioned in Clause22 shall be estimated by the Project Engineer or such other officer as he may appoint and the estimate of the Engineer in charge subject to the decision of the Chief Executive Officer on appeal shall be final and the contractor shall be bound to pay the amount of the assessed compensation on demand, failing which, the same will be recovered from the contractor as damages in the manner prescribed in Clause 1 or deducted by the Project Engineer from any sums that may be due or become due from ASCL to the contractor under this contract or otherwise. The contractor shall bear the expenses of defending any section or other legal proceedings that may be brought by any persons for injury sustained by him owing to neglect of precautions to prevent the speed of fire and he shall bay any damages and cause that may be awarded by the court in consequences</p>
Employment of female labor	<p>Clause-24: The employment of female labors on works in neighborhood of soldier's barracks should be avoided as far as possible. The contractor shall employ the labor with the nearest employment exchange</p>

Work of Sunday	Clause-25: No work shall be done on a Sunday without the sanction in written of the Project Engineer.
Work not to sublet	Clause-26: The contract shall not be assigned or sublet without the written approval of the Project Engineer and if the contractor shall assign or sublet his contract, or attempt to do so, or become insolvent or commence any proceeding to get himself adjudicated and insolvent or make any composition with his creditors, or attempt to do so or if bribe, gratuity, gift, loan, perquisites, reward or advantage pecuniary or otherwise, shall either directly or indirectly be given, promise or offered by the contractor or any of his servants or agents to any public officer or person in the employ of corporation in any way relating to his office or employment, or if in any such officer or person shall become in anyway directly or indirectly interested in the contract the Project Engineer may there upon by notice in written rescind the contract and the security deposit of the contractor shall thereupon stand forfeited and be absolutely at the disposal of ASCL and the same consequences shall ensure as if the contract had been rescinded under Clause 3 hereof and in addition the contractor shall not be entitled to recover or be paid for any work therefore actually performed under the contract
Sum payable by way of compensation to be considered reasonable without reference to actual loss	Clause-27: All sums payable by contractor by way of compensation under any of these conditions shall be considered as a reasonable compensation to be applied to the use of ASCL without reference to the actual loss or damage sustained, and whether any damage has or has not been sustained
Changes in constitution of firm to	Clause-28: In case of tender by partners, any changes in the constitution of a firm shall be forthwith notified by the contractor to the Project Engineer for his information
Direction and control of Chief Executive Officer ASCL	Clause-29: All works to be executed under the contract shall be executed under the direction and subject to the approval in all respects of the Project Engineer for the time being, who shall be entitled to direct at what points and in what manner they are to be commenced and from time to time carried on
	<p>Clause-30:</p> <p>(1) Except where otherwise specified in the contract and subject to the powers delegated to him by ASCL the decision of the Project Engineer for the time being shall be final, conclusive, and binding all parties to the contract upon all questions relating to the meaning of all specifications, designs, drawings and instructions hereinbefore mentioned and as to the quality of workmanship or materials used on the work, or as to any other question, claim, right matter, or thing whatsoever, if any way arising out of, or relating to the contract, designs, drawings, specifications, estimates, instructions, orders or these conditions, 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 completion or abandonment thereof.</p> <p>(2) The contractor may within thirty days of receipt by him of any order passed by the Project Engineer as aforesaid appeal against it to the ASCL concerned with the contract,</p> <p>work or Project provided that-</p> <p>The accepted value of that contract exceeds Rs. 10.00 lakhs (Rs. Ten lakhs) Amount of claim is not less than Rs. 1.00 lakh (Rs. One lakh)</p> <p>(3) If the contractor is not satisfied with the order passed by the Chief Executive Officer, ASCL as aforesaid, the contractor may within thirty days of receipt by him of any such order Appeal against it to the Board ASCL, and the Decision given by the Board ASCL will be final.</p>

Lump sums in estimates	Clause-31: When the estimate on which a tender is made includes lump sums in respect of parts of the work the contractor shall be entitled to payment in respect of the items of work involved or the part of work in question at the same rates as are payable under this contract of each item, or if the part of work in question is not in the option of the engineer in charge capable of measurement, the Project Engineer may as his discretion pay the lump sum amount entered in the estimate and the certificate in writing of the Project Engineer shall be final and conclusive against the contractor with regard to any sum or sums payable to him under the provision of this clause
Actions where no specifications	Clause-32: In the case of any class of work for which there is no such specification as is mentioned in rule 1 such work shall be carried out in accordance with the standard specifications of Public Works Department, and in the event of there being no specification, then in case the work shall be carried out in all respects in accordance with all instructions and requirements of the Project Engineer
Definition of work	Clause-33: The expression “works” or “work” where used in these conditions, shall unless there by something in the subject or context repugnant to such construction be construct to mean the work or works contracted to be executed under or in virtue of the contract, whether temporary or permanent and whether original, altered substituted or additional.
	Clause-34: The percentage referred to in the tender shall be deducted from/ added to the gross of the bill before deducting the value of any stock issued
	Clause-35: All quarry fees, royalties and ground rent for stacking materials if any should be paid by the contractor
	Clause-36: The contractor shall be responsible for and shall pay any compensation to his workmen payable under the Workmen’s Compensation Act 1923 (VIII of 1923) (hereinafter called the said Act) for injuries caused to the workmen. If such compensation is payable paid by ASCL as principal under sub section (1) of section 12 of the said Act on behalf of the contractor under subsection (2) of the said section. Such compensation shall be recovered in the manner laid down in the Clause 1 above
	Clause-36 (A): the contractor shall be responsible for and shall at the expenses of providing medical aid to any workmen who may suffer a bodily injury as a result of an accident. If ASCL the same shall be recoverable from the contractor forthwith and be incurs such expenses deducted without prejudice to any other remedy of ASCL from any amount due or that may be due to the contractor
	Clause-36 (B): The contractor shall provide all necessary personal safety equipment’s and first aid apparatus available for use of persons employed on site and shall maintain the same condition suitable for immediate use at any time and shall comply with the following regulations in connection therewith. a) The workers shall be required to use the equipment so provide by the contractor shall take adequate steps to ensure proper use of the equipment by those concerned. b) When the work is carried in the proximity to any place where there is a risk or drawing all necessary equipment shall be provided and kept ready for use and all necessary steps shall be taken for the prompt rescue of any person in danger. c) Adequate provisions shall be made for prompt first aid treatment of all injuries likely to be sustained during the course of the work.
	Clause-36 (C): The contractor shall duly comply with the provision of “the Apprentices Act” (III of 1961) the rules made there under and the orders that may be issued from time to time under the Act the said Rules

<p>Claim for quantities entered in the tender</p>	<p>Clause-37:</p> <p>1) Quantities in respect of the several items shown in the tender rare approximate and no revision in the tendered rate shall be permitted in respect of any of the items so long as subject to any special provision contained in the specifications prescribing a different percentage of permissible variation the quantity of the item does not exceed the tender quantity by more than 50% and so long as the value of the excess quantity beyond this limit as the rate of the item specified in the tender is not more than Rs 5,00,000/- (Rs Five Lakh only).</p> <p>(2) The contractor shall if ordered in writing by the Engineer to do so, also carry out any quantities in excess of the limit mentioned in sub-clause (1) hereof on the same conditions as in accordance with the specifications in the tender and at the rates as mentioned below:</p> <p>a) if tender rate is above, rate will be at par as per Current PWD SOR</p> <p>b) If tender rate is below, rate will be as per tender quoted rate on Current PWD SOR. For the purpose of operation of this clause, the total cost shall be taken as derived from the PWD SOR.</p> <p>(3) Claims arising out of reduction in the tendered quantity of any item beyond 50 % will be governed by the provision of clause 15 only when the amount of such reduction beyond 50 % at the rate of the item specified in the tender is more than Rs.5,00,000/- (Rs Five Lakh only). This reduction is exclusively of the reduction mentioned in clause No 2, 1, 4 of the work and site condition.</p> <p>There is no change in the rate if excess is less than or equal to 50%. Also, there is no change in the rate if quantity of work done is more than 50 % of the tendered quantity or the value of the excess work at tendered rates does not exceed Rs. 5,00,000/- (Rs Five Lacks only)</p>
<p>Employment of famine labor etc</p>	<p>Clause No-38: The contractor shall employ any famine, convict or other labor of a particular kind or class if ordered in writing to do so by the Project Engineer</p>
<p>Claim for compensation for delay in starting the</p>	<p>Clause No-39: No compensation shall be allowed for any delay caused in the starting of the work on account of acquisition of land or in the case of clearance works on account of any delay in according to sanction of estimates.</p>
<p>Claim for compensation for delay in execution</p>	<p>Clause No-40: No compensation shall be allowed for any delay in the execution of the work on account of water standing in borrow pits or compartments the rates are inclusive for hard or cracked soil Excavation in mud, sub soil, water standing in borrow pits and no claim for an extra rate shall be entertained, unless otherwise expressly specified</p>
<p>Entering upon or commencing any portion of work</p>	<p>Clause No-41: The contractor shall not enter upon or commence any portion of work except with the written authority and instructions of the Project Engineer or of his subordinate in charge of the work. Failing such authority, the contractor shall have no claim to ask for measurements of or payment for work</p>
<p>Minimum age of persons employed, the employment of donkeys and for other animals and payment of fair wages</p>	<p>Clause No-42:</p> <p>(i) No contractor shall employ any person who is under age of 18 Years.</p> <p>(ii) No contractor shall employ donkeys or other animals with breeching of string or thin rope the breeching must be at least three inches wide and should be of tape (Nawar).</p>

	<p>(iii) No animals suffering from sores lameness or emaciation or which is immature shall be employed on the work.</p> <p>(iv) The Project Engineer or his agent is authorized to remove from the work any person or animal found working which does not satisfy these conditions and no responsibility shall be accepted by ASCL for any delay caused in the completion of work by such removal.</p> <p>(v) The contractor shall pay fair and reasonable wages to the workmen employed by him in the contract under taken by him. In the event of any dispute arising between the contractor and his workmen on the grounds that the wages paid are not fair and reasonable, the dispute shall be referred without delay to the Project Engineer who shall decide the same. The decision of the Project Engineer shall be conclusive and binding on the contractor but such decisions shall not in any way affect the conditions of contract regarding the payment to be made by corporation at the sanctioned tender rates.</p> <p>(vi) The contractor shall provide drinking water facilities to the workers similar amenities shall be provided to the workers engaged on large work in urban areas.</p> <p>(vii) Contractor to take precaution against accidents which take place on account of labor using loose garments while working near machinery</p>
Method of payment	Clause No-43: Payments to contractors shall be made by cheque drawn on any bank within the ASCL limits convenient not exceeding Rs 10 /- will be paid in cash.
Acceptance of conditions compulsory before tendering the work	Clause No-44: Any contractor who does not accept these conditions shall not be allowed to tender for works.
Employment of scarcity labor	Clause No-45: If ASCL declares a state of scarcity or famine to exist in any village situated within 10 miles of the work, the contractor shall employ upon such parts of work, as are suitable for unskilled labor, any person certified to him by the Project Engineer, or be any person to whom the Project Engineer may have delegated this duty in writing to be in need of relief and shall be bound to pay to such person wages not below the minimum which government may have fixed in this behalf. Any disputes which may arise in connection with the implementation of this clause shall be decided by the Project Engineer whose decision shall be final and binding on the contractor.
	Clause No-46: The price quoted by the contractor shall not in any case exceed the control price, if any, fixed by the UP PWD or reasonable price which it is permissible for him to charge a private purchaser for the same class and description, the controlled price or the price permissible under the hoarding and Profiteering Ordinance, 1948 as amended from time to time, if the price quoted exceeds the controlled price or the price permissible under the Hoarding and Profiteering Ordinance, 1948 as amended from time to time, if the price quoted exceeds the controlled price or the price permissible under Hoarding And Profiteering Prevention Ordinance, the contractor will specifically mention this fact in his tender along with the reasons for quoting such higher prices. The purchaser at his description will in such case exercise the right of revising the price at any stage so as to conform with the control price on the permissible under the Hoarding and Profiteering Prevention Ordinance. This discretion will be exercised without prejudice to any other action that may be taken against the contractor
	Clause No -47: The rates to be quoted by the contractor must be exclusive of G.S.T. Tax. No extra payment on this account will be made to the contractor.

	<p>Clause No -48: In case of material that may remain surplus with the contractor from those issued for the work contracted for, the date of ascertainment of the materials being surplus will be taken for, the date of ascertainment of the material being surplus will be taken as the date of sale for the purpose of sales Tax and the Sales Tax will be recovered on such sale-Not Applicable.</p>
	<p>Clause No-49: The contractor shall employ at least 80 percent of the total number of unskilled labor to be employed by him on the said work from out of the persons ordinarily residing in the district in which site of the said work is located. Provided, however; that if the required number of unskilled labor from that district is not available, the contractor shall in the first instance employ such number of persons as in available and thereafter may with previous permission in writing of the Project Engineer of the said work, obtain the rest of the requirement of unskilled labor from outside district</p>
	<p>Clause No -50: Wages to be paid to the skilled and unskilled laborers engaged by the Contractor. The contractor shall pay the laborer's skilled and unskilled according to the wages prescribed by the Minimum Wages Act of 1948 applicable to the area in which the work of the contract is located.</p> <p>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 Project 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 provision of Act. The contractor shall pay the laborer's skilled and unskilled according to wages prescribed by Minimum Wages Act applicable to the area in which the work lies</p>
	<p>Clause No -51: All amounts whatsoever which the contractor is liable to pay to the Corporation in connection with the execution of the work including the amount payable in respect of (i) materials and or stores supplied/issued hereunder by the ASCL to the Contractor (ii) hire charges in respect of heavy plant, machinery and equipment given on hire by the ASCL to the contractor for execution by him of the work and/or on which advances have been given by the ASCL to the contractor shall be deemed to be arrears of the Land Revenue and the ASCL may without prejudice to any other rights and remedies of the ASCL recover the same from the contractor as arrears of revenue</p>
	<p>Clause No -52: The contractor shall duly comply with all the provisions of the Contract Labor (Regulation and Abolition) Act, 1970 (37 of 1970) as amended from time to time and all other relevant status and statutory provision concerning payment of wages particularly to workmen employed by the contractor and working on the site of the work. In particular, the contractor shall pay wages to each worker employed by him on the site of the work. If the contractor fails or neglect to pay wages at the said rates or makes short payment and the ASCL makes such payment of wages in full or part thereof less paid by the contractor, as the case may be ,the amount so paid by the contractor to such workers shall be deemed to be arrears of land revenue and the ASCL shall be entitled to recover the same as such from the contractor or deduct same from the amount payable by the ASCL to the contractor hereunder or from any other amount payable by the ASCL to the contractor hereunder or from any other amounts Payable to him by the ASCL.</p>
	<p>Clause No-53: The tendered rates shall be exclusive of Applicable GST taxes, in respect of work contract.</p>

	<p>Clause No-54: If the project is shelved by the ASCL before commencement, the contractor will have no right to claim any loses or compensation due to the same and for whatsoever reasons</p>
	<p>Clause No-55: All disputes and differences of any kind whatever arising out of or in connection with the contract or the carrying out of the work (whether during progress of the works or after their completion and whether before or after the determination , abandonment or breach of the contract) shall be referred to and settled by Project Engineer .But if the contractor be dissatisfied with the decision of the Chief Executive Officer ASCL or as to withholding by the Project Engineer of any certificate of the Project Engineer or as to withholding by the Project Engineer of any certificate to which the contractor may within 60 days after receiving notice of such decision give a return notice to the other party requiring that / may claim to entitled them and in any such case the contractor such matters in disputes be referred to in an appeal before a Committee as mentioned below. Such return notice shall specify the manner which are in disputes and such disputes or difference of which such notice has been given and no other shall be and is hereby referred to Committee consisting of the Chief Executive Officer ASCL, the decision taken by the committee will be final and binding on both the parties Such reference except as to the withholding of any certificate to which the contractor to be entitled shall not be opened or entered upon until after the completion or alleged completion of the works or until after the practical cessation of the works arising from any cause unless with the written consent of the Project Engineer. Provided always that the Corporation shall not withhold the payment of an interim certificate nor the contractor in any way delay the carrying out of the works by reason of any such matters, question or dispute being referred to the Committee but shall, proceed with the work with all the diligence and shall, until the decision of the Committee abide by the decision of the Project Engineer and no award of the Committee shall reliever the contractor of his obligations to adhere strictly to Project Engineer’s instructions with regard to the actual carrying out of the works. The Owner and the contractor hereby also agree that the said reference to the Committee under this clause shall be a condition precedent to any right of action under the Contract</p>
	<p>Clause 56: Contractor shall take out necessary Insurance Policy / policies for all workmen, labor employed on site so as to provide adequate Insurance cover for execution of the awarded contract work from National Insurance Co Ltd. Insurance Policy/policies taken out from any other company will not be accepted. He shall submit the receipt of premium to ASCL before work commencement</p>

Section 5

Specifications

All the works shall be carried out as per specification for Water supply as per separately given with the tender document and Detailed PWD/ Jal Nigam Specification & latest E-in-C circulars.

Section 5 (Cont'd) Drawings

List of Drawings: -

S.no	List of Drawings	S.no	List of Drawings
1	Agra Index Map	2	Satellite Image
3	Topogarchy Map	4	Ward boundary & project area Boundary
5	Proposed water supply Zone map	6	Schematic diagram of proposal water supply system
7	Transmission main alignment	8	Feeder main drawing from Tanjganj ZPS to OHT's
9	Layout drawing of Proposed OHT's and CWR's	10	Proposed pumping station arrangement at Geonimandi WTP
11	SLD for pumping station arrangement for Geonimandi WTP	12	Proposed pumping station arrangement at Tajganj ZPS
13	SLD for pumping station arrangement for Tajganj ZPS	14	Typical arrangement for OHT's
15	Typical standard details of scour valve installation	16	Typical standard details of Kinetic double valve installation
17	Typical Thrust block installation	18	Standard details of water connection
19	Standard details of wash out chamber	20	Standard details of bulk flow meter
21	Typical Sluice valve chamber	22	Typical air valve chamber
23	Distribution Network for Zone-1	24	Distribution Network for Zone-2A
25	Distribution Network for Zone-2B	26	Distribution Network for Zone-2C
27	Distribution Network for Zone-3	28	Distribution Network for Zone-4
29	Distribution Network for Zone-5	30	Distribution Network for Zone-6
31	Distribution Network for Zone-7	32	Valve Location Drawing for Zone-1
33	Valve Location Drawing for Zone-2A	34	Valve Location Drawing for Zone-2B
35	Valve Location Drawing for Zone-2C	36	Valve Location Drawing for Zone-3
37	Valve Location Drawing for Zone-4	38	Valve Location Drawing for Zone-5
39	Valve Location Drawing for Zone-6	40	Valve Location Drawing for Zone-7

Drawings to be followed for actual execution of work should bear the stamp “Good for construction”.

1. Any revision of working drawings should be indicated by pre-fixing R1, R2..... etc. after original reference number. Reasons for each revision should be clearly noted in the drawing.
2. Complete set of drawings should be issued along with other tender documents so as to form part of the agreement.
3. Drawings are not available with the bidding documents downloaded from the website and may be obtained from the office of the ASCL Agra as indicated in the NIT

Section– 6.

Form of Bid

Notes on Form of Bid

The Bidder shall fill in and submit this Bid form with the Bid.

----- (Date)

To
The **CEO,**
Agra Smart City Limited,
Agra.

Description of the work: Providing 24x7 water supply to ABD area with water meter and SCADA system under Smart city Mission

1. I/We offer to execute the works described above and remedy any defects there in conformity with the conditions of contract, specifications, drawings, bill of quantities and addenda for
 - (a.) For Item rate in the Bill of quantity, as referred to in clause 13 of ITB.
2. We undertake to commence the works on receiving the notice to proceed with work in accordance with the contract documents.
3. This Bid your written acceptance of if shall constitute a binding contract between us. We understand that you are bound to accept the lowest or any Bid you receive.

We hereby confirm that this bid complies with the Bid validity and earnest money required by the bidding documents and specified in the Appendix to ITB.

Authorized Signature :- _____

Name and title of Signatory:- _____

Name of bidder :- _____

Authorized Address of Communication:- _____

Telephone No(s): (Office) :- _____

Mobile No :- _____

Facsimile (FAX) No :- _____

Electronic Mail Identification (E-mail ID) :- _____

Section 7

Bill of Quantities Preamble

1. The Bill of Quantities shall be read in conjunction with the Instructions to Bidders, Conditions of Contract Specifications and Drawings.
2. For the construction of works, the quantities given in the Bill of Quantities are estimated, and are given to provide a common basis for bidding. The basis of payment will be the actual quantities of work ordered and carried out, as measured by the Contractor and verified by the Engineer and valued at the rates and prices tendered in the Bill of Quantities in the case of item rate tenders.
3. The rates and prices tendered in the priced Bill of Quantities shall, except in so far as it is otherwise provided under the Contract, include all constructional plant, labour, supervision, materials, erection, maintenance, insurance, profit, taxes and duties, together with all general risks, liabilities and obligations set out in the Contract.
4. Arithmetic errors will be corrected by the Employer pursuant to Clause 27 of the instructions to Bidders.

Section 8
Letter of Acceptance and Other Forms
OFFICE OF THE CEO, AGRA SMART CITY LIMITED, AGRA

NO.....

DATED.....

LETTER OF ACCEPTANCE

To,

M/s.....

.....

.....

This is to notify you that on behalf of the Employer, **CEO, Agra Smart City Limited, Agra** has accepted your Bid dated for execution of the for the Contract Price of Rs..... Rs.....only) is hereby accepted by our Agency.

You are hereby requested to furnish Performance Security, in the form detailed in Cl.32 of ITB for an amount of Rs..... (Rs.....) Within 10 days of the receipt of this letter of acceptance valid up to 45 days from the date of expiry of Defects Liability Period (i.e. up to) and sign the contract, failing which action as stated in Cl. 32.3 of ITB will be taken.

Yours faithfully,

**CEO, Agra Smart City
Limited, Agra**

OFFICE OF THE CEO, AGRA SMART CITY LIMITED, AGRA

Issue of Notice to proceed with the work

LETTER NO.....

DATED.....

To,

.....
.....
.....

Dear Sirs:

Pursuant to your furnishing the requisite performance security as stipulated in ITB Clause 32.1 and signing of the contract for the construction offor Dist. Agra you are hereby instructed to proceed with the execution of the said works in accordance with the contract documents & complete it by

Yours faithfully,
**CEO, Agra Smart City
Limited, Agra**

(c) Standard Form of Agreement

Notes on Standard Form of Agreement
The Agreement should incorporate any corrections or modifications to the Bid resulting from corrections of errors
(Instructions to Bidders, Clause 26).

Standard Form: Agreement **Agreement**

This agreement, made the day of of Between **CEO, Agra Smart City Limited, Agra** (Hereinafter called “the Employer”) of the one part, and

.....
.....
.....

[Name and address of Contractor] (Hereinafter called “the Contractor” of the other part). Whereas the Employer is desirous that the Contractor execute the Work of

.....
District- Agra (Hereinafter called “the Works”) and the Employer has accepted the Bid by the Contractor for the Execution and completion of such Works and the remedying of any defects therein at a cost of Rupees.....
(Rs.....only)

NOW THIS AGREEMENT WITNESSETH as follows:

1. In this Agreement, words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to, and they shall be deemed to form and be read and construed as part of this Agreement.
2. In consideration of the payments to be made by the Employer to the Contractor as hereinafter mentioned, the Contractor hereby covenants with the Employer to execute and complete the Works and remedy any defects therein in conformity in all aspects with the provisions of the Contract.
3. The Employer hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and the remedying the defects wherein the Contract Price or such other sum as may become payable under the provisions of the Contract at the times and in the manner prescribed by the Contract.
4. The following documents shall be deemed to form and be read and construed as part of this Agreement, viz:
 - i) Letter of Acceptance:
 - ii) Notice to proceed with the works:
 - iii) Contractor’s Bid:
 - iv) Contract Data:
 - v) Special Conditions of contract and General Conditions of Contract:
 - vi) Specifications:
 - vii) Drawings:
 - viii) Bill of Quantities: and
 - ix) Any other document listed in the Contract Data as forming part of the contract.

In witness whereof the parties thereto have caused this Agreement to be executed the day and year first before written. was hereunto affixed in the presence of: Signed, Sealed and Delivered by the said To

Binding Signature of Contractor

Binding Signature of Employer authorized
representative

(d) Form of unconditional Bank guarantee for advance payment
BANK GUARANTEE FOR ADVANCE PAYMENT

To,
CEO, Agra Smart City Limited,
Agra Nagar Nigam,
Agra

Gentlemen:

In accordance with the provisions of the General Conditions of contract, clause 45 (“Advance Payment”) of the above-mentioned

Contract, *[name and address of Contractor]*
(Hereinafter called “the Contractor”) shall deposit with
[Name of Employer] a bank guarantee to guarantee his proper and faithful performance under the said Clause of the Contract in an amount of *[Amount of guarantee]* *[in words]*. We, the
.....*[bank or financial institution]*, as instructed by the Contractor, agree unconditionally and irrevocably to guarantee as primary obligator and not as Surety merely, the payment to..... *[name of Employer]* on his first demand without whatsoever right of objection on our part and without his first claim to the Contractor, in the amount not exceeding
.....*[amount of guarantee]*
..... We further agree that no change or addition to or other modification of the terms of the Contract or of Works to be performed there under or of any of the Contractor documents which may be release us from any liability under this guarantee, and we hereby waive notice of any such change, addition or modification.
This guarantee shall remain valid and in full effect from the date of the advance payment under the Contract until
_____ *[name of Employer]* receives full repayment of the same amount from the Contractor.

Yours truly,
Signature and seal: _____
Name of Bank/Financial Institution: _____
Address: _____
Date: _____

1. An amount shall be inserted by the bank or financial institution representing the amount of the Advance Payment, and Denominated in Indian Rupees.

(e) Form of unconditional Bank guarantee “Performance Bank Guarantee”).

PERFORMANCE BANK GUARANTEE

To,

**CEO, Agra Smart City Ltd.
Agra Nagar Nigam,
Agra**

WREREAS [Name and Address of Contractor] (Hereinafter called “the Contractor”) has undertaken, in pursuance of Contract No. Datedto execute[Name of Contract and brief description of Works] herein after called “The Contract”

AND WHEREAS it has been stipulated by you in the said contract that the contractor shall furnish you with a bank guarantee by a Nationalized Bank for the sum specified therein as security for compliance with his obligations in accordance with the Contract,

AND WHEREAS we have agreed to give the Contractor such a Bank Guarantee;

NOW THEREFORE we hereby affirm that we are the Guarantor and responsible to you on behalf of the Contractor, up to a total of[amount of guarantee][in words], such sum being payable in the types and proportions of currencies in which the Contract price is payable, and we undertake to pay you, upon your first written demand and without cavil or argument, any sum or sums within the limits of [Amount of guarantee] as aforesaid without your needing to prove or to show grounds or reasons for a demand for the sum specified therein.

We hereby waive the necessity of your demanding the said debt from the Contractor before presenting us with the demand.

We further agree that no change or addition to or other modification of the terms of the Contract or of the Works to be performed there under or of any of the Contract documents which may be made between you and the Contractor shall in anyway release us from any liability under this guarantee, and we hereby waive notice of any such change, addition or modification.

This Guarantee shall be valid until a date 45 days after the expiry of defect liability period of 5 years after intended completion date.

Signature and seal of the guarantor

Name of Bank

Address

Date

QUALIFICATION INFORMATION

The information to be filled in by the Bidder in the following pages will be used for Purposes of post qualification as provided for In Clause 4 of the Instructions to Bidders. This information will not be incorporated in the Contract.

1. For Individual bidders

1.1 Constitution or legal status of bidder

[Attach Copy]

Place of registration:

Principal place of business:

Power of attorney of signatory of Bid

[Attach]

1.2

Total value of Civil Engineering Construction work executed and payments received in the last five years** (in Rs. million)		

1.3.1. Work performed as prime contractor (in the same name) on works of a similar nature over the last five years **

Project Name	Name Of The Employer*	Description Of Work	Contact No.	Value Of Contract (Rs. Million)	Date Of Issue Of Work Order	Stipulated Period Of Completion	Actual Date Of Completion*	Remarks Explaining Reasons For Delay And Work Completed

1.3.2 Quantities of work executed as prime contractor (in the same name and style) in the last five years:

** Attach certificate (s) from the Engineer - In - Charge*

@ The item of work for which data is requested should tally with specified in ITB clause 4.5A(c)

*** Immediately preceding the financial year in which bids are received
Attach certificate from chartered Accountant*

1.4 Information on bid capacity (works for which bids have been submitted and works which are yet to be completed) as on the date of this bid

(a) Existing Commitments and on-going works:

Description Of Work	Place & State	Contract No. & Date	Name And Address Of Employer	Value Of Contract (Rs. In Million)	Stipulated Period Of Completion	Value Of Works* Remaining To Be Completed (Rs. In Million)	Anticipated Date Of Completion

(b) Works for which bids already submitted

Description Of Work	Place & State	Name And Address Of Employer	Estimated Value Of Works (Rs. In Million)	Stipulated Period Of Completion	Date When decision is expected	Remarks, If Any

** Attach certificate (s) from the Engineer - In – Charge*

1.5 The following items of Contractor's equipment are essential for carrying out the works. The bidder should list all the information requested below. Refer also to sub clause 4.3 (d) of the instructions to bidders.

Item Of Equipment	Requirement Nos.	Availability Proposal			Remarks (From Whom to be purchased)
		Owned/Released/ To be procured	Nos/Capacity	Year (Model)/Condition	

@ As Per Annex 1 of section 1 - Instruction to bidders

1.6 Qualification and experience of key personnel proposed for administration and execution of the contract attach biographical data. Refer also to sub clause 4.3 (e) and 4.5 (B) (b) of instructions to bidders and sub clause 9.1 of the conditions of contract

Position	Name	Qualification	Experience (years)	Experience In The

			in general	Proposed Position
Project Manager				
Construction Engineer				
Material and Quality control Engineer				

1.7 Proposed subcontracts and firms involved. [Refer ITB Clause 4.3 (j)]

Sections Of The Works	Value of Sub Contract	Sub-Contractor (Name And Address)	Experience In Similar Work

- 1.8 Financial reports for the last five years: balance sheets, profit and loss statements, auditors' reports (in case of companies/corporation), etc. List them below and attach copies.
- 1.9 Evidence of access to financial resources to meet the qualification requirements: cash in hand, lines of credit. etc. List them below and attach copies of support documents {sample format attached}.
- 1.10 Name, address, and telephone, telex, and fax numbers of the Bidders' bankers who may provide references if contacted by the Employer.
- 1.11 Information on litigation history in which the bidder is involved.

Other Party (ies)	Employer	Cause of Dispute	Amount Involved	Remarks/Present Status

- 1.12 Statement of compliance under the requirement of Sub Clause 3.2 of the instruction to bidders.

.....

- 1.13 Proposed work method and schedule. The bidder should attach description, drawings and charts as necessary to company with the requirement of the bidding documents. [Refer ITB Clause 4.1 and 4.3 (k)].

2. Joint Ventures - Deleted

3. Additional Requirements

- 3.1 Bidders should provide any additional information required to fulfill the requirements of clause 4 of the instruction to bidders, if Applicable

Check List of Bidder.

Sl. No.	Document/Certificate	References	
		Chapter	Clause
1	2	3	4
1	T - 6	I T B A	3.2, 3.3, 3.5
2	T - 4	- do -	3.4

3	T – 5	- do -	3.4
4	Following information shall be furnished by the contractor on Non- Judicial Stamp paper with Bid.		
a.	Construction or legal status Bidder, Place of registration Principal place of business, Power of attorney.	Section - 3	1.1
b.	Total annual volume of civil Engineering constructions work executed and payments received in the last five years preceding the year in which bids are invited. (Attach certificate from chartered Accountant)	Section – 3	1.2
c.	Work performed as prime contractor (in the same name and style) on construction works of a similar nature and volume over the last five year. Attach certificate from the Engineer-In-Charge.	Section - 3	1.3.1
d.	Existing commitments and on-going constructions works.	Section – 3	1.3.2. A
e.	Works for which bids already submitted.	Section – 3	1.3.2. B.
f.	Availability of major items of contractor’s Equipment proposed for carrying out the works. List all information requested below, Refer also to Clause 4.2 (d) and Clause 4.4 b (b) of the instructions to Bidders.	Section – 3 I T B	1.4, 4.4 (b) (i)
g.	Qualifications of technical personnel proposed for the contract. Refer also to clause 4.2 (e) of the instructions to bidders and clause 9.1 of part-1 General Conditions of Contract.	Section – 3 I T B	1.5, 4.4.3 (b) (ii)
h.	Financial reports for the last five years: balance sheets, profit and loss statement, auditor, reports, etc. List below and attach copies.	Section – 3 I T B	1.6., 1.7
i.	Evidence of access to financial resources to meet the qualification: cash in hand, lines of credit, etc. list below and attach copies of support documents. (Sample format attached)	Section – 3	1.8
j.	Name, address and Telephone, telex, and facsimile numbers of banks that may provide reference if contacted by the Employer.	Section – 3	1.9
k.	Information on current litigation in which the bidders is involved.	Section – 3	1.9 A
5	Undertaking from bidder for minimum investment.	I T B	4.2 (g)
6	Authority to seek reference from the Bidders’s bankers	I T B	4.2 (i)
7	Each bidders must produce the current income-tax clearance certificate. An affidavit that the information furnished with the bid documents is correct in all respects and, Such other certificates as defined in the Appendix to ITB. Failure to produce the certificates shall make the bid non-responsive.	I T B	4.4 B (a)
8	Bid Security	I T B	16
9	The minimum amount of liquid assets and/or credit facilities net other contractual commitments of the successful bidder shall be 10% of the contract value.	Appendix to I T B	4.4.B (b) (iii)
10	The bidder must produce an affidavit stating the names of retired gazetted officer (if any) in his employment who retired within the last two years with the following ranks from the departments listed below.	- do -	4.4 B (c) (ii)
11	Calculation of Bid capacity of Bidder.	Appendix to I T B	4.6
12	The proposed methodology and programmed of construction, backed will equipment and material planning and deployment, duly supported with broad calculations and	I T B	4.2.L

	quality management PI an proposed to be adopted, justifying their capability of execution and completion of the work as per technical specific actions and within the stipulated period of completion.		
13	Any documents which are not mentioned in any list shall be as per standard Bid of Document.	-	-

BID DOCUMENT

**Providing 24 x 7 water supply to ABD area
with smart water meters and SCADA**

PART A

Volume – II

SECTION 5 : TECHNICAL SPECIFICATIONS

Name of Work : Providing 24 x 7 water supply to ABD area
with smart water meters and SCADA

Estimate Amount : Rs.142.52 Crore.

TECHNICAL SPECIFICATIONS

CHAPTER 1

SPECIAL SERVICE TO BE PROVIDED BY THE CONTRACTOR

1 SPECIAL SERVICES TO BE PROVIDED BY CONTRACTOR

The following services are to be provided by Contractor during the entire period of the Contract. Those items not included separately in the Bill of quantities but the cost of providing these services are deemed to be included in the pay items of the Bill of Quantities

1.1 Surveying Equipment

1.1.1 The Contractor shall provide at the site, at his own expense, two approved sets of surveying and measuring equipment. The sets shall be used by the Contractor for requirement at site and also shall be made available from the commencement of contract for the use of the Engineer's Representative. The set shall consist of the following instruments:

ITEMS QUANTITY

- a) Total Station 2
- b) Pogo with Reflector 4
- c) Big Tripod 2
- d) Small Tripod 2
- e) Fiber glass tape (cased 30m) 4
- f) Steel Pocket tape, 3 6
- g) Surveying Umbrellas 2
- h) Ranging Poles, 2.5m long 10
- i) Level books – as required
- j) Field books – as required

1.1.2 All equipment shall be supplied with their tripods, staff and such other equipment/item as
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the Engineer's Representative may require for the measuring, or setting -out of the work.

1.1.3 The Contractor shall be solely responsible for the maintenance of all such instruments and equipment and shall ensure they are, at all times, in good repair and adjustment. All equipment other than expendable items shall revert to the Contractor upon completion of the works.

1.1.4 The Contractor shall provide the Engineer, throughout the Contract period, with all necessary surveyors and survey assistants to assist with surveying work. The assistant shall keep the survey equipment in good order.

1.1.5 There is no pay item for provision of survey equipment or survey support. Payment for the provision of surveying instrument and support service is deemed to be included in the rates for other pay items of the bill of quantities.

1.1.6 The Telemetry system and their components should be verified by the third party qualified concerned before making payment by the ULB.

1.2. Laboratory Testing and Laboratory

1.2.1. Description

Testing of materials for items such as embankment and concrete structures shall be carried out by a site laboratory established and allocated exclusively for that purpose; all testing shall be carried out under the direction and supervision of the Engineer's staff.

All tests shall be performed in strict accordance with the appropriate Indian Standards or other standards as approved by the Engineer.

1.2.2. The Laboratory shall be adequately staffed by the contractor with materials technicians and assistants in the numbers deemed necessary by the Engineer so that no interruption of unnecessary delay shall occur to construction activities due to delays in sampling or testing, in-site or in the laboratory, as required by the Contract. The testing equipment provided in the

Laboratory shall be sufficient to carry out the following tests:

- a) Crushing strength of 150mm size concrete cubes.
- b) Sieve analysis

1.2.3. Alternatively the contractor can get the testing done in an approved laboratory as agreed to by the Engineer. If in case the tests are to be done in an approved laboratory, such an approval shall be obtained from the Engineer within 15 days of commencement of Contract.

Any testing relating to the Works as required by the Engineer which cannot be carried out in the site laboratory or in the approved external laboratory shall be carried out at the Contractor's expense, at an independent laboratory approved by the Engineer.

The provision of laboratory facilities on site, as specified, shall in no way relieve Contractor of the responsibility for providing additional laboratory space and testing equipment as necessary in order to control materials at mixing plants and elsewhere and enable him to fulfill his obligations under the Contract.

Laboratory Building

The Contractor shall provide, furnish, equip, keep clean and maintain to the satisfaction of the Engineer, a laboratory building of a floor area sufficient to accommodate all the testing requirements. The building shall be provided with electrical power, potable water, drainage, and shall have adequate daylight and artificial lighting.

The Contractor shall, at the Commencement of the Contract, submit a detailed list of the equipment he is proposing to provide showing for each item its type and model, serial number, manufacturer's name and year of manufacture for the Engineer's approval.

The testing of the works by the Engineer, in no way, absolves the Contractor from his responsibilities to carry out his own testing of the quality of his works and the materials used.

The laboratory building and equipment shall be used exclusively for the purposes for which they are intended and shall, together with all equipment, all samples and records, be open to inspection by the Engineer during all working hours.

The contractor has to make his own arrangements for locating the laboratory in a n appropriate site near the work area.

1.3. Contractor's Senior Materials Technician

1.3.1. The Contractor shall provide a full-time senior materials technician to be responsible for the day-to-day activities of the laboratory and for site testing. He shall be directly and solely responsible to the Engineer or designated members of his staff.

The senior materials technician shall have not less than ten years experience of the testing of

earthworks and of concrete for structures and shall be fully conversant with the testing of materials as per latest Indian Standards. The experience and qualifications of the senior materials technician shall be to the approval of the Engineer.

Sample

1.3.2. The Contractor shall submit samples of all materials and goods for inclusion in the works to the Engineer and only those approved by the Engineer and to the standards specified elsewhere in the Contract may be ordered for supply. Samples shall be submitted promptly in order not to delay the works.

All work executed shall be of equal standard in all respects to the approved samples and the Engineer may reject any work which, in his opinion, does not comply with the approved samples.

1.3.3. Payment

There is no pay item for provision of establishment of testing laboratory or testing of materials. Payment for the provision of surveying instrument and support service is deemed to be included in the rates for other pay items of the bill of quantities

1.3.4. Site surveys, Setting out and detailing

Description

The Contractor shall be responsible for the true and proper setting-out of the works in relation to the lines and levels of reference given by the Engineer in Charge or shown on the Drawings and for the correctness of the position, levels, dimensions and alignment of all parts of the works and for the provision of all necessary instruments, appliances and labour used in connection therewith.

He shall carry out a detailed route alignment survey of the site in advance of his commencement of Construction work, and shall supply full details to the Engineer as specified in the following sub clauses of Technical Specifications.

All setting out and leveling shall be based on permanent Benchmarks provided by the Employer.

1.3.5. Existing levels and Layouts

1.3.5.1. Before commencing operations of any section of the works, the Contractor shall survey all existing detail in that section, in plan and in level and shall plot the results in such

detail and to such scales as shall be to the satisfaction of the Engineer. These survey plots shall be supplied to the Engineer at least four weeks before the intended commencement of construction on the section. Unless otherwise instructed by the Engineer the detailed survey plots will be supplied in 1:200 scale both as soft and hard copy.

1.3.5.2. In addition to the above mentioned requirements above, horizontal control lines shall be marked out by pegs at intervals of not more than 20m and the lines traversed with total station, by steel band or by any other method acceptable to the Engineer. The alignments established shall be referenced by pegs offset at suitable distance on each side of the horizontal control lines. These offset pegs shall be painted in a conspicuous colour.

1.3.5.3. Cross sections of the existing ground and of the ground after completion of earthworks shall be taken at intervals not exceeding 20m along the horizontal control lines in an approved and acceptable manner.

1.3.6. **Bench Marks, Survey Points and Deliverables**

1.3.6.1. As the work proceeds, the Contractor shall establish, at suitable location, substantial permanent benchmarks, clear of the works, from which, all subsequent setting out and leveling shall be carried out. The location of the benchmarks shall be agreed with the Engineer before they are established.

Benchmarks shall be constructed in class 20/20 concrete, with minimum dimensions of 0.3x0.3m, the upper surface being approximately 50mm above ground level. 20mm diameter mild steel rod, not less than 300mm in length, shall be cast into the concrete so that it projects about 10mm above the centre of the surface of the concrete. The concrete surface shall be clearly engraved with the reference number of the benchmark. The co-ordinates and level of each benchmark shall be determined in metres to 3 decimal places.

Plan of the road shall show the location of the proposed water main alignment, the width of right of way of roads on both sides of the carriageway, the existing services and obstructions to proposed pipelines and edges of existing asphalt carriageway. The drawing shall clearly indicate the location of the plot boundary walls wherever available. The existing services, as determined by site excavation, should also be marked up on these plans. The Contractor shall check co-ordinates and levels of benchmarks at monthly intervals and immediately notify the Engineer of any discrepancies.

1.3.6.2. The cost of alignment survey as explained above shall be included in the quoted items.

1.3.7. **Working and Shop Drawing**

1.3.7.1. General

The Contractor is advised to note that the following requirements are part of the Contract and he will not have any right to claim at any time for delays or for expenditure incurred by him in fulfilling the same.

1.3.7.2. Tender Drawings

The drawings are prepared in such detail as are necessary to give a comprehensive idea of the works. These drawings may be, to suit the site requirements clarified subsequent to the tender, modified, expanded or replaced subsequent to opening of tender. The Drawings if stands finalized at the time of executing the agreement, together with additional drawings and / or modified drawings, signed and made part of the contract will be called Construction drawings for the Contract. Any questions or alterations affecting the requirements or information on the Contract Drawings shall be submitted in writing to the Engineer and shall be reviewed by the Engineer. The lines indicated on the Construction Drawings denoting locations of the existing utilities or services are approximate locations. The Contractor is not to assume that they are exact. He has to confirm the exact location of the utilities in consultation with the relevant authorities.

The locations, layout and scope of works may be altered and in such cases the Contractor shall not be entitled to any claim whatsoever for such alterations over and above the measured works or measured variations at the tendered rates except in accordance with the provisions of relevant Clauses of the Conditions of Contract.

1.3.7.3. Working drawings

The Construction Drawings shall be supplemented by working drawings or shop drawings prepared by the Contractor which are required for the execution of the works. These working drawings shall include, pipe laying details, electrical single line drawings to suit the contractor's submission, mechanical drawings, piping drawings, reinforcement details such as bar bending schedules, manhole schedules, setting out details, layouts, utility relocation and protection if any required, and any other detail the Engineer may ask during construction. Schedules shall be drawn up for each pipeline with the details of depth, levels of pipes, and benching details. The working drawings/shop drawings and documents, including diagrams and schedules shall show the details of proposals for the execution of the works at specific chainages and shall include every information necessary for the following purposes:

- To illustrate in detail the arrangement of the various section of the works and to identify the various components.
- To integrate the various sections of the works

- All drawings shall be computerized and shall be submitted both in hard copy as well as digital data.

The costs of furnishing working drawings shall be included in the rates for various paying items given in the Bill of Quantities. Working drawings and documents shall be made available in sufficient time in order to maintain the Programme of Work on site. The Contractor shall also provide as part of the mobilization to site, latest model Pentium Computers and software together with new colour printer, for the preparation of his working Drawings by his staff. The Engineer shall have access to this Computer. In case the Contractor fails to mobilize such staff and equipment as described above to site, the Employer reserves the right to mobilize the necessary staff and deduct the cost of such mobilization from any money due to the Contractor.

1.3.7.4. Approvals of working drawings and Materials

The Contractor shall liaise with the Engineer for the period required for any approval, which shall be a maximum of two weeks. The Contractor shall ensure that all items to be ordered by him can be accommodated in the positions shown on the drawings and for taking all necessary dimensions on site together with any supporting information which may be necessary for preparing working drawings.

No materials or equipment shall be ordered nor construction of the associated works be commenced until such approval has been obtained from the Engineer. The Contractor shall be deemed to have obtained a full and proper understanding of the Engineer's design and design intents and to have satisfied himself with their accuracy and suitability. In this respect, the Engineer will meet all reasonable requests made by the Contractor in furnishing design information to the Contractor. No claim in respect of lack of knowledge will be admissible.

1.4 Soil Investigation and Report

1.4.1 A soil investigation has been undertaken during the Design phase. However in case additional investigations are required during the course of construction the Contractor shall be advised of such requirement and the Contractor shall promptly carry out such investigations as advised by the Engineer.

1.5 Site Safety

1.5.1 Safety of General Public/Utilities

In order to improve the general vehicular traffic condition and to guarantee public safety from and around the work the Contractor shall provide all labour, and materials, and construct

and maintain temporary traffic diversions throughout the construction activities, to the directive and approval of the Engineer. It is therefore recognized that there is a particular responsibility placed upon the Contractor to take special precautions for public safety and to minimize the scale and extent of disruption to public and commercial life. Plans for traffic diversion shall always be submitted to the Engineer and to the traffic police for their prior approval.

1.5.2 **Safety on Site**

The Contractor shall ensure that the works are carried out in a safe manner according to internationally accepted guidelines on safe working procedures and to the satisfaction of the Engineer. The following requirements shall be complied with by the Contractor:

a) **Excavation** - All excavations shall be adequately supported to avoid collapses and effective safety barriers shall be erected with warning signs and devices around all open excavations to the satisfaction of the Engineer. Struts and walling shall not be used as ladders and for the purpose of access to the base of excavation the Contractor shall provide proper ladders which shall be suitably secured. Reflective overalls shall be worn by all workmen on or close to a road and, where necessary, temporary road signs and cones shall be provided to ensure a safe working area. While excavating along the road reserve, sufficiently strong and wide timber bridges shall be provided for pedestrian crossings. As far as possible the excavations in front of entrances shall be backfilled the same day. Sufficient written notice shall be given to the residents who may be affected by the excavation.

b) **Protective Clothing** - The Contractor shall ensure that all personnel on site are supplied with the necessary protective clothing such as safety helmets, goggles, face masks, ear muffs, gloves, boots, depending on the operations being performed.

c) **Scaffolding** - Suitable and sufficient scaffolds shall be provided and properly maintained for all work that cannot safely be carried out from the ground or from part of the structure or from a ladder. Every scaffold shall be of good construction, of suitable and sound material and of adequate strength for the purpose for which it is used. Unless designed as an independent structure, every scaffold shall be rigidly connected to a part of the structure which is of sufficient strength to afford safe support. Protective headgear shall always be worn.

d) **Lifting Device** - Every rope, chain, pulley, block, hook, winch, crane or other lifting gear used for raising or lowering pipes or as a means of suspending them shall be of good construction, sound material, adequate strength and free from defects. They shall be properly maintained and tested at regular intervals by a competent person, who shall be to the approval of the Engineer.

e) **Working in existing pipelines etc.:** Checks shall be carried out before entry to ensure that the atmosphere is fit for respiration and no smoking naked lights or flames are to be permitted in any pipeline or chambers or in their vicinity when these are open.

The equipment which shall be made available shall include but not limited to:

- a) Gas detector lamps with lead acetate papers.
- b) Lifting harness with ropes
- c) Hand lamps with spare batteries
- d) First aid kit.
- e) Protective head gear.
- f) Rubber Gloves.
- g) Breathing apparatus.

Throughout the period of the Contract, the Contractor shall provide safety helmets and high reflectivity jackets to all employer's staff and visitors. Barriers must be provided to all excavations for the safety of the public and flagmen must be used for all items of plant for the safety of the operatives, supervision staff and members of the public.

1.6 Traffic Management

Before commencing the works, the Contractor shall consult with and obtain from the Traffic Police, Employer and the Engineer their requirements for temporary traffic signs, road markings, lighting and other measures necessary to ensure the safety of the public, and shall comply with these requirements, though such compliance alone will not relieve the Contractor of his obligations under the Contract. The Contractor shall also take a No Objection Certificate from Consultants supervising other Contracts in the area, get details of newly installed and temporary services and obtain access requirements for other contractors.

The Contractor shall deploy a safety officer, as a full time member of his site staff for the duration of the contract, whose duties shall include the production and implementation of traffic management schemes and the safety of vehicular and pedestrian traffic. Qualification and experience of the safety officer (traffic management staff) shall be subject to the approval of the Engineer.

Throughout the Contract, the Contractor shall maintain vehicular and pedestrian access to all properties adjacent to and within the site at all time. The contractor is solely responsible for obtaining the necessary permissions and approvals from the Traffic Police, service authorities and all other concerned authorities for the diversions and closure of sections of the existing roads and footpaths. Details of all proposed traffic management schemes shall be prepared well in advance of their intended implementation and shall be submitted to the Engineer and to other interested parties for approval.

Approval by the Engineer of a scheme will not relieve the Contractor of his responsibility to gain approval from the Traffic Police or other concerned authorities. Ignorance of any restrictions as to the timing and /or placing of diversions imposed by the Traffic Police or other authorities will not be accepted as a basis for claims for additional costs or delays arising from such restrictions.

Adequate warning and direction signs are to be erected wherever necessary and as advised by Traffic Police and diversions are to be maintained in good condition to the satisfaction of the Engineer.

Temporary diversions shall be constructed and maintained to the standards approved by both the Traffic Police and the Engineer. Upon completion of the Permanent works, the temporary diversions shall be removed and the site restored to the satisfaction of the Engineer.

The Contractor shall arrange with the appropriate authorities for any additional land required for temporary diversions. All traffic diversions must be constructed and maintained to the highest standards with regular washing of cones and daily maintenance of flashing lights. The signs and cones should be self-stabilizing, and if extra stability is required, only small sandbags with reflective painting should be used.

All stockpiles of material to be used in the works must be fenced off and all unsuitable material must be removed from site on a daily basis and not stockpiled on site. Payment for Traffic management shall be considered as included in the various pay items of BOQ. The Employer shall reserve the right to deduct penalties from any monies due to the contractor for failure to follow these conditions

1.7 Utility Services

1.7.1 Contractor to establish location of Utilities

Before the Contractor may proceed with the Works in any given area he is required to establish the precise location of all services in that area. Existing service plans are only approximate and may not be taken as an accurate indication of the positions of all services. The contractor will therefore be required, acting in strict co-operation with the Engineer, Agra smart city limited and other concerned authorities, to open up hand excavations, at points to be agreed, in order to establish the precise location of the existing services. The contractor is to locate all existing services by cutting trenches across the road's right of way at least at an interval of 100m. The trench shall be excavated manually without the use of machinery, so as not to damage any service. The width of the trench shall be decided at site. Once the service

is located, its position, location and depth together with any other significant details, shall be marked up on a road layout drawing, provided by the Engineer, and got approved by the Engineer. After collecting the details the trench shall be backfilled with the permission of the Engineer. The backfilling shall follow the specification for earthwork excavation.

The Contractor is required to make adequate allowance in his programming for this process and may be required to adapt his programme to accommodate the service protection and /or relocation works ordered as a result of these investigations. The Contractor shall provide for in his rate for quoted items for minor shifting of utilities.

If any major shifting or realignment of water supply, gas pipelines, electric and telephone lines is necessary then the same may be done by the contractor. The cost of such shifting shall be borne by the Employer.

1.7.2 Protection of Utilities

The Contractor is wholly responsible for the protection and /or facilitating relocation of such utilities as may be required. If any utility is damaged during the execution of works by contractor, the Contractor shall reinstate the utility at no cost to the Employer.

1.8 Protection of the Works during Contract period

It is clearly understood that any damage occurring to the works (completed or under execution) is the responsibility and no claims will be entertained by the Employer since the matter shall be covered by the relevant Insurances.

1.9 Discrepancies in Alignment

Discrepancies in alignment and levels etc., noticed during construction and/or on completion shall be rectified by the Contractor at his own cost, Engineer's approval does not relieve the Contractor of his responsibilities.

1.10 Temporary Water and Power Supply

All costs, both for temporary installations and water required for testing of pipelines and tanks, shall be borne by the Contractor. All costs for power supply in connection with testing of equipment shall be borne by the contractor.

1.11 Progress Photographs

1.11.1 The Contractor shall submit to the Engineer each month, throughout the period of the Contract, one set of progress photographs comprising 2 copies of 12 A4 size photographs selected by the Engineer from not less than 24 exposures of views of the works taken at the direction of the Engineer. The camera used for this purpose shall be such that the date is printed out on the negative.

1.11.2 In addition three copies of each of the 30 previously selected progress photographs
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and mounted in three separate and suitable albums shall also be delivered to the Engineer on the Preliminary Handing-over of the works. The arrangements for the progress photographs are subject to the approval of the Engineer and shall be discussed at as early a date as possible so that complete coverage can be assured.

1.12 As Built Records

On or before the completion of the works, at the direction of the Engineer, the Contractor shall prepare detailed drawings and other records, as required, of the works executed. The Contractor is required to submit the soft copy as well as two hard copies of the as built records to the scale advised by the Engineer.

1.13 Programme of works

1.13.1 In respect of the programme of works required under Clause 25 of the General Conditions of Contract the following specific requirements shall apply:

- The works shall be programmed in such a way as to minimize disruption to public traffic.
- Works shall not be carried out simultaneously over large areas of the site but shall be sequenced so that all operations likely to cause disruption to public traffic shall be undertaken and completed in discrete area before commencement of operations in other areas.
- Works which, by their nature, will create disruption and / or obstructions to vehicular or pedestrian traffic, such as pavement rehabilitation or trench – work shall be programmed to be undertaken in a continuous sequence of events from the initial disruption until the restoration of access without and significant delay between operations.

The programme submission shall be accompanied by outline traffic management plans in sufficient detail to indicate to the Engineer that the Contractor has considered this aspect the work in his programme. Notwithstanding, acceptance of the Contractor's programme will not in any way relieve of his responsibilities for traffic management under Clause 1.6 of this Specification.

- The Contractor's Programme shall, insofar as it is practicable to do so, take into consideration the commercial interest of individual shopkeepers e.g. operations should not be sequenced so as to disrupt access to individual shops having only one access from the road.

1.13.2 The Contractor's Programme of Works, submitted shall be subject to the approval of the Engineer and of Employer. If the Contractor's programme, in the opinion of the Engineer/Employer has not properly achieved the objectives of the programme, then the Contractor shall be instructed to revise his Programme and the Contractor shall do so forth; for this reason the Contractor is advised to liaise closely with the Engineer during the production of his Programme.

1.13.3 In addition to the Works Programme required the Contractor shall produce individual programmes for each element of the works likely to cause significant disruption to public and vehicular traffic, for the approval of the Engineer and prior to commencement of the element of the works, clearly showing the sequencing of construction operations in such a manner as to minimize the duration of the disruption.

1.13.4 The Contractor shall note that different work in various parts of site by other contractors may be in progress or may commence during the Contract Period. It will be the Contractor's responsibility to liaise with contractors on adjacent sites in order to ensure the detail progress. The Contractor's Programme may be phased and the Contractor shall make full allowance for the need for a co-operative timing with adjacent contractors.

1.14 Notice Boards

The Contractor shall provide, erect and maintain for the duration of the contract, two steel framed timber notice boards for the works, in location approved by the City Municipal Corporation and the Engineer's Representative. Notice Boards shall have a block board panel size of around 3m as detailed on the Drawings or equally approved. Prior to sign writing, the board shall be painted with two coats of white oil based paint back and front. The board shall be supported above the ground on steel struts painted matt black and fixed into concrete foundations, all to the approval of the Engineer. The sign shall be painted by a skilled sign writer to show the details described in the Contract. The Contractor is responsible for obtaining all necessary approvals for the erection of these notice boards.

The Contractor shall include the following details in the notice board:

- the name of the project and the financing agency
- the name and address of the Employer, the Contractor and the Engineer
- the name and address of the Design and quality control Consultant
- A short description of the project
- The amount of the Contract Price and
- and the Commencement and completion Dates

Under no circumstances, shall sub-contractor's or supplier's name boards be fixed on hoarding or elsewhere on site.

1.15 Advertising

1.15.1 Neither the Contractor nor any of those in his employment shall give information concerning the works for publication in any form without the written approval of the Engineer.

1.15.2 Neither the Contractor nor any of his sub-contractors shall erect placards or advertisements within the site other than the notice boards permitted under Clause 1.14

1.16 Contractor's offices, yard, stores and plant area

1.16.1 The contractor shall find on his own site for setting up his offices, yard, stores and plant area.

The Contractor's main office shall be used for the purposes of administering the Project but may not be used for the storage of construction materials nor for storage or maintenance of plant and shall not be allowed to become unsightly.

1.16.2 The Contractor's other offices, yard, stores and plant area shall be provided, by the Contractor, at location(s) to the approval of the Employer. The Contractor shall be responsible for all associated expenses including rents, assessments or temporary occupation license fees, establishment, running and maintenance costs, the supply of all services, as well as the obtaining of any appropriate No Objection Certificates.

1.16.3 Within 7 days of the Commencement date of the Contract, the Contractor shall submit, for the approval of the Employer, a drawing showing detailed plans for his offices, yard, stores and plant area, together with all sanitary arrangements, and for the supply of water and electricity. Until the Employer has given his approval in writing, no construction of any of the Contractor's buildings, fences, services or roads shall commence. The area shall be fenced in accordance with City Municipal Corporation regulations.

1.16.4 The Contractor shall not be permitted to erect temporary building or structures elsewhere without the specific permission in writing of the Employer, including approval of the dimensions and specifications of such buildings or structures and their location.

1.16.5 The Contractor shall take all steps necessary as directed by the Employer to minimize or eliminate dust, noise or any other nuisance, which may occur. Plant emitting dust, smoke, excessive noise or other nuisance shall not be permitted to be sited at any location which shall cause nuisance to any building or other installation, whether complete or under construction, site offices, camps, or other similar buildings.

1.16.6 Under no circumstances shall overnight accommodation be permitted on site except for Site watchman in carrying out their duties.

1.16.7 Throughout the period of the Contract, the Contractor shall maintain the area of his operation within the limits of the site in a clean, tidy and safe condition by arranging materials

and the like in an orderly manner. All rubbish, debris, waste materials and the like shall be systematically cleared from the site as it accumulates.

1.16.8 The Contractor shall satisfy himself as to the means of access to the site and other relative items affecting him, his sub-contractors and suppliers.

1.16.9 Upon completion of the Contract, or, in the case of facilities required by the Contractor during the Period of Maintenance, on completion of the period of maintenance the Contractor shall remove all buildings and other facilities from the site including all foundations and services, clean and level the site and restore the ground to its original condition.

1.2 SITE PREPARATION

1.2.1 General

The Contractor shall maintain close liaison with all Service Authorities and the Municipal Council Authorities and shall obtain their approval prior to removal of any service installation. Where Service Authority installations are to be removed, they shall be removed after the existing facilities have been relocated and commissioned or after they have been redundant and after any electrical supply has been made safe by the Authority or the Contractor whichever is appropriate. It is deemed that except for the items mentioned in this bill, costs of all other works in connection with site clearance are included in various pay items of other bills. If up stand kerb and/or flush kerbs to be removed are part of an asphaltic pavement to be removed, then, no separate payment will be considered for removal of kerbs.

1.2.2 Removal of Trees

a) General

1. This item consists of the removal of trees of any girth, their disposal as instructed by the Employer and Engineer and the backfilling of the hole left after uprooting the tree.
2. If any tree is conflicting with the road works then Contractor shall inform the Consultant.

The Contractor shall remove the trees only after obtaining the necessary approval from competent authority through the Employer.

b) Measurement and Payment

Payment under this item shall be made per unit of trees removed. The unit price shall constitute full compensation for the removal, hauling, disposing off of the tree of any girth as described herein and as directed by the Engineer and for all material, labour equipment, supplies and incidentals necessary to complete the Work. No payment shall be made for the

removal of bushes, stumps, roots etc., whose cost is considered as included in other pay items of the bill.

1.2.3 Removal and Reinstallation of Traffic Signs

The Contractor shall carefully remove the traffic signs and posts and or any similar directional signs located along the alignment by breaking out foundations/base/backing, disposal of all debris to Contractor's tip, backfilling of voids with suitable material in an approved manner, taking item to a store until required for re-erection, or delivery to the Municipal Stores or elsewhere as directed. The Contractor shall reinstate the traffic sign with foundation after completing the pipe laying and backfilling. Payment for the removal and reinstatement of traffic signs is deemed to be included in the quotable items.

a) Measurement and Payment

Payment under this Item shall be made per linear metre of fence removed. The unit price shall constitute full compensation for the works described herein and as directed by the Engineer and for all material, labour equipment, supplies and incidentals necessary to complete the Works.

1.2.4 Removal of Concrete Structures

a) General

The Contractor shall remove wholly or in part and satisfactorily dispose of all structures (manhole, slabs, walls, small building or any other concrete structure) as indicated on the Drawings / obstructing the pipeline alignment or as directed by the Engineer, and which are not specifically described under a separate Clause of this Specification. All material removed and all structures demolished shall be removed from the Work Site, hauled away and disposed off in approved disposal area and as approved by the Engineer. The voids or depression which are the result of the demolition of structures shall be backfilled with borrow material as approved by the Engineer. Backfilling material shall be placed in horizontal layers of over 15cm in depth and compacted to not less than 98%.

b) Measurement and Payment

Payment for the removal and disposal of all structures and related obstructions as described above will be at the cubic metre rate included in the Bill of Quantities which shall include all labour and equipment to demolish, remove the obstructions as building materials, concrete, debris etc., loading, hauling irrespective of haulage distance, disposing off all materials removed, and backfilling with borrow material and depression of voids, as indicated on the Drawing, specified herein and as directed by the Engineer.

Providing 24 x 7 water supply to ABD area
with smart water meters and SCADA

TECHNICAL SPECIFICATIONS

CHAPTER 2: MATERIALS

All materials required for the works shall be procured and supplied by the contractor himself. The materials shall be of good quality and conforming to relevant BIS .The materials that are classified for ISI marking should be supplied with ISI marking only.

2.1 Cement

The entire quantity of cement and steel required for the work will be procured by the contractor. The Contractor is responsible for all transport and storage of the materials and shall bear all related cost. The Employer shall be entitled at any reasonable time to examine the cement and steel supplied by the contractor.

The cement procured by the contractor shall comply with the requirements of IS:269/1976 with the latest revision thereof for ordinary port land cement and IS:8112/1989 with the latest revision thereof for 43 grade ordinary Portland cement. It shall be of the best normal setting quality unless specially rapid hardening or quick setting quality if expressly instructed by the Engineer to be supplied. Each bag shall bear ISI Certification mark and as per specification no.10 of TNBP volume

All cement shall be procured in bags and shall be stored in a dry place for which the contractor shall be responsible. Consignment of bagged cement shall be property stacked in a manner, which will permit easy access for inspection and definite identification. Cement shall be used in approximately in the chronological order in which it is received, but cement that has been stored for a period longer than 4 months from the date of initial sampling shall not be used unless it has been retested at the expenses of the contractor and passed by the Engineer in charge as good quality on the retest. Cement aged more than 180 days from the date of initial sampling shall be rejected.

Cement, which has become caked or perished, shall on no account be used on the works and shall be rejected. Although the Engineer may have passed any consignment if he finds that any deterioration in the quality thereon has taken place.

2.2 Steel

The steel bars shall comply with the requirements set forth in the IS:432 Part 1, IS:1139, IS:1786 as the case may be with the latest revision thereof and the test as described for

ultimate tensile strength, bond test and elongation tests.

All reinforcing steel shall be clean and free from oil, grease, loose scales or rust or other coatings of any character which would reduce or destroy the bond. Each band containing the bars shall bear the ISI Certification marks.

The Cement/steel shall be tested in nearby laboratories of Polytechnic or Engineering College by the Employer. Two samples should be taken by the Engineer in charge in the presence of the contractor or his authorized representatives or the technical personnel employed by the Contractor as in the Agreement. The contractor shall without extra cost, provide samples and cooperate in the testing of the cement/steel. One sample shall be got tested and the other sample shall be retained by making clear identification in the sample by the Engineer in charge so as to identify at a later date. The cost of such test shall be borne by the contractor.

A record of the quantity of cement/steel procured with the name of dealer, bill number and date shall be maintained by the contractor. This should be produced for examination by the Engineer in charge at any time. The age of the cement shall be reckoned from the date of manufacture and it shall be verified by the Engineer in charge.

The rejected consignment of cement and steel should be removed from the site within two days.

2.3 Aggregates

2.3.1 Sand

Sand for use in masonry and plaster works shall conform in relevant specification in TNBP (Specification No.7) and IS: 2116/1985, IS:1542/1977.

The coarse and fine aggregates for concrete shall conform to IS:383/1970 and as specified in the relevant clauses of IS:456/2000. Other aggregates free from deleterious materials shall be used at the concurrence and approval of the Engineer after sufficient tests have been carried out at the contractors cost.

The maximum quantities of deleterious materials in the aggregates, as determined in accordance with IS: 2386/ (Part II/1963 shall not exceed the limits given in table 1 of IS:383. Unless otherwise specified all coarse aggregate in RCC shall be graded aggregate of 20mm nominal size. All aggregates shall be stored in hard impervious surface to ensure exclusion of all foreign materials and as per IS: 4082/1977 and specification no.5 of TNBP Volume 1.

2.4 Water required for Construction

The water used in the construction shall be of potable quality and shall be tested at the contractor's cost. The contractor has to make his own arrangements at his cost for water required for construction, testing, filling, etc., either from local bodies or from elsewhere by paying the charges directly and arranging tanker etc., as per necessity. No claim for extra payment on account of non-availability of water nearby extra lead for bringing water shall be entertained. All required the contractor at his cost should make piping arrangements and pumping if required for water. Water for mortar mixing and curing of concrete shall be free from harmful mater or other substances that may be deleterious to concrete or steel and taken from a source approved by the Engineer. Ground water for mixing and curing shall conform to the provisions in the class 4.3 of IS: 456/2000

2.5 Form work and Centering

Steel /wooden form centering shall be used. If wooden formwork is used, it shall consist of planks not less than 40mm thick and strong props. This shall be provided complying with clause 10 of IS: 456/1978 and specification no. 30.8 of TNBP. The timber for form works shall be best hard wood and got approved by the Engineer in charge. This shall be deemed to be included in the items of contract even otherwise specified.

2.6 Separator (Cover Block)

For bottom cover of beams, slabs etc., separators of pre-cast cement mortar blocks of suitable size with wire embedment as directed shall be used and tied to the reinforcement. Between layers of reinforcements, separators consisting of pieces of bars of suitable diameter shall be used. The required cover shall be provided as per clause 24-4 of IS: 456/1978

2.7 Pipes, Specials and Valves.

2.7.1 General

All types of pipes required for the works should be of good quality conforming to relevant BIS and should be procured from reputed manufacturer or his authorized dealer. Each pipe should bear the trade mark of the manufacturer, the nominal diameter, class, weight, batch number and the last two digits of the year of manufacture suitably and legibly marked on it. The Engineer shall have the right to conduct any test to ascertain the quality of the pipes supplied by the contractor. The contractor should make all necessary arrangements for testing the pipes. All the charges and expenses towards the testing shall be borne by the contractor. The materials, which are classified for ISI marking, should be supplied with ISI marking only.

If on examination of any sample from any portion of the supply, the material is found to be

substandard and not fully in accordance with the relevant specification, the entire consignment shall be rejected. In case of doubt whether the materials confirm to the specification or not, the decision of the Executive Engineer shall be final.

2.7.2 PVC Pipes

- The unplasticised PVC rigid pipes shall strictly conform to IS: 4985/1988 and as amended from time to time and shall carry ISI marking in every pipe.
- The contractor should procure the PVC rigid pipes from a reputed manufacturer.
- The contractor should furnish the test certificate issued by the manufacturer.
- The manufacturer's test certificate and third party inspection certificate should be produced by the contractor for the pipes used in the works.
- In addition to third party inspection, wherever felt necessary, the Engineer shall have the power to test the PVC pipes for its quality such as specific gravity, impact strength, internal hydraulic pressure test, diameter, thickness etc, in authorized laboratory.
- The PVC pipes joints shall be with solvent cement of good quality, conforming to IS: 14182/1994.
- The Engineer in charge, shall verify, in addition to the test certificate, whether the pipes are as per BIS, by visual examination, diameter, weight, wall thickness, flexibility, Colour etc.
- All the PVC specials required for use in conjunction with PVC pipes, should be got approved by the Engineer-in-charge.

2.7.3 PVC Specials & Fittings

The Specials and fittings should be in conformity to the relevant BIS specification.

2.7.4 MS pipes

The MS pipes shall be of spirally welded, manufactured conforming to IS 5504 -1997 with mild steel HR coils conforming to IS 10748 grade 3

Following tolerances are applicable even if found stringent than the applicable codes

Wall thickness	: As per IS 3589
Ovality	: As per IS 3589
Straightness	: 2 mm per mtr of pipe

Pressure rating:

Pipes shall be suitable for an internal maximum working pressure as per IS 3589.

Length of pipe:

Pipes shall be supplied in 12 to 12.5 m length.

Pipe Ends:

Pipe ends shall be beveled and end faces shall be at right angle to pipe axis. Beveling shall be done as per standards suitable for but-welding joints.

Internal lining:

Pipes shall be lined internally with cement mortar coat as per IS 3589 -2001 Hazen William coefficient of friction "C" should not be less than 150. Thickness of lining shall be 12.5 mm. The outer coating shall be 25 mm thick cement mortar guniting for the underground pipes and enamel coating for above ground level piping conforming to relevant BIS/BSS.

Pipe fittings:

Pipe fittings shall be manufactured in accordance with IS 3589, and lined internally.

Welding Procedure:

The welding procedure shall be as follows:

Submerged arc welding in accordance with IS 4353 (SAW)

For submerged arc welding, alloying is not permitted via the flux.

2.8 Welding Electrodes and Consumables

All welding electrodes/consumables shall comply with IS 814, IS 3613, IS 6419 and IS 7280. The electrode/consumable chemistry shall meet the requirements of the base material and shall be selected such that the deposited weld metal exhibits mechanical properties equal to or in excess of the base material. All welding electrodes/consumables shall, as a minimum, be stored and used in accordance with the manufacturer's recommendations.

2.9 Non-destructive Examination (NDE)

All NDE shall be performed by a qualified personnel to recognized National or International Standard (E.g. PCN, ASNI Level 11, etc.). A document listing the relevant NDE procedures, methods and technique for the item, shall be submitted to us for review. Any subsequent revision to the document shall be approved by the Purchaser. Purchaser have right to review certification of NDE personnel at you works.

2.10 Pipe Marking

All pipes shall be marked with unique serial number. The number shall be hard stamped in letters or numbers not less than 15 mm high on the external face 200 mm from the pipe end and clearly stenciled in Red or White paint in letters or numbers not less than 200 mm high on the internal and external face of the pipe close to the pipe end.

Diameter and length of pipe

Date of Manufacture

Manufacture's name

Identification mark/number as certified by our representative stationed at suppliers premises.

The pipe thickness shall be designed to withstand Maximum working pressure plus the surge pressure. Field test pressure i.e. 1.5 times the working pressures Collapse pressure

Min. thickness for handling

2.11 *Quality Assurance*

During the whole process of manufacturing, department's representative shall be present to supervise the Quality Assurance process and witness the test performed.

2.12 *Testing At Work Site*

Ten percent of the field joints shall be tested radiographically (Samples at random) as per IS: 4853, in case of failure 20% field joints shall be selected. In case of second failure, 100% field joints shall be radiographed. Five percent of the field joints shall be tested ultrasonic test as per IS: 4260.

The welding of pipes in the field should comply with IS 816-1965 and electrode used should comply with IS 814-1967. Welded joints shall be tested in accordance with procedures laid down in IS 3600-1966 and one test specimen shall be taken from at least one field joint out of 10.

2.13 *Field Hydraulic Test*

After erection at site and after the concrete anchor/ thrust blocks have been constructed, the pipe section shall be put to sectional testing. The pipe line shall be tested for site test pressure of 1.5 times the maximum working pressure. Before start of the testing the pipe shall be kept filled at low pressures for minimum 24 hours to allow absorption of water by lining in case testing is allowed after lining by EIC. In any case the field welded joints shall be lined only after successful testing of the section. Pressure building shall be gradual at a rate of 0.1 N/mm² per minute. The duration of the test shall be 24 hours after attaining full pressure. If a drop in pressure occurs, the quantity of water added in order to re-establish the test pressure should be carefully measured. This should not exceed 0.1 liter/ mm of pipe diameter per km of pipeline per day for each 30 m head of pressure applied. Additional water will be pumped in the pipeline whenever drop in pressure is 10% of test pressure or 0.5 kg/cm², whichever is less or continuously maintaining the test pressure with required system.

The test will be declared successful only if the quantity of water thus added is within permissible limit, as prescribed above. Length of a section for testing shall not be more than 1.0 km. Field Joints shall be kept open during testing. Adequate anchorages shall be provided to avoid any movement of pipes. If any joint leaks during testing, the section shall be put to retest after repair of the joint by contractor. The contractor shall provide and maintain all requisite facilities, instruments, for the field testing of the material. All pipes, specials, valves and civil works shall be replaced by the contractor free of cost if damaged during testing. All pipes, specials, valves and Civil Works shall be replaced by the contractor free of cost if damaged during testing.

2.14 *Failure to pass the test*

All pipes or joints which are proved to be in any way defective shall be replaced or remade and re-tested as often as may be necessary until a satisfactory test shall have been obtained. Any work which fails or is proved by test to be unsatisfactory in any way shall be redone by the Contractor.

2.15 *Disinfection of mains*

Upon completion of a newly laid main or when repairs to existing pipes are made, the main shall be disinfected by heavily chlorinated water. After final flushing and before the water main is placed in service, a

sample or samples shall be collected from the end of the line and tested for bacteriological quality and shall show the absence of coliform organisms.

2.16 Fill, Backfilling and Site Grading

Trenches shall be backfilled with approved selected excavated material only after the successful testing of the pipeline. 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 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. Each layer shall be consolidated by watering, ramming, care being taken to avoid damage to the pipeline.

2.17 Material

To the extent available, selected surplus soil from excavations shall be used as backfill. Backfill material shall be free from lumps, organic or other foreign material. All lumps of earth shall be broken or removed. Where excavated material is mostly rock, the boulders shall be broken into pieces not larger than 150 mm size, mixed with properly graded fine material consisting of murum or earth to fill the voids and the mixture used for filling.

If fill material is required to be imported, the Contractor shall make arrangements to bring such material from outside borrow pits. The material and source shall be subject to the prior approval of the Employer. The approved borrow pit areas shall be cleared of all bushes, roots of trees, plants, rubbish, etc. Top soil containing foreign material shall be removed. The materials so removed shall be disposed of as directed by Employer. The Contractor shall provide the necessary access roads to borrow areas and maintain the same if such roads do not exist.

2.18 Sand Filling

Where backfilling is required to be carried out with local sand it shall be clean, medium grained and free from impurities. The filled-in-sand shall be kept flooded with water for 24 hours to ensure maximum consolidation. The surface of the consolidated sand shall be dressed to required level or slope. Construction of floors or other structures on sand fill shall not be started until the Employer has inspected and approved the fill.

2.19 Refilling of trenches

On completion of the pipe laying operations in any section, for a length of about 100m and while further work is still in progress, refilling of trenches shall be started by the Contractor with a view of restricting the length of open trenches. Pipe laying shall closely follow the progress of Trench Excavation and the Contractor shall not permit unreasonably excessive lengths of trench excavation to remain open while awaiting testing of the pipeline. If the Employer considers that the Contractor is not complying with any of the foregoing requirements, he may prohibit further trench excavation until he is satisfied with the progress of laying and testing of pipes and refilling of trenches. Only soft earth and murrum of good quality free from stones boulders, roots, vegetation etc., shall be utilized after the lumps are broken for filling in around the pipes for at least 30cm all around for pipes.

Filling shall be done in layers not exceeding 150mm and compacted to 70 to 80% of max. dry density percent of the maximum dry density as per part VII of IS:2720. The excavated material

nearest to the trench shall be used first. Care shall be taken during backfilling, not to injure or disturb the pipes, joints or coating. Filling shall be carried out simultaneously on both sides of the pipes so that unequal pressure does not occur. Walking or working on the completed pipeline unless the trench has been filled to height of at least 30cm over the top of the pipe except as may be necessary for tamping etc., during backfilling work.

The remaining portion of the trench may be filled in with a mixture of hard and soft material free from boulders and clods of earth larger than 150mm in size if sufficient quantity of good earth and murrum are not available. Filling in shall be done in layers not exceeding 225mm in thickness accompanied by adequate, ramming etc., so as to be compacted to 70 to 80% of the maximum dry density as per part VII of IS:2720. Water contents of the soil shall be as near the optimum moisture content as possible. The trench shall be refilled so as to build up to the original ground level, keeping due allowance for subsequent settlement likely to take place.

To prevent buckling of pipe shell of diameters 1200mm and above, pipes shall be strutted from inside while the work of refilling is in progress, for which no separate payment shall be made separately.

Strutting shall be done by means of strong spiders having at least 6 arms which shall be sufficiently stiff to resist all deformation. Spiders shall be provided at a maximum interval of 2m.

The Employer shall, at all times, have powers to decide which portion of the excavated materials shall be for filling and in which portion of the site and in what manner it shall be so used. If any material remains as surplus it shall be disposed of as directed by the Employer, which includes loading, unloading, transporting and spreading as directed within a distance of 15 km. If the Contractor fails to remove the earth from site within 7 days after the period specified in a written notice, the Employer may arrange to carry out such work at the Contractor's risk and cost or may impose such fine for such omission as he may deem fit. Particular care shall be taken to keep the trench dry during the entire refilling operation.

If suitable material for refilling is not available for excavation the Contractor shall bring earth, murum of approved quality as directed by the Employer.

No mechanical plant other than approved compacting equipment shall run over or operate within the trench until backfilling has reached its final level or the approval of the Employer has been obtained.

In case of excavation of trenches in rock, the filling up to a level 30 cm above the top of the pipe shall be done with fine materials such as earth, murum, etc. The filling up to the level of the centre line of the pipe shall be done by hand compaction in layers not exceeding 8 cm whereas the filling above the centre line of the pipe shall be done by hand compaction or approved means in layers not exceeding 15 cm. The filling from a level 30 cm above the top of the pipe to the top of the trench shall be done by hand or other approved mechanical methods with broken rock filling of size not exceeding 15 cm mixed with fine material as available to fill up the voids.

Filling of the trenches shall be carried out simultaneously on both sides of the pipe to avoid unequal pressure on the pipe.

Subsidence in filling: Should any subsidence take place either in the filling of the trenches or near about it during the maintenance period of 12 months from the completion of the Contract Works, the Contractor shall make good the same at his own cost or the Employer may without notice to the Contractor, make good the same in any way and with any material that he may think proper, at the expense of the Contractor. The Employer may also, if he anticipates occurrence of any subsidence, employ persons to give him timely notice of the necessity of making good the same, and the expenses on this account shall be charged to the Contractor.

2.19.1 CI pipes

- The Cast Iron pipes shall strictly conform to IS: 1536/2001 and as amended from time to time and shall carry ISI marking in every pipe.
- The contractor should procure the CI Pipes from a reputed manufacturer.
- The contractor should furnish the test certificate issued by the manufacturer.
- The manufacturer's test certificate and third party inspection certificate should be produced by the contractor for the pipes used in the works.
- In addition to third party inspection, wherever felt necessary, the Engineer shall have the power to test the CI pipes for its quality such as specific gravity, impact strength internal hydraulic pressure test, diameter, thickness etc, in authorized laboratory.
- The CI pipe joints shall be push-on joint for Spigot & Socket pipes conforming to IS:1538 & IS:13382.
- The Engineer in charge, shall verify, in addition to the test certificate, whether the pipes are as per BIS, by visual examination, diameter, weight, wall thickness, flexibility, Colour etc.
- All the CI specials required for use in conjunction with CI pipes, should be got approved by the Engineer-in-charge.

2.19.2 CI Specials and Fittings

The Specials and fittings should be in conformity to the relevant BIS specification.

2.19.3 DI pipes

- The Ductile Iron pipes shall strictly conform to IS: 8329/1994 and as amended from time to time and shall carry ISI marking in every pipe.
- The contractor should procure the DI Pipes from a reputed manufacturer.
- The contractor should furnish the test certificate issued by the manufacturer.
- The manufacturer's test certificate and third party inspection certificate should be produced by the contractor for the pipes used in the works.
- In addition to third party inspection, wherever felt necessary, the Engineer shall have the power to test the DI pipes for its quality such as specific gravity, impact strength

internal hydraulic pressure test, diameter, thickness etc, in authorized laboratory.

- The DI pipe joints shall be push-on joint for Spigot & Socket pipes conforming to IS: 9523.
- The Engineer in charge, shall verify, in addition to the test certificate, whether the pipes are as per BIS, by visual examination, diameter, weight, wall thickness, flexibility, Colour etc.,
- All the DI specials required for use in conjunction with DI pipes, should be got approved by the Engineer-in-charge.

2.19.4 DI Specials and Fittings

The Specials and fittings should be in conformity to the relevant BIS specification.

2.19.5 HDPE pipes

- The HDPE pipes shall strictly conform to IS:4984/1995 and as amended from time to time and shall carry ISI marking in every pipe.
- The contractor should procure the HDPE Pipes from a reputed manufacturer.
- The contractor should furnish the test certificate issued by the manufacturer.
- The manufacturer's test certificate and third party inspection certificate should be produced by the contractor for the pipes used in the works.
- In addition to third party inspection, wherever felt necessary, the Engineer shall have the power to test the HDPE pipes for its quality such as specific gravity, impact strength internal hydraulic pressure test, diameter, thickness etc, in authorized laboratory.
- The Engineer in charge, shall verify, in addition to the test certificate, whether the pipes are as per BIS, by visual examination, diameter, weight, wall thickness, flexibility, Colour etc.,
- All the HDPE specials required for use in the conjunction with HDPE pipes, should be got approved by the Engineer-in-charge.
- All HDPE joints and specials shall be of electro fusion coupler joints

2.19.6 HDPE Specials and Fittings

The Specials and fittings should be of coupler joints in conformity to the relevant BIS specification.

Testing of Pipes

The manufacturer test certificate third party inspection certificate should be produced by the contractor for the pipes used in the work. The Engineer shall have the right to test the pipes,

wherever felt necessary for its quality. All testing charges should be borne by the contractor.

Testing of materials to be used in works, for the quality of finished items shall generally be done by the contractor at his own cost in the laboratory approved by the Employer by providing requisite materials transport of test specimen and other assistance required thereof.

TECHNICAL SPECIFICATIONS

CHAPTER 3

3.1 General

CIVIL WORKS

Tamil Nadu Building Practice (TNBP) shall be strictly followed for carrying out different items of the work for which no standard specifications are available and no alternate specification have been given under the description of works.

Where any provision of the TNBP is repugnant to or at variance with any provision under BIS or description of work, technical specifications and conditions of contract, the provisions of the later shall be deemed to supersede the provision of the TNBP.

3.2 Well Steining-Deleted

3.3 Chambers and Manholes

Valve chambers, air valve chambers, flow meter chambers, manholes and similar structures shall be built into the pipeline where shown in the Drawings and shall be constructed in accordance with the Drawing. Valve chambers in which pipes are anchored shall be treated as specified for anchor and thrust blocks. If undisturbed ground has not been maintained next to a thrust-bearing surface, the gap shall be backfilled with mass concrete

Brick works

Bricks used for construction of valve chambers shall conform to the relevant Indian Standards. They shall be sound, hard, homogeneous in texture, well burnt in kiln without being vitrified, table moulded, deep red, cherry or copper coloured, of regular shape and size and shall have sharp and square and parallel faces. The bricks shall be free from pores, chips, flaws or humps of any kind. Bricks containing unground particles and/or which absorb water more than 1/6th of their weight when soaked in water for twenty-four hours shall be rejected. Over burnt or under burnt bricks shall be liable to rejection. The bricks shall give a clear ringing sound when struck and shall have a minimum crushing strength of 35 Kg/sq.cm. The class and quality requirements of bricks shall be as laid down in IS : 1077.

The size of the brick shall be 23.0 x 11.5 x 7.5 or unless otherwise specified; but tolerance upto (+) 3 mm. in each direction shall be permitted. Only full size brick shall be used for masonry work. Brick bats shall be used only with the permission of the Engineer-in-charge to make up required wall length or for bonding. Sample bricks shall be submitted to the Engineer-in-charge for approval

and bricks supplied shall conform to approved samples. If demanded by the Engineer-in-charge, brick sample shall be got tested as per IS: 3495 by Contractor at no extra cost to the client. The bricks rejected by the Engineer shall be removed from the site of works within 24 hours.

Pipe entering or leaving manhole

Whenever a pipe enters or leaves a manhole, bricks on edge must be cut to a proper form and laid around the upper end of the pipe so as to form an arch. All around the pipes, there shall be a joint of cement mortar (1:2) 13 mm thick between it and the bricks.

Manhole steps

Except where otherwise specified or shown on the Drawings, manhole step shall be of malleable cast iron in accordance with IS 5455. The shape and dimensions shall be to the figure of that BS.

Cast iron frame and cover

The cast iron frame and cover shall be of grey cast iron as per IS : 1728. The general requirements for casting and coating of CI frame and cover shall be as specified for CI steps in Clause. The locking device for cover shall be not less than 4 mm. The locking device for cover shall be provided. The CI covers for load test shall be selected at one for every lot of fifty or part thereof for each type and size manufactured and as directed by the Engineer-in-charge. The frame shall be fixed in cement concrete of M15 grade all round and finished with neat cement. The manhole frame shall have clear opening and shall weigh including cover shall be as per the bill of quantity.

3.4 Earth work

3.4.1 Specification

Tamil Nadu Detailed Building Practice (specification No.23 to the extent applicable) shall be followed for earthwork excavation.

3.4.2 Conveyance

The excavated earth, blasted rubble etc., shall be conveyed and deposited in the departmental lands within 150m of work site and as directed by the Engineer in charge.

3.4.3 Stacking

Where the location of the work is such and does not permit the deposition of excavated earth while digging trenches for laying pipes, the excavated earth should be conveyed to a convenient place and deposited there temporarily, as directed by the Engineer-in-charge. Such

deposited soil shall be reconveyed to the site of work for the purpose of refilling of trenches, if it is suitable for refilling. The unit rate for trench work of excavated and refilling shall include the cost of such operation.

3.4.4 Disposal of surplus Earth

The excavated soil, which is surplus to that, required for filling and after allowing for settlement will have to be removed, spread and sectioned at places shown on the site during excavation for purpose of widening or leveling. Sectioning is to be done as detailed in TNBP, It is to be understood that no extra payment, will be made for this and the unit rate for trench work of excavation and refilling shall include the cost removal of surplus earth to disposal site approved by the Engineer in charge, its spreading and sectioning at the bidder's expense.

3.4.5 Shoring, Strutting and Bailing out water

The rate for excavation of trench work shall include charges of shoring, strutting, bailing out water wherever necessary and no extra payment will be made for any of these contingent works. While bailing out water, care should be taken to see that the bailed out water is properly channelized to flow away without stagnation or inundating the adjoining surfaces and properties.

3.5 Concrete

3.5.1 Specification

Concrete for use in the works shall generally comply with TNBP specification No.30 and the relevant BIS. The concrete mix shall be in specified proportions satisfying the maximum aggregate size, water cement ratio and required cube strength and workability as per IS 456-2000. Such concrete must be adequately vibrated to form solid mass without voids. The entire concreting works should be done only with the prior approval and in the presence of Engineer-in-charge.

3.5.2 Fabrication Steel Reinforcement

Supplying, fabricating and placing in position MS/RTS Steel reinforcements for all RCC Works as per design/drawing etc. as per standard specifications.

3.5.3 Mixing Concrete

The concrete shall be proportioned as far as cement and aggregates are considered by volume. The amount of water required being measured either by weight or volume the adjustments must be made to frequent intervals at the discretion of the Engineer or his assistant to account for the moisture content of the aggregates. The mixing operation shall be performed only in a

mechanical concrete mixer and shall continue until the whole batch of uniform consistency and colour. The mixing of concrete shall be done in accordance with clause 8 and 9 of IS:456-2000.

3.5.4 Transporting, Placing and Compacting Concrete.

3.5.4.1 Transportation, placing and compaction of concrete mix by mechanical vibrators shall be done in accordance with clause 12 of IS: 456-2000. It is imperative that all concreting operations be done rapidly and efficiently with minimum rehandling and adequate manpower shall therefore be employed to ensure this.

3.5.4.2 The forms shall be first cleaned and moistened before placing concrete.

3.5.4.3 The mix should not be dropped from such a height as it may cause segregation and air entrainment. When the mix is placed in position, no further water shall be added to provided easier workability.

3.5.4.4 No concrete mix shall be used for the work if it has been left for a period exceeding its initial setting time before being deposited and vibrated into its final position in the member.

3.5.4.5 While one concrete is being placed in position it shall be immediately spread and ramped sufficiently and suitable to attain dense and complete filling of all spaces between and around the reinforcement and in to the corners of form work for ensuring a solid mass entirely free from voids.

3.5.4.6 Construction joints required in any of the structural members shall be provided generally complying with clause 12.4 of IS: 456-2000 and as directed by the Engineer-in-charge. The efficiency of tempering and consolidation will be judged by complete absence of air pockets, voids and honey combing after removal of form works.

3.3 Curing

3.3.1 Curing shall be done to avoid excess shrinkage or harmful effort to the members generally complying with clause 12.5 of IS:456-2000.

3.3.2 The method adopted shall be effective and any special method used must be approved by the Engineer and be subject to complete supervision.

3.3.3 Any deficiency in concreting such as cracking, excessive honey combing exposure of reinforcement or other fault which entail replacement of the defective part by fresh concrete without hampering the structural safety and architectural concept, all at the cost of contractor.

3.4 Removal of Form Work

3.4.1 Removal of form work shall be done as per TNBP and BIS and as directed by the Engineer in such a manner that no damage is caused to the structures. The stripping time shall not be less than that indicated in clause 10.3 of IS:456-2000.

3.5 Testing of Concrete

3.5.1 During the course of construction works, preparation of test specimens, curing and casting of concrete shall be done in accordance with IS:1199 and IS:516 to ascertain the strength requirements and acceptance criteria indicated in IS:456-2000. The contractor shall provide all apparatus, labour and arrange to test the cubes at his own cost at the test laboratory decided by the Engineer.

3.5.2 In addition to the above tests, any other test which may if desired by the Engineer-in-charge be carried out from time to time as per relevant specifications at the cost of contractor. In case the concrete does not meet the strength required, all corrective measures shall be taken at once at the contractor's cost.

3.5.3 The inspection and testing of structures shall be done in accordance with clause 16 of IS 456/2000.

Masonry

3.6.1 All masonry works such as Random Rubble/Brick work / Partition wall in Brick Work must be done as per TNBP Specification and Bid schedule specification.

3.6.2 Dismantling:

- a) Dismantling brick work in Cement Mortar and clearing away the debris and carefully stacking materials useful for reuse for any thickness of wall etc. complete as directed.
- b) Dismantling brick work in Cement Mortar and depositing the debris in low lying areas and leveling the debris as directed.
- c) Brick on edge are confirming to standard specification No.39C of TNBP.

3.7 Plastering

3.7.1 Plastering would be 10mm, 12mm & 20mm thick cement plaster either plain or waterproof as may be specified.

3.7.2 The plastering items shall be executed in thickness and cement mortar of proportion as detailed in respective items in the BOQ. Similarly the plastering shall be either ordinary or waterproof as specified in respective item in the BOQ.

3.7.3 In case of water proof plaster standard approved water proofing compound shall be mixed in cement mortar in required percentage as directed and then the plaster is applied.

3.7.4 The finishing shall be either smooth or rough as may be directed by the Engineer

unless otherwise specifically mentioned in the BOQ.

3.7.5 Neat finish wherever directed by the Engineer shall be done at no extra cost.

3.7.6 Curing and watering shall be one as directed and plaster shall be in alignment and level. Any substandard work is liable to be rejected and shall have to be re-done at contractors cost. Sand to be used shall be of approved quality only. Cost of all scaffolding shall be included in the rates quoted in the BOQ.

3.8 Flooring & Base Concrete

3.8.1 100mm thick cement concrete 1:4:8 / 1:5:10 shall be provided for flooring as base concrete.

The size of metal shall not be more than 40mm and it shall be properly graded. A thin coat of very fine plaster shall be provided on top to give a smooth finish.

The marking of false grooves to surfaces as directed includes the cost of labour. Floor finish shall be of:

1. Granolithic Flooring
2. Ceramic tiles
3. Cuddappah Slab
4. Granite Stone
5. Polished Granite

3.9 Doors and Windows.

3.9.1 Sizes shown on drawings are clear openings in masonry and not the shutter's size. These sizes shown on drawings are, therefore, inclusive of required frame sizes and doors windows, etc., and shall be manufactured, accordingly. If sizes bigger than shown in drawings are manufactured, as instructed specifically in writing they shall be measured and paid for accordingly.

3.9.2 The work shall be executed as per the size of frame thickness of shutter type viz. Plain planked paneled, glazed etc., and fixture, etc., as described in tender item. Iron bars for windows and ventilators are to be provided if specifically mentioned in the tender item at Contractor's cost. Specifications in TNBP shall be applicable.

3.9.3 The design of shutters and quality of wood shall be got approved from the Engineer-in-charge before manufacture. The CW/TW to be used for wood work shall be uniform in substance straight, free from large deed knots, flows flanks. The work shall be done as per specification of TNBP latest edition. The joints shall be perfect.

3.9.4 Part of wood embedded in masonry shall be painted with the tar. The frames of doors, windows, ventilators, etc., shall have proper hold -fasts embedded in masonry.

3.9.5. Whenever iron bar is to be provided as per tender item the rate thereof is included in tender item. The painting shall be done as prescribed in tender item. No painting, however, shall be permitted till the wood work is approved by the Engineer-in-charge.

3.9.6 Any substandard work not conforming to the specifications are liable to be out rightly rejected and Executive Engineer's decision in such case shall be final and binding on the Contractor.

3.9.7 The mode of measurement shall be on units as mentioned in BOQ.

3.10 White Washing, Colour Washing & Painting.

3.10.1 The work shall be carried out as per the description of the tender item and as directed by Engineer-in-charge. It shall be white washing, distempering and/or cement painting. Shade and make shall be as directed by the Engineer and for decorative purpose. Engineer may ask for different shades to be provided for different components or different parts of the same component which the Contractor shall have to do within his tendered rate only at no extra cost to the Employer. Cost of priming coat as directed, scaffolding etc. shall be included in the tender rate. The work shall be executed as per the specifications of TNBP for painting including metal surfaces.

In general, all items of works must be done as per TNBP specifications and bid schedule specifications.

Painting two coats with approved cement paint over one coat of cement primer on the new plastered wall surface, ceiling and other new surface and including cleaning, preparing the surface and curing etc. complete complying with standard specifications.

TECHNICAL SPECIFICATIONS

CHAPTER 4

WATER SUPPLY WORKS

4.0 General

4.1 The earthwork for the pipe laying work shall generally conform to the details given below.

Sl. No.	Size of pipe in mm	Depth of Excavation (cm)	Width of trench at bottom (cm)
1	For other pipes upto	105	0.60
2	For other pipes 150	105	0.75
3	For other pipes 200	110	0.80
4	For other pipes 250	120	0.80
5	For other pipes 300	135	0.80
6	For other pipes 350	145	0.90

4.1.1 Wherever necessary, sand cushioning for the bed shall be given as per IS Standards and as directed by the Engineer in charge. The pipe should be laid true to the alignment line and grade wherever necessary, appropriate bends should be used. The pipes laid must be jointed properly and carefully by using approved type of jointing materials.

4.2.1 After the pipes are laid and jointed, the pipelines are to be subjected to hydraulic pressure test as detailed in the relevant BIS Specification for various types as indicated below.

a)	Cast iron Pressure Pipes	:	Clause 6 of IS 3114/1985
b)	PVC Pressure Pipes	:	Clause of IS 7634/1975
c)	DI Pressure Pipes	:	Clause of IS 7634/1975

In portion of pipeline, where the pipes have developed cracks or sweating, such pipes with jointing materials shall be removed and re laid with new pipes at the contractor's cost and the pipe line shall be re tested to the entire satisfaction of the Engineer in charge. No extra payment will be made on this account. The bidder has to make his own arrangements for the procurement of the required equipment for testing of pipes which shall be subjected to such test as the Engineer-in-charge deems fit to ensure the accuracy of the gauge.

Refilling shall be done with proper compaction with excavated earth. In no case the contractor shall be allowed to refill the trenches in hard excavated portion to be refilled by the boulders or excavated stuffs. This portion of trench shall be refilled by the soft strata from excavated stuff from distance place at no extra cost. The refilling shall be done in 15cm thick layers duly watering

and compacting each layer. The refilling may be done up to a height of 20 to 30cm than the natural ground level to allow that sinking afterwards. If the refilling gets sunk below the natural ground level at any time till the completion of the work, the contractor at his cost should make good the refilling to the required level as may be directed by the Engineer in charge

4.2.2 Case of pipe trenches, the Engineer may reduce the width of trench wherever a hard strata is met with, if he feels adequate and just sufficient to lay the pipe line in order to reduce the hard rock quantity. In such case the contractor will be paid as per the actual measurement.

4.2.3 If the work is in a residential area, the contractor should carry out the excavation carefully to avoid collapse of any structure.

4.2.4 Valves shall be provided with valve pits with proper cover to bear the loads coming on it as per bid documents and departmental drawings and specification Public fountains, Fire hydrants shall be provided as per type design and specification.

4.2.5 Adequate protective measures should be taken against surge pressure. Zero velocity valves and air cushion valves should be provided at the appropriate places Thrust blocks and anchor blocks should be provided at all bends and appropriate places.

4.2.6 Water required for testing the pipeline shall be arranged by the contractor at his cost.

4.3 **LAYING AND JOINTING OF DI PIPES**

4.3.1 **TRANSPORTATION**

The transportation of materials to work site and stacking shall be done in such a manner as to cause minimum inconvenience to the traffic and other construction works. Pipes shall be protected during handling against impact, shocks and free fall to avoid cracks and damage. Pipes shall be loaded for transportation in such a way that they are secured and no movement can take place on the vehicle during transit. The same care shall be taken if pipes are transferred from one vehicle to another, however short the journey may be. The cement mortar lining of pipes that are damaged during transportation is to be repaired by hand application if possible; otherwise it has to be rejected. The decision for rejection shall be taken by the Engineer in charge.

4.3.2 **UNLOADING OF PIPES:**

Each pipe consignment shall be inventoried and inspected with care upon arrival even though the pipes have been inspected and loaded with care at the factory. Overall examination shall be made during unloading to ensure that the pipes have reached destination in good condition. If there is any sign of rough treatment on the coating, each pipe shall be inspected for damage.

While unloading, pipes shall not be thrown down from the truck to the hard roads. Cranes or Mechanical equipment shall be used for unloading the pipes from the truck. If mechanical equipment is not available, care should be taken to unload the pipes on timber skids. Unloading them on timber skids without a steadying rope and thus allowing the pipe to bump hard against one another should not be allowed. In order to avoid damage to the pipes specially to the spigot end, pipe should not be dragged along concrete and similar pavements with hard surfaces.

The pipes shall be laid on timber battens and secured with wooden wedges. The pipes shall be stacked with each tier at right angles to the preceding tier.

4.3.3 LOWERING OF PIPES AND FITTINGS:

The pipes shall be lowered cautiously to prevent disturbances of the bed and sides of the trench. Proper implements, tools and facilities satisfactory to the Authority shall be provided and used for the safe and convenient execution of the work. All pipes, fittings, valves and hydrants shall be carefully lowered into the trench, piece by piece, by means of a derrick, ropes or other suitable tools or equipment, in such a manner as to prevent damage to pipes materials and protective coatings and linings. Under no circumstances shall pipes materials be dropped or dumped into the trench. Pipes over 300mm diameter shall be handled and lowered into trenches with the help of chain pulley blocks or preferably by cranes. Tripod supports used for this purpose shall be regularly checked to prevent all risks of accidents.

4.3.4 CLEANING OF PIPES AND FITTINGS:

All lumps, blisters and excess coating material shall be removed from the socket and spigot end of each pipe. The outside of the spigot and the inside of the socket shall be wire-brushed and wiped clean and dry and free from oil and grease before the pipe is laid.

4.3.5 LAYING:

Before lowering the pipe, the trench section shall be got approved from the Engineer in charge. Trenches are to be dug to the specified level / grade. Sufficient cushion shall be provided for protection from surface traffic, future changes in the ground elevation. The width of the trench shall be to the required specifications providing room for pipe laying operation, backfilling, compaction etc., Trenches should be shored and braced when conditions so warrant.

The bottom of the trench shall form a continuous bed for the pipe. Where rock is encountered, trenches shall be dug deeper and then filled and compacted to grade with suitable bedding material. The Contractor shall have to provide and maintain sight rails and boning rods wherever required till the completion of work. The pipe shall be laid in reasonably dry condition and under no circumstances they shall rest on slushy bedding.

The pipes shall be lowered slowly into the trench by means of chain pulley block and tripod stand or with the help of ropes and suitable size of wooden bullies or with the help of cranes. They shall be brought to the required level by giving packing with wooden sleeper pieces and ultimately with well-consolidated hard murum if required. The chain pulley block and tripod stand must be approved from the Engineer in charge. Under no circumstances pipe shall be allowed to be thrown in the trenches. At the end of each day, the end of the pipe should be plugged to prevent entry of rodents, foreign substances, water etc.

4.3.6 **SUPPORT OF PIPE FOR NALLAH / RIVER CROSSING:**

Venteak piles are proposed for portion of pipeline which crosses the nalla / river or slushy soils. Each pipe shall be supported on a pair of Venteak piles driven upto 3.50m or firm ground whichever is met earlier.

One pair of timber piles shall be driven 150mm behind the shoulder of toe socket and another pair about 750mm in front of the spigot end of the pipe.

The size of timber section to be used for Venteak piles shall be: 100mm x 100mm for pipe sizes upto 300mm

150mm x 150mm for pipe sizes above 300mm

A cross piece of section same as that of pile shall be bolted to a pair of piles which have been driven to the required depth.

The level of the cross piece should be such that when the pipe rests on its top, its Invert level coincides with the proposed invert of the pipe.

The pipe shall be aligned for straightness and secured in position by wooden wedges nailed down to the wooden cross piece. The spigot end of each pipe shall be thoroughly homes in to socket of preceding pipe and jointing made. The pipe shall be further secured from moving upwards by timber cross pieces bolted to the supporting piles. The section of the cross piece shall be same as that of pile.

The socket ends of all pipes shall face up hill irrespective of the direction of water flow. Any deviation either in plan or elevation of less than $11 \frac{1}{4}$ deg. angle shall usually be effected by laying straight pipes round a flat curve; of such radius that rubber gasket shall not be disturbed in its place. Wherever new pipes laid are to be jointed with existing pipe line, first pipe laying work of new pipes are to be completed. Jointing of new pipe line with existing pipe line has to be completed within a stipulated time as per the instructions of Engineer in charge to keep the distribution system ready to supply water to the city. No extra payment will be made for this time bound urgent work.

4.3.7 TESTING:

After laying and jointing, the pipe line must be pressure tested to ensure that the pipes and joints are sound enough to withstand the maximum pressure likely to be developed under working conditions. The Contractor shall submit for the Engineers approval, details of his proposed methods and programme for testing including details of test equipment and shall provide for all tests to be carrying out testing and cleaning including water pumps, gauges, piped connections, stop ends, and all other temporary works.

Pipe lines shall be properly completed and supported before being put under test. No testing will be permitted until ten days after thrust blocks and other holding down works have been completed. In addition to any tests of individual joints or other interim tests which may be specified elsewhere, the Contractor shall submit, all parts of the pipe lines to a final test. Notwithstanding the foregoing, the Contractor may at any stage of construction, carry out such other tests as he considers desirable to check materials and workmanship on the pipe lines but this shall not relieve the Contractor of his obligations to achieve successful test under the contract.

All water required for testing and cleaning the pipelines shall be potable water and shall be provided by the Contractor at his cost. The test can be carried out by means of a hand pump or a pressure pump.

Pipelines shall be tested in lengths between valve pits or such lengths as the Engineer may direct or permit.

Fittings required for temporarily closing the openings in pipelines to be tested shall be properly designed for this purpose and shall be adequately strutted to withstand the pressure specified. The completed pipe line may be tested in sections, the length of section should be decided by considering:

- a) the availability of suitable water;
- b) the number of joints to be inspected; and
- c) the difference in elevation between one part of the pipe line and another.

The maximum length that can be tested in one operation shall be restricted to 500m and minimum length shall be 50m.

Where joints are left uncovered until after testing, sufficient materials should be back filled over the centre of each pipe to prevent movement under the test pressure. The Contractor shall make his own arrangements to procure necessary equipment, apparatus etc., required for testing and shall provide necessary labour for filling with water the length of pipes to be tested, fixing all apparatus and for carrying on the testing operations until the length of pipe,

specials and connections are firmly passed by the Engineer. If the testing apparatus and equipment are available with the TW AD Board, they can be hired by the Contractor at usual conditions and charges.

The length to be tested shall be provided with two blank flanges fastened on the usual manner by collar bands and bolts to the end pipes or if the length to be tested shall have a sluice valve at each end, such blank flanges may be dispensed with.

The length of pipes to be tested shall first be filled in with from a higher section of pipes already laid or with clean water obtained from a service connection, as the Contractor may arrange with the approval of the Engineer.

Before the actual testing pressure is applied, any air which has logged in the length of pipe to be tested shall be got rid of, by screwing on at the highest part of the length of pipes or temporary air valve, or by opening a temporary stop – cock or by means as the Engineer may direct.

The test pressure shall not be less than 10 kg / cm^2 .

Each pipe line or section thereof shall be filled with water and all air removed. The pressure in the pipe lines shall be raised steadily until the site test pressure is reached in the lowest part of the section. This pressure should be disconnected and no further water permitted to enter the pipe line for a period of 1 hour. At the end of this period, the reduced pressure in the pipe line should be measured, the original test pressure restored by pumping and the loss measured by drawing off water from the pipe line until the pressure has fallen to match the reduced pressure previously noted.

The loss shall not exceed 0.02 litre per mm diameter per Kilometer per 24 hours for each bar of head applied. If the pipeline fails to pass the test, the faults shall be located and repaired and the pipeline retested until it passes the pressure test. All exposed pipe, fittings, valves and joints shall be visually inspected during the tests.

If the length of pipeline under test is found to be satisfactory and no leaks or sweating are found at the pipe joints or at the joints of specials and connections, then this length of pipeline will be passed by the Engineer.

But should any pipe, joint, special or connection be found to sweat or leak, Contractor shall make good at his cost such defective joints and the length of pipe line shall be retested until all pipes, joints specials and connections are found to be satisfactory.

After satisfactory test, the Contractor shall remove water from the pipeline and clean it after testing at his own cost, without flooding adjoining areas.

Duration of Hydraulic Test:

The test is for 1 hour only. The rate of allowable leakage is given on per day basis. The leakage observed within one hour shall be converted to per day basis and compared with criteria given.

Maximum field test pressure for pipes with flexible joints:

Table – 1 on page 11 of IS: 12288 is not applicable in this case as our test pressures are well below the maximum field hydraulic test pressures given in the table.

Allowance of test pressure for lower elevations:

As regards allowance for lower points, there is marginal level difference in levels, between 2 points in the section to be chosen for testing and hence the difference in pressure developed will be insignificant.

Saturation of pipe material:

As regards saturation of material, it is significant in case of RCC, PSC pipes for DI pipes it is insignificant. We are not clear whether the remark is aimed at saturation of inner CM lining. The adequate curing of the lining will take care of this. Also the duration of the test is long enough to discount such possibility.

4.3.8 INTERCONNECTION WORK:

The interconnection work between the existing main and the proposed main to be laid under this contract shall proceed from the new main to the existing main. Before actually proceeding with the interconnection work, the Contractor shall make ready necessary tools and plants required for the work at site, such as pump sets, shoring materials etc. He shall also keep ready at site necessary pipes, jointing materials, specials and valves required for the work.

The Contractor shall keep necessary skilled workmen of sufficient strength at site and once the work commenced, the entire interconnection work shall proceed without interruption by engaging labour for carrying out the work on a continuous basis both day and night till the work is completed. The work shall be executed as per programme drawn up by the Engineer and shall be completed within the time ordered by the Engineer, for each individual interconnection. The work shall be carried out under the direction of the Engineer from the beginning to end.

Laying of specials, valves (except straight pipes from the branch of the new main to the connecting point in the existing main) including conveying specials etc., from the stores or site of stacking, excavating, timbering, pumping out water from the trenches, lowering, aligning,

jointing specials and valves, cutting the existing mains, dealing with water, inserting the necessary branches, jointing, testing, refilling etc., is included in the item of providing, laying and jointing DI pipes. Any ancillary work either of Temporary or Permanent nature required for interconnection and not covered by schedules shall be executed by the Contractor at no extra cost.

4.3.9 **FLANGED JOINTS:**

Flanged joint should be made by painting the facing of the flange with white lead freely and bolting up evenly on all sides. A thin fiber of lead wool may be very useful in making the joints water tight where facing of the pipes is not true. When packing must be used, it should be of rubber insertion three ply and of approved thickness. The packing should be of the full diameter of the flange with proper pipe hold and bolt holes cut out evenly on both the inner and outer edges. Where the flange is not full faced, the packing may be of diameter of the packing strip only, proper placing of the packing should be checked before another pipe is jointed on.

4.3.10 **DISINFECTION OF MAINS:**

Upon completion of a newly laid main or when repairs to existing pipes are made, the main shall be disinfected as directed by the Engineer. The main shall be flushed prior to disinfection except when the tablet method is used. After initial flushing, the hypochlorite solution shall be applied to the water main with mechanically or electrically powered chemical feed pump designed for feeding chlorine solutions. For small applications, the solution may be fed with a hand pump. In the case of mains of large diameter, water from the existing distribution system or other approved source shall be made to flow at a constant measured rate into the newly laid pipeline. The water shall receive a dose of chlorine also fed at a constant measured rate.

The two rates shall be proportioned so that the concentration in the water entering the pipeline is maintained at not less than 300 mg/l. The chlorine shall be applied continuously and for a sufficient period to develop a solid column of 'Slug' of chlorinated water that will, as it passes along the line, expose all interior surfaces to a concentration of at least 300 mg/l for atleast 3 hours. As the chlorinated water flows through tees and crosses, related valves and hydrants shall be operated so as to disinfect the appurtenances.

In the case of newly laid mains in which scrupulous cleanliness has been exercised, the tablet method can be adopted and in this method. The initial flushing is dispensed with the calcium hypo chlorate tablets are placed in each section of pipe and also in hydrants, hydrants branches and other appurtenances. The tablets shall be attached by an adhesive and must be at the top of the main. The main shall then be filled with water and the water shall remain in the pipe for at least 24 hours. After the applicable retention period, the heavily

chlorinated water shall be flushed from the main until the chlorine concentration in the water leaving the mains is no higher than that generally prevailing in the system or less than 1 mg/l. After final flushing and before the water main is placed in service, a sample or samples shall be collected from the end of the line and tested for bacteriological quality and shall show the absence of coliform organisms. If the initial disinfection fails to produce satisfactory samples, disinfection shall be repeated until satisfactory samples have been obtained. When the samples are satisfactory, the main may be placed in service.

The Contractor is expected to carry out the disinfection work as a part of laying the pipes and his rates for laying the pipes should include the disinfection and other connected works till the main is placed in service unless otherwise specified in the schedule.

4.4 Fixing Sluice Valve

The sluice valves to be fixed on the pipelines shall be examined, cleaned and placed in the positions as shown in the drawings. The valves shall be placed on the pipeline and valve chambers constructed according to drawings. The depth at which the valve is to be laid and the dimensions of concrete and masonry shall be varied when necessary under the orders of the Engineer.

As the pipes in some instances may be required to be fixed at a less depth than will permit the top of the valve spindle being below the level of the road (but this may only be in cases where the position of the valve is to one side of the metalloid road) the walls of the valve chamber shall in such cases be carried upto such height at may be ordered, and the chamber shall have such covering as the Engineer may direct. The valve shall be supported in the valve chamber so that no stress or strain occurs in the flange or other joints of the valve. The valve shall be carefully protected from slime or dust by a suitable mat or gunny covering and the pit itself shall be cleared of all unwanted material.

4.5 Fixing Scour Valve

Scour valves shall be fixed at places shown in the drawings or as directed by the Engineer, and the scour connections from the main shall be carried out completely as per drawings.

4.6 Fixing Air Valve

Air valves shall be fixed at the summits of pipe lines or at places as may be directed by the Engineer. The air valve connections etc. shall be carried out as per drawing.

4.7 Interconnection Work

The Interconnection Work between the existing main and proposed main to be laid under this contract shall proceed from the new main to the existing main. Before actually proceeding with the interconnection work, the Contractor shall make ready necessary tools and plants required for the work at site, such as pump sets, shoring materials etc., He shall also keep ready at site necessary pipes, specials, valves if any required for the work. The Contractor shall keep necessary skilled workmen of sufficient strength at site and once the work is commenced, the entire interconnection works shall proceed without interruption by engaging labour for carrying out the work on a continuous basis both day and night till the work is completed. The work shall be executed as per Programme drawn up by the Engineer and shall be completed within the time ordered by the Engineer, for each individual interconnection. The work shall be carried out under the direction of the Engineer from the beginning to end.

Laying of Specials, valves (except straight pipes from the branch of the new main to the connecting point in the existing main) including conveying specials etc., from the stores or site of stacking, excavation, timbering, pumping out water from the trenches, lowering, aligning, jointing specials and valves cutting the existing mains, baling out water, inserting the necessary branches, jointing, testing, refilling etc ., shall comprise as one unit of work and will be paid at the lump sum rate quoted in the schedule for interconnections.

4.8 Works to be left Water tight

The Contractor shall construct the pipes chambers and all other Works so that they shall be water tight. Should any leakage appear, it shall be made good by him at his expense by removing and reconstructing the portions of the Work so affected or by other method which will render the Work thoroughly water tight to the satisfaction of the Engineer.

4.9 Cleaning of Mains

During the execution of the work the contractor shall keep the interior surface of the mains free from cement, brick, soil or other superfluous matter and shall hand over the mains perfectly clean and free from deposit on completion.

4.10 Masonry chambers

Chambers for sluice valves, inspection, scour valves, air valves shall be constructed on the pipes in the positions as shown in the drawings or in such positions as the Engineer may direct. The work shall be done strictly in accordance with the detailed drawings or as ordered by the Engineer.

The excavation shall not be made lower than necessary to admit of the earth being properly

timbered. The bottom of the excavation shall be properly levelled, rammed and a bed of concrete laid thereon. When the concrete has sufficiently set the building of the brick walls shall then be proceeded with and all iron work fixed in as the building proceeds. The inside of all chambers shall be plastered with cement mortar 20 mm thick and the outside with cement mortar 12mm thick.

The chamber shall be topped with pre-cast RCC Slab 1:2:4 or cast iron surface box of valve cover as ordered by the Engineer. The surface box or valve cover shall be fixed on the top of the RCC slab by a layer of; cement mortar and sides of the surface box or valve cover covered over with cement concrete.

Where pipes pass through walls of chambers relieving arches shall be turned neatly over the upper half of the pipes or RCC lintels shall be provided to avoid load of the walls transmitted to the pipes.

Cast Iron steps shall be built in each chamber as the Work proceeds on being inserted to every 4 courses of brick work, horizontal distance center to center of each row being 30cm.

The Contractor shall include in his rate for brick work cost for fixing steps, frame, cover etc., for completing all chambers in accordance with the drawings and with the above specifications.

4.11 Restoring Road Surface

The surface of the road or ground shall be finished off to the proper level with the same kind of materials upto the surface consisted of before the excavation commenced, except in the case of superior roads and tarred roads in which case the surfaces should be finished off with water bound macadam surface. The road top surface/finishing restoration shall be carried out by road work. Should any settlement occur after refilling is completed, and upto the end of the period of maintenance, it shall be made good at once and the surface restored to the satisfaction of the authority under whose jurisdiction such road or ground may be, all at the cost of the contractor.

4.12 Collection of Rubbish

The Contractor shall, at his cost, on the completion of the Work remove all water and all materials or rubbish of every description which may have been collected in the works find a deposit thereof and anything which may have collected within the works, during the period of maintenance shall also be removed before the Works are finally accepted by the Employer.

4.13 Earth work excavation

4.13.1 General

Before commencing the work, and also during the progress of the work the contractor shall give notice to the concerned authorities viz., the Panchayats, the Municipalities, the Railway, the Electricity Board, the Telegraph Department, the Traffic Department attached to the Police and other Departments or Companies, as may be required to the effect that the work is being taken up in a particular locality and that necessary diversion of traffic may be arranged for. The contractor shall cooperate with the department concerned and provide for necessary barricading of roads, protection to existing underground cables, etc. met with during the excavation of trenches.

The contractor shall also provide at his own expense watch and light during the day and night and put required notice towards such as "Caution" "Road Closed for Traffic", etc. He should also provide and maintain at his own expense the necessary supports for underground cables, etc, to afford the best protection to them in consultation with the authorities in charge of the properties and to their best satisfaction.

4.13.2 **Trench excavation**

The width and depth of excavation of trench shall be as per relevant BIS. The rate for excavation shall include charges for shorting, strutting, bailing and pumping water whenever necessary and no extra payment shall be made for any of these contingent works.

Excavation and refilling for the socket hollows shall be paid for as excavation and refilling for trenches in soil of appropriate classification. The supply of river sand required for refilling should be paid for separately if provided in BOQ as separate item.

The Contractor shall deposit the surplus earth if any from trench work to proper place as may be directed by the Engineer and no extra rats shall be paid.

Whenever earthen road or gravel road is cut for the laying of pipes, the contractor shall restore the surface after the pipes and specials are laid and jointed with available materials to the satisfaction of the Engineer without extra cost either for cutting or relaying. The clause shall not apply to the cutting of concrete or macadam or brick surfacing or black top roads. The pipes shall be laid to correct levels and gradients, as may be directed by the Engineer, after fixing the sight rails as in Clause No. 106 of TNBP without extra cost.

If the floor of the trench is other than rock, hard clay or boulders, the floor shall be rounded to fit the curve of the pipe to form an even bedding for the pipe for a width equal to half the outer diameter of the pipe.

If the floor of the trench is in rock, hard or clay which will otherwise not provide uniform support for the pipe, the floor shall be excavated below the proposed bottom level of the pipe to a

depth of 20cm and the trench shall be refilled with approved soil or river sand as may be directed by the Engineer and properly compacted to a level of 10cm above bottom of the pipe. If river sand is used for refilling, the sand shall be paid for separately if provided in BOQ as a separate item.

4.13.3 **Hard Rock**

“Rock requiring blasting” shall exclude all rock such as soft rock, disintegrated rock, small boulders, all of which can be removed either with pick axe or crow bars and shall apply to rocks of different kinds which cannot be removed by any of these means. In case of difference of opinion, the Engineer’s decision as to which rock shall be considered as “rock requiring blasting” shall be final.

Refilling of the trench in reaches where the excavation is in rocky soil shall be with approved soil which is surplus from trench work operations elsewhere along the alignment or which shall be obtained from new borrow pits.

It is to be distinctly understood that if surplus soil from trench work elsewhere along the alignment is used no extra payment shall be paid for conveyance of the soil to the refilling site. No payment will be made for any excess earth brought to site and it shall be disposed off by the contractor at his own cost. Hard rock which is blasted and removed will be stacked at site as shown by the Departmental officers which are the property of City Municipal Corporation. The stacking shall be as directed by the Engineer.

4.14 **Lowering of pipes and jointing of pipes and specials**

4.14.1 All laying and jointing shall be in accordance with Clause 9.1, IS: 783-1985 for laying of concrete pipes. All the pipes and fittings shall be carefully handled and lowered into the trench by means of mobile cranes. Any other method of handling shall be got approved by the Executive Engineer concerned.

The pipes and specials should be handled by flat rubber bolts. Iron chain or iron crow bars should not be used under any circumstances for handling the pipes and specials at any stage.

The sockets shall face opposite to the direction of flow of water in the pipe. Pipes shall be normally laid so that the spigot end enters the socket of the last pipe that is, socket faces and direction of lying. The socket and spigot ends of pipe shall be cleaned of all extraneous matter especially clay or grease. Rubber ring shall be clean and dry.

4.14.2 Pipes shall be laid true to the lines and grades given on the plans. The rubber rings shall be kept evenly positioned on the spigot groove, and when satisfied that pipe and ring are correctly

positioned, the pipe shall be forced right home to the full depth of the joint. Inside the joint, the two pipe ends shall be in close proximity.

4.14.3 Bailing or pumping out of water from trench including shoring, strutting and removing slush while laying, jointing and testing shall be done by the contractor at his expense.

4.15 **Special Fittings**

4.15.1 Special Fittings have to be located at the exact chainage as shown on plans. It might entail in the necessity of laying short pipes in specified length. The number of gaps should be got approved by the Executive Engineer concerned.

4.15.2 Jointing between the special and pipe shall be done with rubber rings.

4.15.3 The construction of all anchor blocs at beds 'Y's and Tees shall be done by the contractor. It shall be his responsibility to chequy for the adequacy of the anchor block.

4.15.4 All HDPE pipes shall be jointed by electro fusion coupler joints only.

4.16 **Testing pipes on position**

4.16.1 The finished pipe line shall be tested in convenient sections between stop valves. The test gap and short reaches which could not be tested simultaneously as a continuous reach due to circumstances prevailing during execution may be subjected to the pipe line static pressure or maximum working pressure plus surge pressure which may be created during testing the short reaches and test gap whichever is higher as the case may be. The Executive Engineer's decision regarding the test pressure at field for the above test gap and short reaches will be final. When testing the pipe line hydraulically, the line shall be filled completely with water and kept filled for a week. The pressure shall then be increased gradually to full test pressure and maintained at this pressure for one hour. In testing pipe lines, a seepage allowance of 2.5 liters per kilometer per hour per centimeter diameter of the pipe shall be permissible.

4.16.2 **Joint Testing**

When testing the finished pipe line hydraulically after filling the pipe line section under test with water it shall be left under operating pressure for a certain length of period which will depend upon initial permeability, absorption movement of the pipe line under pressure and the quantity of air trapped. More water shall be pumped from a calibrated container until the required test pressure is reached, the test pressure shall be maintained throughout the test by means of continued pumping using a pressure relief calibrated container. The rate of flow of water from the container shall be determined at regular intervals. The pipe line is satisfactory provided the successive measurements show a diminishing quantity. An allowance of 3 liters per millimeter diameter of pipe per kilometer of pipe line per day per each 30 meter head of pressure applied

shall be allowed.

The field test pressure to be imposed should be not less than the greatest of the following:

- a) 1½ times the maximum sustained operating pressure
- b) 1½ times the maximum pipe line static head; and
- c) Sum of the maximum sustained operating pressure or the maximum Pipeline static pressure and the maximum calculated surge pressure.

Subject to a maximum equal to the works test pressure for any pipes and fittings incorporated in the pipeline. However, the line test pressure, in no case, shall exceed the hydrostatic proof test pressure. Pressure gauges shall be inserted at both ends of the line and test so that leakage can be precisely calculated.

4.17 Back filling trenches

4.17.1 The initial back fill shall be of selected materials suitable for tamping under the pipes and down at the sides. Earth shall be placed by hand in 7.5 cm- layers and rammed well until the backfill materials reaches 15 cm above the crown him of the pipe. Mechanical rammers may also be used.

4.17.2 The remainder of the trench shall be filled carefully with ordinary excavated material without rock and rammer property.

4.17.3 Refilling can be done leaving the joints portion exposed, after laying.

4.18 River crossings.

All the supporting structure for pipeline to be taken above MFL (Maximum Flood Level) in river. The contractor shall furnish detailed drawings showing the type of bedding needed to support the pipe.

4.19 Railway Crossings

Required permission for laying, jointing and testing the pipe line across the railway lines will be obtained by the Employer. The contractor will carry out the work according to the specifications and stipulations made by the Railway authorities.

4.20 Road Crossings

Wherever pipeline has to cross roads or cart tracks, it shall be done through a culvert or bridge, wherever necessary.

4.21 **Distance indicators**

The Employer shall supply and *fix* indicators at all points of change of direction, at all valves and at every one kilometer intervals along the pipeline. Indicators shall consist of 10 x 10cm precast concrete posts 1.25m length set 0.75m into the ground and painted white about ground level. The description shall be written in blue at one face of the precast post.

4.22 **Drawings**

The drawings are only indicative. The site conditions will only be the governing factor for manufacture, laying and payment.

4.23 **Disinfections of Mains**

Upon completion of a newly laid main or when repairs to an existing pipe are made, the main shall be disinfected as directed by the Engineer.

The mains shall be flushed prior to disinfections except when the tablet method is used. After initial flushing, the hypo chlorite solution shall be applied to the water main with mechanically or electrically powered chemical feed pump designed for feeding chlorine solutions. For small applications, the solution may be fed with a hand pump.

In the case of mains of a large diameter, water from the existing distribution system or other approved source of supply shall be made to flow at a constant measured rate into the newly laid pipe line. The water shall receive a dose of chlorine also fed at a constant measured rate. The two rates shall be proportioned so that the concentration in the water entering the pipeline is maintained at not less than 300 mg/l. The chlorine shall be applied continuously and for a sufficient period to develop a solid column of 'Slug' of chlorinated water that will as it passes along the line expose all interior surfaces to a concentration of at least 300 mg/l. for at least 3 hours. As the chlorinated water flows past tees and crosses, related valves and hydrants shall be operated so as to disinfect the appurtenances.

After the applicable retention period, the heavily chlorinated water shall be flushed from the main until the chlorine concentration in the water leaving the mains is not higher than the generally prevailing in the system or less than 1 mg/l. After final flushing and before the water main is placed in service, a sample or samples shall be collected from the end of the line and tested for bacteriological quality and shall show the absence of coliform organisms. If the initial disinfection fails to produce satisfactory samples, disinfections shall be repeated until satisfactory samples have been obtained. When the samples are satisfactory, the main shall be

placed in service.

4.24 **General**

1. The water for the works shall be as far as practicable free from earthing vegetable or organic matter and from salts or other substance likely to interface with the setting of mortar or otherwise prove harmful to the work.
2. All items of work shall be done in accordance with the relevant classes of T.N.B.P and agenda volume to the TNBP or amendments from time to time.
3. The contractor shall be responsible for the safe custody of all the departmental materials once they are handed over to the contractor at the departmental stores. The cost of any materials in the custody of the contractor stolen, lost, destroyed or damaged or if rendered unfit for the work will be recovered from the contractor at the issue rate.
4. For testing the concrete and aggregate the contractor must procure the following equipment and make them available at site:-
5. Steel mould for making 45cm cube of concrete (The mould will be in two halves for easy removal)
6. Slump cone for testing consistency (slump test) the cone will be 30cm height truss casted cone with top and bottom diameters of 1cm and 20 cm respectively. In addition a steel rod 15cm diameter and 50cm in length and with tamping and rounded is to be procured.
7. For finding fineness modules and coarse aggregate hand operated over a apparatus may be procured along with weighing machine for weighing the aggregate and the sand.
8. In the case of any breach of the terms of the contract the contract will be closed at the risk and the costs of the contractor in addition to the forfeiture of the EMD & security deposit.
9. The testing is to be done at the contractor's cost for all building materials and also for concrete cubes.
10. The work shall be executed and measured as per metric dimension given in the schedule of quantities drawing etc. (F.P. units where indicated are for guidance only)
11. Unless otherwise specified the entire rate quoted by the contractor shall be for works at all levels of the buildings.
12. Rates for every item of work to be done under this contract shall be for all lifts and leads, heights, depths, lengths and widths.
13. Except when specifically mentioned in the item, otherwise nothing extra will be paid on this account.
14. The rate for all item in which use of cement is involved is inclusive of charges for curing.

TECHNICAL SPECIFICATIONS

CHAPTER 5

WATER RETAINING STRUCTURES

5.1 Elevated Service Reservoir/Ground Level Service Reservoir/Sump etc

1. Each service reservoir shall be executed as per the drawings and specifications and as directed by the Engineer in charge.
2. The service reservoirs shall be provided with suitable size CI D/F Pipes for inlet, delivery, overflow and scour connections and painted with two coats of anticorrosive paint as per BOQ/Drawing.
3. Suitable size sluice valves with gear arrangements wherever necessary shall be provided for all inlet and outlet connections with valve pits.
4. Water level indicators enamel painted with float and painted with graduations in metric units shall be provided to indicate water level inside the reservoir.
5. Suitable size and required number of ventilators, manhole covers shall be provided as directed by the Employer.
6. RCC spiral staircases shall be provided for outside and access ladder inside the service reservoirs as per Specifications.
7. The finishing colour of the service reservoirs shall be aesthetically selected after its approval by Employer and double coating shall be applied after water tightness certificates is given by the Engineer.
8. Letterings to indicate the capacity and other details as directed by the Employer shall be written on the side wall of the service reservoirs.
9. Valves shall be provided with valve pits and cover to bear the loads coming on it as per departmental type design and plans.

5.1 Testing for Water Tightness

5.1.1 For water retaining structures above ground level, the requirement of the test shall be deemed to be satisfied if the external face shows no sign of leakage and remain apparently dry over a period of observation of seven days after filling upto maximum water level and allowing seven days period for absorption.

5.1.2 In case of underground structures with top covered the tanks shall be deemed to be water tight if the total drop in water level over a period of seven days does not exceed 40mm.

5.1.3 If the structure does not satisfy the condition of the test period, the test may be extended for a further period of seven days and if the specified conditions of the test are satisfied the

structures shall be considered to be water tight.

- 5.1.4** In case of unsatisfactory test result, the contractor; shall ascertain the cause, make all necessary repairs and repeat the procedure in the preceding clauses until the test has been passed satisfactorily at no extra cost to the Employer.
- 5.1.5** The fact carrying out water tightness test should be recorded in M.Book. The last part bill should be passed only after above certificate is issued. However the contractor shall be permitted to execute an indemnity bond in lieu of the recovery of 40% in each bill in prescribed form in stamp paper for a value of Rs.22.50 towards water tightness and structural stability of the reservoir/water retaining structure. The period of guarantee required by the contract shall be two years from the date of completion and commissioning (with filling of water upto maximum water level in the case of service reservoir/overhead tank/water retaining structure). If defects are noticed within the stipulated period of 24 months of satisfactory performance, the defects should be rectified by the contractor at his own cost and the performance period again shall be reckoned from the date of completion of the rectification of defects by the contractor. In the case of service reservoir/overhead tanks and other water retaining structures during this period, structure under full working head of water should show no sign of leakage. The test for water tightness should be arranged to be carried out and completed within 30 days from the date of intimation, by the Engineer. The testing of the service reservoir/OHT/and other water retaining structures should be done by the contractor at his own cost inclusive of all necessary equipment, water etc., complete. The test for water tightness of the structure as well as materials of construction used shall be conducted in conformity with the standard specification as per IS: 3370 (Part-1)-1965 as amended from time to time and the other specifications as mentioned in the bid document.

5.2 C.I. Pipe Connections

- 5.2.1** The vertical pipe connections shall be hoisted and fixed true to plumb without any deviation from the verticality as directed by the Engineer-in-charge.
- 5.2.2** The jointing of pipes shall conform to the requirement and all required jointing materials shall be arranged by the contractor at his cost.

5.3 Scour

- 5.3.1** Scour and overflow arrangements should be connected and let to a common pit from where it will lead to the nearest open drain.

5.4 Maintenance

During the maintenance period, the contractor should clean the elevated service Reservoir and sump at the intervals as directed by the Engineer.

TECHNICAL SPECIFICATION
CHAPTER – 6
MECHANICAL & ELECTRICAL WORKS

6.1. Mechanical equipment and Works

6.2. Centrifugal Pumps

6.2.1.General

The pumps shall be designed to operate satisfactorily without detrimental surges, vibration, noise, or dynamic imbalance over the required head range. The head-capacity curve of the pump shall have a continually rising head characteristic with decreasing capacity over the whole range of total head. The shut off head of the pump shall be at least 135 % of the total head. The Pump shall have the maximum efficiency at the specified duty point.

The Contractor shall guarantee that adequate required Net Positive Suction Head (NPSH) is available to ensure that pumps can operate without cavitation under the worst operating condition. The required NPSH at duty point and throughout the range shall be at least 1.0 M, and 0.5 M less than the available NPSH respectively at the lowest water in the sump.

Each pump must be capable of running satisfactorily in parallel with other sets in the system without throttling and by itself, without cavitation or overload under all operating conditions within the system resistances indicated.

The unit shall be designed to operate safely at the maximum speed attainable in the reverse direction of rotation due to water returning through the pump at times when the power supply to the motor is interrupted and the discharge valve fails to close. The first critical speed of the pump set shall be at least 30 % above the operating speed.

Pumps shall run smooth without undue noise and vibration. The velocity of vibration shall be within the 4.5 mm/sec. Noise level shall be limited to 85 dBA at a distance of 1.86m.

All rotating parts shall be statically and dynamically balanced as per relevant ISO standards

All pumps shall be provided with mechanical seals of working life not less than 20,000 hours of operation.

A stationery coupling guard shall be provided for the coupling conforming to all relevant safety codes and regulations. Guard shall be designed for easy installation and removal, complete with necessary support, accessories and fasteners.

The pumping unit shall be provided with a common base plate. The base plate shall be of sufficient size and rigidity to maintain the pump and motor in proper alignment and position.

Pump design shall be as per IS:6595 and pump performance shall be as per IS:5120.

The power rating of the pump motor shall be the larger of following:

- (i) 115 % of the power required by the pump at the duty point.
- (ii) 105 % of the maximum power required by the pump from zero discharge to run off point total head.

Materials of Construction

Casing	:	CI IS210 Gr FG 260
Impeller	:	SS ASTM A743 Gr CF8M
Shaft	:	ASTM A276 SS 431
Shaft Sleeve	:	ASTM A 743 CF8M
Casing ring	:	SS AISI 410
Gland	:	Bronze conforming to IS 318 Gr LTB 2
Gland Packing	:	Graphited Asbestos
Base Plate	:	CI/Epoxy Coated MS

Testing:

Material Test Certificate:	:	Casing, Impeller and shaft
Hydrostatic Test	:	1.5 times the shut-off head or twice the rated discharge head, whichever is greater
Performance Test	:	As per IS:5120 &: at full speed
NPSH Test	:	“Type” test certificate for the offered model
Mechanical Balancing	:	As per ISO:1940, Gr. 6.3 or better
Visual Inspection	:	Pumps shall be offered for visual inspection before shipment. The pump components shall not be painted before inspection
Field Tests	:	Field performance tests required for satisfactory operation

Inspection: Category A

6.3. CRANES

6.3.1. General

Electric driven, short headroom, wire rope hoists with motor driven, traveling trolley and I-beams for suspension shall be provided at chlorine room and chemical house. The construction of the hoists, its components, the design, testing and commissioning shall conform to IS 3938, Class II duty.

Mechanical details

The specifications of the hoists are as follows:

- Rope drums shall be of cast steel or fabricated from rolled steel plates, conforming to the relevant Indian Standards. Fabricated rope drums shall be stress relieved before any machining takes place. The drum grooves shall be smooth finished and the rope drum shall be flanged at both ends. The drum shall be designed for a single layer of ropes. A precision machined rope guide to suit the drum grooves shall move over the drum like a nut, guiding the rope into the grooves and preventing an overlapping of the rope.

- Brakes shall be D.C. electromagnetic type/thrust type. Brakes shall be designed to hold the load at any position whenever there is a current interruption, either intentionally or by main power supply failure.

- The wires shall be hemp cored and galvanised. Ropes shall be of regular right hand lay as per IS 2266. The rope construction shall be 6 x 37 with a factor of safety specified as per IS.

- The sheaves shall be fully encased in close fitting guards fabricated from steel plate. Smooth opening shall be provided in the guards to allow for free movement of the rope. Holes shall be provided for oil drainage. The lifting hook shall be supported on a bearing for 360 ° swivel under load.

- Straight and helical spur gearing shall be used for all motions. All first reduction gears shall have helical teeth. All pinions shall be integral with the shaft. All gears shall be hardened and shall be of tempered alloy steel having metric module. Overhung gears shall not be used. All gearing shall be totally enclosed and grease lubricated.

- Single flanged wheels shall be mounted in anti-friction roller bearings housed in “L” shaped bearing brackets for ease of removal during routine maintenance. Solid wheels shall be of forged/rolled steel or cast steel.

- 415 V, 50 Hz, heavy duty motors suitable for hoist and trolley operation, suitable for reversible motion, frequent acceleration and mechanical braking, totally enclosed, fan cooled, wound rotor motor shall be used. Class of insulation shall be “F”, with temperature rise limited that for “B”. The pullout torque shall not be less than 225% of full load torque, corresponding to 40% CDF (Cycle Duration Factor of the motor). 200 switching per hour shall be considered for the selection of motors. The hoist shall have the following speed ranges:
 - a) trolley travel : 10 m/min; micro travel: 2 m/min
 - b) hoisting : 2 m/min

Roller operated, resetting limit switches shall be provided for all motions. Limit switches shall be fitted to prevent over traveling and over hoisting.

- A flexible traveling cable system mounted on a retracting support system shall be used. The conductor shall consist of insulated multi-conductor cable with permanent termination on the connection box and on the trolley. The flexible trailing cable shall have ample length and shall be supported by means of properly designed movable clamps. These clamps shall be fitted with rollers and shall run freely on a guide rail along the beam. The flexible copper cable shall be butyl rubber or EPR insulated CSP sheathed type 650/1100 V Grade.

- From fixed control panel from where the entire operation area can be overlooked or from a pendant push button control block hanging on a cable from the hoist. Control voltage is 110 V from a single phase step-down transformer. The following control is possible:

- a) Key operated ON push button - standard green button.
- b) ON signal lamp - green lens.
- c) Emergency OFF push button - standard red button.
- d) Hoisting push button - standard black button.
- e) Lowering push button - standard yellow button.
- f) Micro hoisting push button - standard black button.
- g) Micro lowering push button - standard black button.
- h) Cross traverse forward push button - standard black button.
- i) Cross traverse reverse push button - standard black button.
- j) Micro cross traverse forward push button - standard black button.
- k) Micro cross traverse reverse push button - standard black button.
- l) Long traverse forward push button - standard black button.

- The beam shall be suitable for the trolley, complete with end stops, holding down bolts and taper washers and shall be suitable for connection to the station earth. It shall be designed according to the capacity of the hoist, the beam fixation/support points, length and alignment. It shall be of galvanised mild steel. All fixation elements shall be of galvanised steel.

The following documents are to be furnished after award of work.

- General arrangement drawing of crane with details
- Note on erection and testing
- Test certificate for hook, chain and chain pulley block assembly.

6.4. Full Bore Electromagnetic Flow Measuring System

- a. For flow measurement full bore electromagnetic flow measuring system shall be provided.
- b. The full bore electromagnetic flow measuring system shall comprise of flow tube, flow transmitter cum computing unit, panel mounted digital flow indicator cum integrator and any other item required to complete the flow measurement system.

c. 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 tube shall be provided, as required by the flow meter manufacturer.

d.

Flow Tube			
i.	Type	:	In line full bore electromagnetic
ii.	Size of the flow tube	:	Same as pipe size
iii.	Material of internal lining of flow tube	:	Rubber / Neoprene / Polyurethane
iv.	Minimum flow	:	As per process requirement
v.	Maximum flow	:	As per process requirement
vi.	Maximum pressure	:	As per process requirement
vii.	Weather protection class	:	IP 68
viii.	Electrode material	:	SS 316
ix.	Coil housing	:	SS 304 / CS / Die cast aluminium
x.	Prefabricated integral cables for connecting flow tube to flow transmitter cum computing unit	:	Required
xi.	Process connection	:	Flanged

e.

Flow Transmitter cum Computing Unit			
i.	Type	:	Microprocessor based with facility to configure the flow meter
ii.	Type of display	:	Digital seven segment back-lit LCD/LCD display
iii.	Unit of display	:	Flow rate - m^3 / hr Totalised flow – ML
iv.	Input	:	From flow tube
v.	Output	:	4-20 mA DC (isolated) proportional to flow rate
vi.	Zero and span adjustment	:	Required
vii.	Enclosure material	:	Die cast aluminium / non-corrosive
viii.	Enclosure protection class	:	IP 65
ix.	Battery backup for totalised flow	:	Required
x.	Facility for on line diagnosis	:	Required

xi. Mounting : Separate from flow tube

f. Digital Flow Indicator cum Integrator

Refer specifications of digital flow indicator cum integrator elsewhere.

6.5. Pressure Gauges

a. Pressure gauges shall comply with IS 3624. Where the gauge is subject to pressure pulsations and/or vibration, it shall be provided with either snubber or glycerin filled dial.

b. The minimum diameter for round pressure gauges shall be 150 mm unless specified otherwise or as per the equipment manufacturer's standard practice when the gauge forms part of the equipment.

c. Technical Requirements

Raw water (diaphragm seal assembly with SS 316 diaphragm shall be provided)

Waste wash water (diaphragm seal assembly with SS 316 diaphragm shall be provided)

Alum dosing tanks (diaphragm seal assembly with SS 316 diaphragm shall be provided)

Chlorine (diaphragm seal assembly with silver diaphragm shall be provided)

Clear water

Air

ed parts

Aluminium with white back
ground and black numerals
3 way isolation valve
Impulse tubing, fittings
Snubber
All other installation hardware

6.6. Scope of Work

Control panels, power distribution and control cabling, plant and area lighting, DG set, power transformer etc whatsoever required for completion of work & successful operation is included in the work.

The main Power supply will be provided by Utility authority for which the funds will be deposited through the provisional sum. The work up to DP and Metering will be carried out by the utility authority and the contractor will be required to make the remaining power supply arrangement for the STP. This will broadly include, but not limited to following:

The work after metering which includes 11 KV DP, transformer, 11 KV cable with terminations, LT PMCC Panels, starters, LT cables etc. shall be provided by the contractor if supply is on 11 KV.

Provision of main LV switchboard, Screen DB cum Control Panel and lighting panels (as per drawing), glanding, termination and connection of incoming and outgoing cables including provision of lugs etc., metering, protections and indications shall be provided on the LV switchboard and other DBs as per the design criteria given subsequently.

Provision and installation of an APFC control panel having a capacitor bank with a rating of suitable kVAR (switchable in at least 8 steps) and associated protection, indications and metering, and glanding, termination and connection of the incoming cable including provision of lugs, etc. The APFC panel shall have a micro processor based relay to improve the overall plant 'pf' up to a minimum of 0.98 lag.

Provision of earthing for all the electrical equipment such as main LV switchboard, other DBs and control panels, APFC panel, main motors, process equipment, valve actuators, drainage pump motor, exhaust fan motors, etc. by GS flats and wire of sizes given elsewhere in the specification and interconnecting with the auxiliary earthing grid inside STP/SPS, including installation on floor/wall, all including fixing, clamping, welding, bolting etc.

Provision and installation of XLPE/ PVC insulated cables, of sizes given elsewhere in the specification and drawing, in air, buried in ground and in trench and their termination and connection at the transformer, main LV switchboard, other sub-DBs, panels, motors, etc. including fixing, clamping, glanding, provision of lugs, etc.

1. Provision and installation of a local Start/Stop push button stations (boxes) made from GS sheet as required including its earthing by 12 SWG GI wire and termination of cable.
2. Provision of overall earthing, cabling and lighting systems as per the enclosed detailed specifications and drawings.

System Parameters

(a) Voltage	11 KV \pm 10% , 3 phase, 3 wire for HT and 415V, 3 phase, 50 cycles for LT system
(b) Short circuit level	1100 V \pm 10 % 3 phase, 4 wire 18.4 KA for 1 second for 11 KV system
(c) Frequency	50 C/S \pm 5%
(d) Ambient Temperature	50°C
(e) Earthing System	Solidly earthed
(f) Control circuit	AC, 230V, Single phase
(g) Lighting circuit	AC, 230V, single phase

General Criteria

The General Criteria followed for the equipment and systems are as given below.

Equipment

All the indoor electrical equipment shall be rated and sized for a 'design ambient temperature' of 45°C, while all the outdoor electrical equipment shall be rated and sized for a 'design ambient temperature' of 50°C.

The main LV switchboard and other DBs shall be with 'Form-4' enclosure as per the Indian Standards. All indoor boards/panels shall be with a degree of protection of IP 54, while all outdoor equipment shall be with a degree of protection of IP 55.

All LT power cables shall be 1100 V grade, XLPE insulated, extruded inner and outer PVC sheathed, stranded aluminium conductor and armoured, while all control cables shall be 1100 V grade, PVC insulated, extruded inner and outer PVC sheathed, stranded copper conductor and armoured.

All the electrical equipment, accessories and systems shall conform to the latest editions of the Indian Standards or other equivalent international standards.

Cabling, Earthing and Lighting Systems

The cabling/earthing/ and lighting system shall get approved from Employer. Main earthing conductors outside and inside the building shall be planned in such a manner that all the equipment are connected to the earthing system by two connections in a reliable manner.

Protections

The following protections shall be provided on the LV switchboard/Sub-DB, as applicable.

- i. Thermal overload and short circuit protection features on MCCBs and MCBs for feeders
- ii. Thermal overload, locked rotor, short circuit, negative sequence and earth fault protection for main motor feeders

- iii. Overload protection by thermal (bimetal) relays with single phasing preventor (SPP) for contactors for other motor feeders

Metering

The following metering shall be provided on the main LV switchboard/Sub-DBs.

- i. Incomer
- Ammeter with selector switch
 - Voltmeter with selector switch (only for main LV switchboard)
 - Kilowatt meter (only for main LV switchboard)
 - Power factor meter (only for main LV switchboard)
 - Kilowatt-hour meter (only for main LV switchboard)
- ii. Outgoing Feeders of main LV Switchboard
- MCCB and Ammeter with CT's & selector switch on main motor feeders
- iii. Indicating Lamps

The following indications will be provided on the LV switchboard/Sub-DB, as applicable.

- Incomer
- Supply 'ON' (Red, Yellow & Blue)
- Phase Motor Feeders
- Motor 'ON', 'OFF' & 'Trip' indications (Red, Green & Amber)

6.7. Transformers

General

The transformer tank shall be made from high-grade sheet steel, suitably reinforced by stiffeners made of structural steel sections. All seams, flanges, lifting lugs, braces, and other parts attached to the tank shall be welded. The interior of the tank shall be cleaned by shot blasting and painted with two coats of heat resistant, oil insoluble paint. Adequately sized manholes shall be provided for ease of inspection and maintenance. Steel bolts and nuts exposed to atmosphere, shall be galvanised. The tank cover shall be removable and shall be suitably sloped so that it does not retain rainwater.

The thickness of transformer tank (rolling tolerance as per IS) shall be Top & (i) Bottom – 5 mm, (ii) Sides – 4 mm. Lifting lugs and eyebolts shall be so located that a safe clearance is obtained without the use of a spreader, between the sling and transformer bushings.

- a. Transformers of rating above 200 kVA shall be equipped with detachable or separately mounted radiator banks. Transformers of rating 200 kVA and below shall be three star level with fixed type radiators. Fins of the radiators shall not have sharp edges and shall be rounded in shape.
- b. When transformers are provided with separately mounted radiators, flexible joints shall be provided on the main oil pipes connecting the transformer tank to the radiator banks, to reduce vibration and facilitate erection and dismantling. The interconnecting pipes shall be provided with drain plug and air release vents.
- c. The transformer core shall be constructed from high grade, non-ageing, cold-rolled, grain oriented, silicon steel laminations. The steel laminations shall be of "core" type. Each lamination shall be coated with insulation which is unaffected by the temperature attained by the transformer during service. Core laminations shall be annealed and burrs removed after cutting. Cut edges shall be insulated. The framework and clamping arrangements of core and coil shall be securely earthed inside the tank by a copper strap connection to the tank.
- d. Windings shall be of insulated copper wire or copper strip. Windings and insulation shall be so arranged that free circulation of oil is possible between coils, between windings, and between winding and core. The windings shall be fully shrunk under vacuum before assembly. High voltage end-windings shall be suitably braced to withstand short circuit stresses and stresses caused up by surges.
- e. Off-load taps shall be provided on the HV winding.
- f. The core and coil assembly shall be dried out and impregnated under vacuum.
- g. The sequence and orientation of HV/LV side phase and neutral bushings shall be as specified in the latest edition of relevant IS.
- h. Transformer shall operate without injurious heating at the rated KVA and at any voltage up to + 10 % of the rated voltage of any tap. Transformer shall be designed for 110 % continuous over fluxing withstand capability.
- i. Noise level of the transformer shall be less than 80 dB conform to IS -2026.

Bushing

Solid porcelain bushings with brown glaze shall be used up to 12 kV class. Solid bushings shall have the characteristics specified in the latest edition of IS 2099.

Cable Terminations

LV side cable boxes shall have sufficient space for segregating the cable cores and for adequate clearance in air between bare conductors at the terminals. Cable boxes shall be complete with necessary glands, lugs and armour grips.

All auxiliary wiring from current transformers, buchholz relay, oil/winding temperature indicators, etc. shall be marshalled to a separate weatherproof and vermin proof marshalling box with an independent access cover. The degree of protection of the enclosure of the marshalling box shall be IP 55.

The marshalling box shall be complete with necessary cable glands and cable lugs. The marshalling box and components shall comply with the requirements specified for control cabinets elsewhere in this specification.

Applicable Standards

The transformer and its accessories shall conform to the latest editions, including all amendments and revisions, of the following standards.

- a. Power transformer : IS 1180, 2026/IEC 60076
- b. Fittings & Accessories : IS 3639
- c. Transformer oil : IS 335/IEC 60296
- d. Bushing > 1000 V AC : IS 2099/IEC 60137
- e. Transformer above 200 KVA rating: CBIP Pub. No. 295"Manual on
Transformers
- f. Transformer of rating 200 KVA & below :Three star level with BEE
Specifications

Fittings and Accessories

The following fitting and accessories shall be provided on the transformer.

- Inspection manhole in the cover.
- Lifting lugs for both the transformer and the core.
- Two earthing terminals on opposite ends of the transformer tank.
- Name plate, rating plate and diagram plate.
- Radiator banks with suitably located thermometer pockets for measuring inlet and outlet oil temperature.
- Conservator, complete with filling plug, sump and drain valves and a shut-off valve on the pipe connection between transformer tank and conservator, to permit removal of the conservator. The conservator shall be designed to maintain an oil seal up to a temperature of 1000 degree C.
- Oil temperature indicator with a range of minimum 30 degree Celsius up to the maximum operating temperature.
- Weather proof dehydrating breather with activated alumina or silica gel as the dehydrating agent.
- For transformer rating above 250 kVA, magnetic type oil level gauge mounted on the conservator, and with a low oil level alarm contact and a waterproof and dustproof terminal box. For transformer less than 250 kVA, oil level indicator shall be provided.

- Gas detector relays, with separate alarm and trip contacts, complete with shut-off valves.
- Separate drain valve, oil-sampling valve with plug and a top filter valve on the tank.
- Explosion vent with diaphragm. The device shall be rainproof. An equaliser pipe connecting the pressure relief device to the conservator shall be provided.
- Separately mounted, waterproof and dustproof marshalling box (IP 65) housing the oil temperature indicator with alarm and trip contacts and marshalling facilities for electrical devices mounted on the transformer. Winding temperature indicator shall be provided for transformer rating of 250 kVA and above.
- Adequate number of air vents for relieving trapped air during oil filling and during maintenance.
- Thermometer pockets and sensing element mounted on the transformer tank cover for measuring top oil temperature.
- Bidirectional wheels for movement of the transformers.
- Accessories for clamping the wheel to the foundation channel in order to withstand earthquake forces.
- Adequate amount of insulating oil required for first filling, plus 10% excess oil.

Tolerance on Losses

The permissible tolerances on the guaranteed values of transformer losses shall be as per IS 2026. The No load & Load losses of the transformer for rating above 200 KVA shall be as per CBIP Pub. No. 295: "Manual on Transformers". The Load losses & 50% Load losses for Transformers of rating 200 KVA and below shall be as per BEE Specification, Three star level.

Rejection

The Engineer or the Engineer's Representative reserves the right to reject the transformer if the same does not meet the specification requirement, subject to tolerances as per IS 2026. The rejected transformers shall be replaced by transformers complying with the requirements of this specification at the Contractor's cost.

If the commissioning of the project is likely to be delayed by the rejection of a transformer, the Engineer's Representative reserves the right to accept the rejected transformer until the replacement transformer is made available. Transporting the rejected and replacement transformers as well as installation and commissioning of both the transformers shall be at the Contractor's cost.

6.8. Technical Particulars

The specific technical particulars of the transformer shall be as given below:

Sl.No.	Description	Particulars
1	Rated output (kVA)	As per design
2	Transformer installation	Outdoor plinth mounted
3	No load transformation ratio	11 kV/0.433 kV
4	Number of phases	Three
5	Rated Frequency	50 Hz
6	Impedance at principal tap	As per CBIP Pub. No. 295” “Manual on Transformers” for transformers of rating more than 200 KVA. Three star level BEE specification for transformers of rating up to 200 kVA.
7	Number of windings / Material of conductor	Two / Copper for transformer of rating above 200KVA
8	Type of cooling	ONAN
9	Vector group	Dyn 11
10	LV neutral earthing	Solidly earthed
11	Design ambient temperature.	50°C
12	Winding temperature rise measured by resistance method	45°C for transformer of rating above 200 KVA and as per BEE specification for transformer of rating 200 KVA & below
13	Oil temperature rise by thermometer	40°C for transformer of rating above 200 KVA and as per BEE specification for transformer of rating 200 KVA & below.
14	Tap changer	Full capacity, off-circuit type on HV side with pad locking facility
15	Tap range	+ 5 % to -10 %
16	Tap step	2.5 %
17	Terminal connection	
a)	HV bushing	Bushings suitable for overhead ACSR “DOG” conductor
b)	LV cable box	Cable box suitable for terminating 1100 V, 3.5 core, XLP cables (Number and size of cable shall be as per the one line diagram)
c)	LV Neutral	LV neutral shall be through a 1.1 kV rated bushing, both inside the cable box for forming the 3 Ph, 4-wire system and outside the cable box for direct connections to earth pits.

Tests

All tests required by the specification including repeated tests and inspection that may be necessary owing to the failure to meet any tests specified, shall be carried out at the Contractor's expense.

If the transformer fails to pass the tests specified, the Engineer shall have the option to reject the unit. Additional tests shall be conducted to locate the failure and after rectification, all tests shall be repeated to prove that the rebuilt transformer meets the specification in all respects, all at the Contractor's expense.

The following tests shall be carried out on the assembled transformer during inspection at the manufacturer's works.

- a) Temperature rise test on one transformer.
- b) Measurement of resistance of windings at principal and extreme taps.
- c) Measurement of voltage Ratio at each tap, polarity and phase relationships.
- d) Measurement of impedance voltage at principal and extreme taps.
- e) Measurement of no load current and no load losses at rated frequency and at both the rated voltage and 110 % rated voltage.
- f) Measurement of efficiency at $\frac{1}{2}$, $\frac{3}{4}$ and full loads.
- g) Measurement of insulation resistance.
- h) Induced over voltage withstand test .
- i) Separate source voltage withstand test.
- j) Magnetic unbalance test.
- k) Impulse Test.

In addition to the above tests, a withstand test with lightning impulse, chopped on the tail, shall be carried out on one limb of HV winding of the transformer if impulse test has not been already carried out on transformer of similar capacity in the last two years. Type test certificate shall be submitted along with the bid, if such a test has been already carried out. If the type test has to be carried out, it shall be at the contractor's expense.

6.9. Main LV Switchboard, And Control Panels / Cabinets

The following clauses shall be deemed to apply for all LV switchboards, distribution boards/panels, marshalling boxes, control cabinets/panels, etc.

6.10. General Constructional Features

Sheet steel used for fabrication of switchboards, control cabinets, marshalling boxes, etc shall be cold rolled.

All panels, cabinets, kiosks and boards shall comprise rigid welded structural frames made of structural steel sections or of pressed and formed cold rolled sheet steel of thickness not less than 2 mm. The frames shall be enclosed by sheet steel of at least 2 mm thickness. Stiffeners shall be provided wherever necessary.

All doors, removable covers, gland plates, etc. shall be of at least 1.6 mm thickness and shall be gasketed all around the perimeter.

All doors shall be supported by strong hinges of the disappearing or internal type and braced in such a manner as to ensure freedom from sagging, bending and general distortion of panel or hinged parts.

All floor mounted panels/boards shall be provided with a channel base frame. Total height of all floor mounted cubicles/panels shall not be greater than 2300 mm. Where steel pedestals for mounting of boards/panels are specified, the total height including that of the pedestal shall not exceed 2500 mm. It should be extendable at both ends.

Switchboard/control cabinet/panel shall be dust and vermin proof. Degree of protection of the enclosure shall be IP 54 for indoor installations and IP 55 for outdoor installations.

6.11. LV Switchboard

Separate, segregated metal clad compartments shall be provided for main and auxiliary bus bars, each feeder and cable alleys. Metal clad cubicles/modules shall be provided with hinged doors in the front, with facility for padlocking door handles. More than one module may be arranged in the same vertical section. Circuits shall be of the fixed type. The switchboard enclosure shall conform to "Form-4" as per IS 8623. It shall be possible to extend the switchboard on both sides

The fixed type module shall have all the circuit components mounted in the compartment, with bolted type power and control connections. It shall be possible to remove all circuit components after removing the connections and the component fixing bolts.

Instruments, relays and control devices shall be mounted flush on hinged door of the cubicles. Switchboard shall be complete with inter-panel wiring.

Each switchboard shall also be fitted with a label indicating its title. Each cubicle shall be fitted with a label on the front and rear of the cubicle. Each relay, instrument, switch, fuse, contactor and MCCB/MCB shall be provided with a separate label.

One metal sheet shall be provided between two adjacent vertical sections running to the full height of the switchboard except for the horizontal bus bar compartment. However, each shipping sections shall have metal sheets at both ends. After isolation of the power and control connections of a circuit, it shall be possible to carry out maintenance in a compartment safely, with the bus bars and adjacent circuits alive..

The Screen DB cum Control Panel shall have separate control section for mounting control and indicating devices and control logic wiring. The power section shall be with compartmentalized modules.

6.12. Bus Bars

The phase and neutral bus bars shall be rating indicated in the corresponding single line diagram. Bus bars shall be of aluminium and shall be provided with minimum clearances as specified. Bus bar shall be made of high conductivity, high strength aluminium complying with requirements of

grade E91E of IS 5082. The bus bar shall be suitably braced with non-hygroscopic SMC supports to provide a through fault withstand capacity of 50 KA RMS symmetrical per second.

All bus bars and bus taps shall be insulated with close fitting sleeve of hard, smooth, dust and dirt free, heat shrunk PVC insulation of high dielectric strength, to provide a permanent non-ageing and non-tracking protection, impervious to water, tropical conditions and fungi. The insulation shall be non-inflammable and self-extinguishing type and in fast colours to indicate phases. The dielectric strength and properties shall hold good for the temperature range of 0 to 95 degree centigrade. If the insulating sleeve is not coloured, bus bars shall be colour coded with coloured PVC tape at suitable intervals.

Bus bar joints shall be of the bolted type. High tensile bolts, spring washers shall be provided to ensure good contact at the joints. Bus bars shall be thoroughly cleaned at the joints and suitable contact grease shall be applied just before making a joint.

Direct access to, or accidental contact with bus bars and primary connections shall not be possible. All apertures and slots shall be protected by baffles to prevent accidental shorting of bus bars due to insertion of maintenance tools.

Sequence of red, yellow and blue phases and neutral for four-pole equipment shall be left to right and top to bottom, for horizontal and vertical layouts respectively.

6.13. Circuit Breakers

6.13.1. Moulded Case Circuit Breaker (MCCB)

MCCBs shall be of the air break, quick make, quick break and trip free type and shall be totally enclosed in a heat resistant, moulded, insulating material housing.

MCCBs shall have an ultimate short circuit capacity not less than the prospective short circuit current at the point of installation.

MCCBs shall have a service short circuit breaking capacity equal to the ultimate short-circuit capacity.

Each pole of MCCB shall be fitted with a bi-metallic thermal element for inverse time delay protection and a magnetic element for short circuit protection. Alternatively, they shall be fitted with a solid state protection system. Such a protection system shall be fully self-contained, needing no separate power supply to operate the circuit breaker tripping mechanism. Thermal element shall be adjustable.

Adjustments shall be made simultaneously on all poles from a common facility. Thermal elements shall be ambient temperature compensated. The ON, OFF and Trip position of MCCB shall be clearly Indicated and visible to the operator.

The MCCBs shall be provided with the following features.

- Common trip bar for simultaneous tripping of all poles.
- Shrouded terminals
- Time for clearing short circuit current of 20 msec.

- 2 NO + 2 NC auxiliary contacts
-

6.14. Miniature Circuit Breaker (MCB)

MCB shall be hand operated, air break, quick make, quick break type.

Operating mechanisms shall be mechanically trip-free from the operating knob to prevent the contacts being held closed under overload or short-circuit conditions.

Each pole shall be fitted with a bi-metallic element for overload protection and a magnetic element for short-circuit protection. Multiple pole MCBs shall be mechanically linked such that tripping of one pole simultaneously trips all the other poles. The magnetic element tripping current classification shall be of the type suitable for the connected load. Where this is not specified, it shall be Type C.

The short circuit rating shall be not less than that of the system to which they are connected.

6.15. Contactors

The power contactors used in the switchboard shall be of, air break, single throw, triple pole, electromagnetic type. Contactors shall be suitable for uninterrupted duty and rated for Class AC3 duty in accordance with the latest edition of IS 13947.

Operating coils of all contactors shall be suitable for operation on 240 V, single phase, 50 Hz supply. Contactors shall be provided with at least two pairs of NO and NC auxiliary contacts. Contactors shall not drop out at voltages down to 70 % of coil rated voltage.

Contactors shall be provided with a two element, positive acting, ambient temperature compensated, time lagged, hand reset type thermal overload relay with adjustable settings. The hand reset button shall be flush with the front door of the control module, and shall be suitable for resetting the overload relay with the module door closed. Relays shall be either direct connected or CT operated. Overload relay and reset button shall be independent of the "Start" and "Stop" push buttons. All contactor shall all be provided with single phasing preventer (SPP). Motor starters shall be complete with auxiliary relays, timers and necessary indications.

6.16. Switch Disconnectors and Fuses

LV switch disconnectors shall be of the load break, fault make, group operated type. For use on 3-phase systems, the switches shall be of the triple pole type with a link for neutral wire. For use on single phase system and DC systems, the switches shall be of the two pole type.

Switch disconnectors shall be of the heavy duty, quick make and quick break type. Their contacts shall be silver plated, and contact springs shall be of stainless steel. Their handles shall have provision for locking in both fully open and fully closed positions. Mechanical ON-OFF indication shall be provided.

Switch disconnectors for controlling motor circuits shall be of the load break, fault make type, and shall be capable of breaking locked rotor current of the associated motor.

Where combination units of switch disconnectors and fuses are used, the following interlocks shall be incorporated.

(a) The fuses should not be accessible unless the switch disconnector is in fully open condition.

(b) It should not be possible to close the switch disconnector when the fuse cover is open, but an authorized person may override the interlock and operate the switch disconnector. After such an operation, the cover shall be prevented from closing if the switch disconnector is left in the "ON" position.

All fuses shall be of the HRC cartridge type, mounted on plug-in type of fuse bases. Fuses shall be provided with visible indicators to show that they have operated. Current vs. time characteristics of all types of fuses shall be furnished to the Engineer's Representative.

Fuses and links functionally associated with the same circuit shall be mounted side by side.

An adequate number of spare fuse cartridges of each rating shall be supplied and fitted in clips inside the panel.

6.17. Instrument Transformers

Current transformer (CT) shall have polarity markings indelibly marked on each transformer and at the lead terminations at the associated terminal block. CT shall be able to withstand the thermal and mechanical stresses resulting from the maximum short circuit current. CT core laminations shall be of high grade silicon steel. The accuracy class for CTS shall be 1.0 for metering & 5P10 for protection. Secondary winding of voltage transformer (VT) shall be rated for a two phase line to line voltage of 230 V. Identification labels giving type, ratio, output and serial numbers shall be provided.

6.18. Relays

Main protective relays shall be Numerical / Static type. All relays shall be enclosed in rectangular shaped, dustproof cases and shall be suitable for flush mounting.

All relays shall be accessible from the front for setting and resetting. Access to setting devices shall be possible only after the front covers of the relays are removed. Resetting facilities shall however be accessible external to the relay case.

All protective relays shall be of the draw-out type and shall be provided with operation indicators visible from the front. Auxiliary relays and timers shall be rated to operate satisfactorily between 70% and 110% of the rated voltage.

6.19. Control and Selector Switches

Control and selector switches shall be of the rotary type, having enclosed contacts, which are accessible by the removal of the cover. Control and selector switches for instruments shall be flush mounted on the front of the panels and desks. The ammeter selector switches shall have four positions for reading three phase currents and fourth shall be off position.

All control switches shall be of the spring return to normal type and shall have momentary contacts. Selector switches shall be of the stay-put, maintained contact type. Voltmeter selector

switch shall have four positions – three for phase to phase voltage and fourth shall be off position.

6.20. Indicating Instruments & Meters

Electrical indicating instruments shall be 110 mm square with 2400 scale. Taut band type of instruments is preferred. Taut band moving coil instruments for use on AC systems shall incorporate built-in transducers.

Instrument dials shall be white with black numbers and lettering. Normal maximum meter reading shall be of the order of 60 % normal full scale deflection. Ammeters for motor feeders shall have suppressed scale to show current from full load up to six times the full load current. Instruments shall have an accuracy of Class 1.0.

6.21. Indicating lamps

Indicating lamps shall be of the cluster LED type, with low watt consumption. Indicating lamp shall be of the double contact, bayonet cap type rated for operation at either 240 V AC or at the specified DC system voltage as applicable. Lamps shall be provided with translucent lamp covers to diffuse light.

Bulbs and lenses shall be interchangeable and easily replaceable from the front.

6.22. Push Buttons

"Start" and "Stop" push buttons shall be coloured green and red respectively. Stop Push Button shall be lockable stay-put type with Mushroom head. The contacts shall be of silver alloy of 10 A continuous current rating at 240 V AC. Each push button shall be provided with 2 NO + 2 NC contacts Emergency stop push button shall be of press to lock and turn to release type.

6.23. Space Heaters

Adequately rated anti-condensation space heaters shall be provided, one for each control panel, for each switchboard and for each marshalling kiosk. Space heater shall be of the industrial strip continuous duty type, rated for operation on a 240 V, 1 phase, 50 Hz, AC system. Each space heater shall be provided with a single pole MCB with overload and short circuit release, a neutral link and a control thermostat to cut off the heaters at 40 degree Celsius.

6.24. Cubicle Lighting/Receptacle

Each control panel, control cabinet, marshalling box, etc. shall be provided with interior lighting by means of a 20 W fluorescent tube lighting fixture. A MCB shall be provided for the lighting circuit. The lighting fixture shall be suitable for operation from a 240 V, 1 Ph, 50 Hz, AC supply.

A 240 V, 1 phase, AC receptacle (socket) plug point shall be provided in the interior of each panel with a MCB for connection of hand lamp.

6.25. Safety Arrangements

All terminals, connections and other components which may be “live” when front access door is open, shall be adequately screened. It shall not be possible to obtain access to an adjacent cubicle or module when any door is opened. Components within the cubicles shall be labelled to facilitate testing.

6.26. Power and Control Cable Terminations

Equipment terminal blocks for power connections shall be complete with adequate phase segregating insulating barriers, shrouds and suitable crimping type of lugs for terminating the cables. Double compression type cable glands shall be provided for all power and control cables.

Earthing connectors between cable armour and earth shall be routed outside the cable gland in an approved manner. Gland insulation shall be capable of withstanding a high voltage test of 3000 V for one minute.

6.27. Wiring for Control and Protective Circuits

All wiring for control, protection and indication circuits shall be carried out with 650 V grade, PVC insulated cable with stranded, tinned copper conductor of minimum 1.5 sq.mm size. The size of conductor for CT circuits shall be minimum 2.5 sq. mm.

All wiring shall be run on the sides of panels and shall be neatly bunched and cleated without affecting access to equipment mounted in the panel. All wiring shall be taken to terminal blocks without joints or tees in their runs.

All wiring shall be colour coded as given below.

AC Circuit	:	Red, Yellow or Blue determined by the phase with which the wire is associated
A C phase wire :		White
A C neutral	:	Black
D C circuits	:	Grey
Earth connections	:	Green

Engraved core identification ferrules, marked to correspond with the wiring diagram, shall be fitted to each wire and each core of multicore cables terminated on the panels. Ferrules shall fit tightly on wires, without falling off when the wire is removed. Ferrules shall be of yellow colour with black lettering.

All wires forming part of a tripping circuit shall be provided with an additional red ferrule marked 'T'. Each wire shall be identified by a letter to denote its function followed by a number to denote its identity, at both ends. Unused core of multicore cables shall be ferruled U1, U2 etc., at both ends, and connected to spare terminals. Spare auxiliary contacts of electrical equipment shall be wired to terminal blocks.

6.28. Control Wiring Terminal Blocks

Terminal blocks shall be of the 650 V grade and stud type. Brass stud of at least 6 mm dia. with fine threads shall be used and securely locked within the mounting base to prevent turning. Each terminal shall comprise two threaded studs, with a link between them, washers, and matching nuts and locknuts for each stud. Connections to the terminals shall be at the front.

Terminals shall be numbered for identification, grouped according to function. Engraved 'black on-white' labels shall be provided on the terminal blocks describing the function of the circuit. Terminals for circuits with voltage exceeding 110 V shall be shrouded. Terminal blocks at different voltages shall be segregated into groups and distinctively labeled.

Terminals used for connecting current transformer secondary leads shall be 'disconnecting and shorting' type with a facility grounding the secondary. Terminal blocks shall be arranged with 100 mm clearance, between any two sets. Separate terminal stems shall be provided for internal and external wiring respectively. All wiring shall be terminated on terminal blocks, using crimping type lugs or claw type of terminations.

6.29. Test Terminal Blocks

Test terminal blocks, if any, shall be provided for secondary injection and testing of relays. A suitable metering block shall be provided where specified for the connection of a portable precision instrument to be operated when required for specific plant testing purposes.

6.30. Earthing of Switchboards/Panels

Each switchboard, control panel, etc. shall be provided with an earth bus bar running along its entire length. The earth bus bar shall be located at the bottom of the board/panel. Earth bus bars shall be of copper and shall be rated to carry the rated symmetrical short circuit current of the associated board/panel for one second, unless otherwise specified. Earth bus bars shall be properly supported to withstand stresses induced by the momentary short circuit current of value equal to the momentary short circuit rating of the associated switchboard/panel.

Positive connection of the frames of all the equipment mounted in the switchboard to the earth bus bar shall be maintained through insulated conductors of size equal to the earth bus bar or the load current carrying conductor, whichever is smaller.

All instrument and relay cases shall be connected to earth bus bar by means of 650 V grade, green coloured, PVC insulated, stranded, tinned copper, 2.5 sq. mm conductor looped through the case earth terminals.

6.31. Applicable Standards

The following standards and codes of practice shall be applicable. These shall be the latest editions including all official amendments and revisions. The standards referred to therein shall also be applicable.

Air break switches, MCCBs, etc. for voltage not exceeding 1000 V AC or 1200 V DC	IS: 13947
Current transformer	• IS: 2705 / IEC: 60044
• Voltage transformer	• IS: 3156 / IEC: 44, 60186
• Electrical Relays	• IS: 3231, 3842 / IEC: 60255
• Contactors for voltage not exceeding 1000 V AC	• IS: 13947 / IEC: 60947
• Control Switches	• IS: 6875 / IEC: 60947
• High Voltage Fuses	• IS: 9385 / IEC: 60282
• Low voltage Fuse	• IS: 13703 / IEC: 60269
• Electrical direct acting indicating instruments	• IS: 1248 / IEC: 60051
AC electricity meters of induction type for voltage greater than 1000 volts	IS: 722, 8530 / IEC: 60145, IEC:60211
Porcelain post insulators for system with nominal voltages greater than 1000 volts	IS: 2544
• Specification for copper rods and bars for electrical purposes	• IS: 613
• Specification for low voltage switchgear and control gear	• IS: 13947 / IEC: 60947
Degree of protection provided by	

enclosures for low voltage switchgear and control gear	IS: 13947 / IEC: 60947
Marking and arrangement for switchgear, bus bars, main connections and auxiliary wiring	IS: 5578 / IS: 161.253
Code of practice for selection, installation and maintenance of switchgear and control gear	:IS: 10118
Miniature Circuit Breakers	:IS: 8828 / IEC: 60898
Control Switches/ Push buttons	:IS: 6875
Low voltage switchgear and control gear	:IS: 8623

6.32. Technical Particulars

The Specific technical particulars of switch board shall be as given below;

SI. No.	Description	Particulars
1	Rated voltage, Phases and Frequency	415 V +/-15%, 3 Ph, 50 Hz +/-1%, conform to IS 8623
2	Design ambient temperature	45 Deg. Celsius
3	Type of Construction	Single front, fixed type
4	Maximum system voltage	476 V
5	One minute Power Frequency withstand voltage	
a)	Power circuit	3000 V (rms)
b)	Control Circuit	2000 V (rms)
c)	Auxiliary circuit connection to secondary of CTs	2000 V (rms)
6	Current rating of bus bars over design ambient temperature of 45°C	As per Line Diagram got to be approved from EIC
7	Short circuit withstand for main and auxiliary bus bars (1 sec.)	As per Line Diagram got to be approved from EIC
8	Maximum temperature of main and auxiliary bus bars at continuous rated current rating under site design ambient temperature of 45°C	85°C
9	Colour finish shade as per IS:5	
a)	Interior	Glossy white
b)	Exterior	Light gray, semi-glossy, shade 631 of IS5

SI. No.	Description	Particulars
10	Earthing bus material and size	Copper, 25 x 6 mm
11	Clearances in air of live parts	25.4 mm
12	Power contactors	
a)	Contactor rated duty	Uninterrupted
b)	Utilization category	AC3
13	Motor Starters	For motor < 5.5 kW – DOL, >5.5 KW star delta > 75 KW soft starter
14	Type of Mounting	Floor
15	Cable Entry	Bottom

Tests

The following routine tests shall be carried out on the assembled switchboard/panel during inspection at the manufacturer's works in addition to other tests.

- (a) Inspection of assembly including inspection of wiring, if necessary electrical operation tests.
- (b) One minute power-frequency voltage dry withstand tests on the main circuits
- (c) One minute power-frequency voltage dry withstand tests on the auxiliary circuits
- (d) Checking of protective measures and of the electrical continuity of the protective circuit.

6.33. Capacitors and APFC Panel

General

The capacitor bank 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. It shall be complete with the required capacitors along with the supporting post insulators, steel rack assembly, copper bus bars, copper connecting strips, foundation channels, fuses, fuse clips, etc. The steel rack assembly shall be hot dip galvanized.

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 over voltage on the units in parallel with it, which will result in the failure of the parallel units. The assembly of the banks shall be such that it provides sufficient ventilation for each unit. Each capacitor case and the cubicle shall be earthed to a separate earth bus.

Capacitor shall conform to IS 2834. Capacitors shall be of mixed dielectric or APP type. Each unit shall satisfactorily operate at 61.25 % of rated kVAR including factors of over voltage, harmonic currents and manufacturing tolerance. The units shall be capable of continuously

withstanding satisfactorily any over voltage up to a maximum of 10 % above the rated voltage, excluding transients.

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 upon disconnection, in accordance with the provisions of the latest edition of IS:2834.

Unit Protection

Each capacitor unit shall be individually protected by a HRC fuse suitably rated for load current and interrupting capacity, so that only the faulty capacitor unit will be disconnected without causing the bank to be disconnected. An operated fuse shall give visual indication so that it may be detected during periodic inspection. The fuse breaking time shall co-ordinate with the pressure built up within the unit to avoid explosion. Mounting of the individual fuse should be internal to the capacitor case.

APFC microprocessor based relay shall automatically switch ON/OFF the capacitor banks to attain the value of "pf" close to the set value. Switching shall follow first in first out (FIFO) method to ensure uniform use of all capacitor banks. At least eight steps shall be provided for switching.

Capacitor (APFC) Control Panel

Capacitor and capacitor control shall be housed in a metal enclosed cubicle. Capacitor shall be housed in the lower compartment and capacitor control unit at the top compartment, the two compartments being segregated.

The cubicle shall be fabricated out of 2 mm thick cold rolled sheet steel and shall of a degree of protection of IP 54. The panel shall comprise:

- a. Isolating MCCB
- b. Contactors with overload element
- c. Relays responsive to current/voltage/kVAR/pf for automatic switching
- d. Sequencing devices, timers and auxiliary relays for automatic sequential switching of capacitor units in and out of circuit
- e. Auto-manual selector switch
- f. Microprocessor based Automatic Power factor correction (APFC) Relay
- g. Push button for opening and closing the power circuit.
- h. Red and Green lamps for capacitors ON/OFF indication.
- i. Protective relays to protect the healthy capacitor units when one unit fails in a series connection.

j. Space heater and cubicle lighting.

The specific technical particulars of capacitors shall be as given in the table below.

SI. No.	Description	Particulars
1	Rated Capacity	As per design
2	Rated voltage, frequency and phases	433 V, 50 Hz, 3 Phase
3	Design ambient temperature	45 Degree Celsius
4	Insulation level	3 kV (rms)
5	Capacitor bank connection	Delta
6	Control	Automatic by "pf" correction relay (micro-processor based)
7	No. of steps for control	At least 8
8	Capacitor Bank Enclosure	
a)	Type	Floor mounted
b)	Colour finish / shade	Interior: glossy white Exterior: Light grey, semi glossy, shade 631 of IS 5

6.34. Tests and Test Reports

All routine and mutually agreed special tests shall be conducted in accordance with the latest edition of IS: 2834 and as applicable for the controls. Type test certificates for similar capacitor units shall be furnished.

6.35. Power and control cables

All existing undamaged / un-jointed cables having adequate length, meeting the requirements of the new designs, will be utilized in the new installations. The existing cables with ratings same or more than the requirement would be HV tested / IR tested during the execution of the project and decided accordingly. It will be checked whether the voltage drop of such cables will be limited to 2.5 % at rated equipment current rating. The applicable standards will be IS 1554, 7098, 8130, 5831, 3975, IEC 60183, 60227, 60502, 60885. The cable shall be ISI marked.

6.36. Technical Data Sheet

Description	Particulars
Voltage grade of cable	1100V
Permissible voltage variation	+10% & -15%
Permissible frequency variation	+ 3%
Material of conductor	Aluminum, H4-grade, Class-2
Type of conductor	Stranded

Description	Particulars
Material of insulation	Extruded PVC, Type-A / XLPE – (Refer Single Line Diagrams for details)
Material of inner sheath	Extruded thermoplastic or unvulcanized rubber
Material of armour	Galvanized steel
Material of outer sheath	Extruded PVC, Type-ST 2
Core identification	Required

6.37. Earthing System

6.1 Scope

The scope includes supply of earthing conductors and earth electrode pits and their installation including associated civil work as per the specifications and drawings, to the satisfaction of the Engineer's representative and the Electrical Inspector.

Proper earthing shall be provided to ensure adequate system neutral earthing and for equipment and personnel safety.

All work such as cutting, bending, supporting, painting/coating, drilling, welding, clamping, bolting and connection to structures, equipment frames, terminals, etc. shall be in the Contractor's scope of work. All incidental hardware and consumables such as fixing cleats/clamps, anchor fasteners, lugs, bolts, nuts, washers, bituminous compound, welding rods, anti-corrosive paint as required for the complete work shall be deemed to be included by the Contractor as part of the installation work.

6.38. Earthing System Installation

Earthing system shall conform to the latest edition including all official amendments and revisions of IS: 3043 and Indian Electricity Rules, 1956. All materials and fittings used in the earthing installation shall conform to the relevant Indian Standards or shall be as approved by the Engineer's Representative.

Installation work shall be in accordance with approved earthing layout drawings and any change in routing, size of conductors etc. shall be subject to the prior approval of the Engineer's Representative.

Installation of earth conductors in outdoor areas, buried in ground, shall include excavation of trench of size 600 mm deep and 450 mm wide, laying of conductor at 600 mm depth, welding as required of main grid conductor joints; as well as provision of risers upto 500 mm above ground at required locations and then backfilling of excavated area by material that is free from stones and other harmful mixtures. Backfill shall be placed in layers of 150 mm, uniformly spread along the trench and compacted by approved means. If the excavated soil is found unsuitable for backfilling, the Contractor shall arrange for suitable material from outside.

Metallic frames of all electrical equipment shall be earthed by two separate and distinct leads and then connected with earthing system

Neutral points of transformers shall be earthed by two separate and distinct connections to two treated electrode pits. The neutral of the transformer should be solidly earthed.

Crane rails shall be connected to the earthing system.

An earthing pad shall be provided under each operating handle of the disconnect. Operating handle of the disconnect and the supporting structure shall be bonded together by a flexible connection and connected to earth grid.

Cable sheaths and armour shall be bonded to the earthing system. Metal pipes and cable conduits shall be effectively bonded and earthed.

Neutral connection shall never be used for equipment earthing.

The scope of installation of earthing leads to the equipment and risers on steel structures/walls shall include laying the conductors, welding/cleating at specified intervals, welding to the main earth grids, risers, bolting at equipment terminals and coating welded joints by bituminous paint. Galvanized conductors shall be touched up with zinc-rich paint, when holes have to be drilled in them at site for bolting to equipment/structure.

The substation consisting of structure, transformer, fence and gate shall be properly earthed.

Wherever earthing conductor crosses underground service duct and pipes, it shall be laid 300 mm below them. If the distance is less than 300 mm, the earthing conductor shall be bonded to such service ducts/pipes.

Wherever earthing conductor passes through walls, GS sleeves shall be provided for the passage of earthing conductor. The pipe ends shall be sealed by suitable water-proof compound. Water stops shall be provided where earthing conductor enters the building from outside, below grade level.

Wherever there is hard rock and earthing resistance is not as per IS, than chemical earthing viz Pipe in Pipe or Strip in Pipe earthing may be provided.

Connections

All connections in the main earth conductors buried in earth/concrete shall be welded type. Connection between earthing conductor and earth leads shall also be of welded type. Connection between buried MS conductor and GS conductor above ground shall be done above ground.

Connection between earth leads and equipment shall be of bolted type.

6.39. Earth Electrode Pits

Electrodes shall, as far as practicable, be embedded below permanent moisture level.

Test pits with concrete covers shall be provided for periodic testing of earth resistance. Installation of pipe electrodes in test pits shall be suitable for watering. The necessary materials required for installation of test pits shall be supplied and installed by Contractor. The installation work shall also include civil works such as excavation/drilling and connection to main earth grid.

Treated earth pits shall be treated with salt and charcoal. Soil, salt and charcoal placed around the electrode shall be finely graded, free from stones and other harmful mixtures. Backfill shall be placed in layers of 250 mm thick uniformly spread and compacted. If excavated soil is found unsuitable for backfilling, the Contractor shall arrange for a suitable soil from outside.

6.40. Technical Particulars

The specific technical particulars of earthing system shall be as given below.

Sl. No.	Description	Size & Material	No. of Leads
1	11 kV equipment, transformer neutral, body and 2-pole structure	50 x 6 mm GS flat	2 each
2	Main LV Switchboard at SPS	50 x 6 mm GS flat	2
3	STP Distribution board	50 x 6 mm GS flat	2
4	Capacitor Control panel	50 x 6 mm GS flat	2
5	Cable tray support	50 x 6 mm GS flat	2
6	DBs & LPs	25 x 3 mm GS flat	2
7	Local PB station	12 SWG – GS	1
8	Motors		
a)	Small motors	8/12 SWG GS wire	2
b)	Main motors	50 X 6 mm GS flat	2
9	Earth Electrode	40 mm dia., 3 M long, heavy duty GI pipe electrode	-
10	Main grid buried in ground	50 x 6 MS flat	-

6.41. Cabling system

6.2 General

The cabling system covers the supply of cable trays, racks, supports and associated accessories, hardware and their installation. It shall be the responsibility of the contractor to complete the cabling system in all respects.

The following points shall be noted while planning cabling system.

- a) *Inside the building: Cable trenches with cable racks and or cable trays*
- b) *Cables shall be clamped to the cable racks at regular intervals*
- c) *All cable trays shall be hot dip galvanized while racks and supports shall be painted.*

- d) *All steel sections such as angles, channels, and brackets etc., required for supporting the cable trays shall be supplied by the contractor and fabricated at site.*
- e) *Flexible metallic conduits shall be used for termination of connection to equipment such as motors, limit switches and other apparatus.*

6.42. Installation of Cables

The Contractor shall install, test and commission the cables in accordance with the approved drawings, and instructions issued by Engineer's Representative. Cables shall be laid directly buried in earth, on cable racks, in built up trenches and supports, on trays, in conduits and ducts or bare on walls, ceiling etc. as per approved drawings. Contractor's scope of work includes unloading, laying, fixing, jointing, bending, and termination of the cables. The Contractor shall also supply the necessary materials and equipment required for jointing and termination of the cables.

All apparatus, connections and cable work shall be designed and arranged to minimize risk of fire and any damage, which might be caused in the event of fire. Wherever cables pass through floor or wall openings or other partitions, suitable bushes of an approved type shall be supplied and put into position by the Contractor. The Contractor shall seal the cables into the bushes using fire resisting materials to prevent the spreading of fire through each partition.

Standard cable grips and reels shall be utilized for cable pulling. If unduly difficult pulling occurs, the Contractor shall check the pull required and suspend pulling until further procedure has been approved by the Engineer's Representative. The maximum pull tension shall not exceed the recommended value for the cable measured by the tension dynamometer. In general, any lubricant that does not injure the overall covering and does not set up undesirable conditions of electrostatic stress or electrostatic charge may be used to assist in the pulling of insulated cables in conduits and ducts.

After pulling the cable, the Contractor shall record cable identification with date pulled neatly with waterproof ink in linen tags / aluminium tag and shall securely attach such identification tags. Identification tags shall be attached to each end of each cable with non-corrosive wire. The said wire must be non-ferrous material on single conductor power cable. Tags may further be required at intervals on long runs of cables on cable trays and in pull boxes. Cable and joint markers and RCC warning covers shall be provided wherever required.

Sharp bends and kinks in cables shall be avoided. The bending radii for various types of cables shall not be less than 15 times the overall diameter of the cable.

Power, control and instrumentation cables shall be laid in separate cable racks/trays.

Where cables cross roads or water/sewage pipes, the cables shall be laid in reinforced spun concrete or steel pipes. For road crossings, the pipe for the cables shall be buried at not less than one meter depth.

Cables laid in ground shall be laid on a 75 mm riddled earth bed. The cables shall then be covered on top and at their sides with riddled earth of depth of about 150 mm. This should be then filled up to a depth of about 100 mm above the top of uppermost cable to provide bedding for the protective cable covers which shall be placed centrally over the cables. The protective cable covers for LV cables may be of earthenware and for HV cables of reinforced concrete. The RCC covers shall have one hole at each end, to tie them to each other with GI wires to prevent displacement. The trench should be then backfilled with the excavated soil and well rammed in successive layers of not more than 300 mm thick, with the trenches being watered to improve consolidation wherever necessary. To allow for subsidence, a crown of earth not less than 50 mm in the center and tapering towards the sides of the trench should be provided.

Each cable shall be pulled into the particular conduit and shall be taken from the particular reel designated for the run. In hand holes, pull boxes or junction boxes having any dimension over 1000 mm, all conductors shall be cabled and/or racked in an approved manner. Care shall be taken to avoid sharp bending or kinking cables, damaging insulation or stressing cable beyond manufacture's recommendations in pulling. Cable shall be protected at all times from mechanical injury and from absorption of moisture at unprotected ends.

In each cable run, some extra length shall be kept at a suitable point to enable one or two 'straight through joints' to be made, should the cable develop a fault at a later date.

Cables on cable racks, and conduits shall be formed to avoid bearing against edges or trays, racks, conduits or their supports upon entering or leaving racks or conduits.

Cables splices shall not be used except where permitted by the Engineer's Representative. Splices shall be made by Contractor for each type of wire or cable in accordance with the instructions issued by cable manufacturers and the Engineer's Representative. Before splicing, insulated cables shall have conductor insulation stepped and bound or penciled for recommended distance back from splices to provide a long leakage path. After splicing, insulation equal to that on the spliced conductors shall be applied at each splice.

At cable terminal points, where the conductor and cable insulation will be terminated, terminations shall be made in a neat, skillful and approved manner by specially trained staff. Terminations shall be made by the Contractor for each type of wire or cable in accordance with instructions issued by cable manufacturers or the Engineer's Representative.

Control cable termination shall be made in accordance with wiring diagrams, using proper colour codes for the various control circuit, by code marked wiring diagram.

When control cables are to be fanned out and corded together with cord, the Contractor shall make connections to terminal blocks, and test the equipment for proper operation before cables are corded together. If there is any doubt about correctness of connection, the Contractor shall make a temporary connection with sufficient length of cable so that the cable can be switched to another terminal without splicing. After correct connections are established, cables shall be cut to their correct lengths, connected to terminals in the specified manner, and corded together where necessary to hold them in place in a skillful manner. Jointing of cables shall be in accordance with relevant Indian Standards Codes of Practice and manufacturer's instructions.

Materials and tools required for cable jointing work, including cold setting bituminous compound shall be supplied by the Contractor. Cables shall be firmly clamped on either side of a 'straight through joint' at a distance of not more than 300 mm away from the joints. Identification tags shall be provided at each joint at all cable terminations.

Cable seals shall be examined to ascertain if they are intact and that cable ends are not damaged. If the seals are found to be broken the cable ends shall not be jointed until after due examination and testing under supervision of the Engineer's Representative. Before jointing is commenced, insulation resistance of both sections of cables to be jointed shall be checked by megger.

After installation and alignment of motors, the Contractor shall complete the conduit installation, including a section of flexible conduit between motor terminal box and trench/tray. The Contractor shall install and connect the power, control and heater supply cables as per equipment manufacturer's drawings, if any. The Contractor shall be responsible for correct phasing of the motor power connection and shall interchange connections at the motor terminal box, if necessary, after each motor is test run.

Connections to recording instruments float switches, level electrodes, limit switches, pressure switches, thermocouples, thermostats and other miscellaneous equipment shall be done as per manufacturer's drawings and instructions.

Metal sheath and armour of the cable shall be bonded to the earthing system of the station. The size of conductor for bonding shall be appropriate with the system fault current.

All cables shall be tested for insulation resistance before jointing. After jointing is completed, all cables shall be tested again by a 1000 volt megger.

Cable core shall be tested for

- a) Continuity;

- b) Absence of cross phasing;
- c) Insulation resistance to earth; and
- d) Insulation resistance between conductors.

Contractor shall furnish testing kits and instruments required for field testing.

6.43. Outdoor HV Substation Equipment with Structure

6.3 General

The scope of supply consists of a two pole (or more, as required) galvanised steel (GS) structure fabricated out of ISMBs and ISMCs; PCC poles for drawing overhead line; GS structural sections for supporting and fixing various equipment; transformer, lightning arresters, disconnector, drop-out fuses, insulators and hardware, ACSR conductor, etc.; fixing accessories, and chain link fencing with padlockable gate.

The design, material, construction, manufacture, inspection and testing of all HV outdoor substation equipment and overhead line shall comply with the currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed.

The equipment shall conform to applicable standards. All standards and code of practices shall be the latest editions including all official amendments and revisions.

The details of the steel structure and support sections/members shall be subject to approval of structural design calculations to be furnished by the contractor.

6.44. Disconnector

6.4 Constructional Features

- i. The disconnectors shall conform to IS 9921 and IEC 60129.
- ii. The disconnector switch shall be complete with all parts that are necessary for complete operation. Such parts shall be deemed to be within the scope of supply, whether specifically mentioned or not. Clamps/connectors shall also be supplied.
- iii. The disconnector design shall be such that it is free from visible corona discharge in both closed and open positions, at the visible discharge test voltages as per the applicable standards.
- iv. The disconnector shall be provided with high current carrying contacts on the hinge and jaw ends. All contact surfaces shall be silver faced copper.
- v. The disconnector handle shall be provided with a padlocking facility to lock it in fully open or fully closed positions. Rust proof padlocks shall be supplied with the disconnectors.
- vi. Insulator used in the assembly of disconnector shall be of porcelain and of brown colour. Insulator cap and base shall be of high-grade cast steel or malleable steel casting and they shall be machine faced and galvanised.
- vii. Disconnector base shall be of galvanized steel.

6.5 Operating Mechanism

- i. Operating devices for disconnector shall be manually operable.

ii. Operating mechanism shall provide a quick, simple and effective operation. One man shall be able to operate the disconnecter without undue effort.

iii. The manual operating handles shall be mounted on the base of the supporting structure. Guide bearings shall be provided at a height of 750 mm above grade level. All brackets, angles, guides, guide bearings or other members necessary for attaching the operating mechanism and the operating handles to the supporting structure shall be supplied as an integral part of the disconnecter. Rustproof pins and bearings of bronze bushing, ball and roller type, shall be furnished. All bearings shall be weather protected by means of covers and grease retainers. Bearing pressures shall be kept low to ensure long life and ease of operation.

iv. Disconnecter and its operating mechanism shall be such that it cannot be dislodged from its open or closed positions by gravity, wind pressure, vibrations, shocks or accidental touching or breaking of the connecting rods or the operating mechanism.

The specific technical particulars of disconnectors shall be as given below.

Sl.No.	Description	Particulars
1	Installation	Outdoor
2	Rated voltage	11 kV
3	Rated Current	40 A / as per approved SLD
4	Frequency	50 Hz
5	Short circuit withstand rating for one second	26 kA (rms)
6	Design ambient temperature	50° C
7	Impulse withstand voltage across the isolating distance Across the isolating distance. Between poles and earth	75 kV rms /conform to IS 75 kV rms /conform to IS
8	One minute power frequency withstand voltage kV Across the isolating distance. Between poles and earth	28 kV rms /conform to IS 28 kV rms /conform to IS
9	Phase spacing (minimum)	914 mm/ conform to IS

6.45. Lightning Arrester

Lightning arrester (LA) shall be of outdoor, metal oxide (gapless) type and shall conform to IEC 60099. LA shall be of hermetically sealed type and of self-supporting construction, suitable for mounting on steel structures.

Housing of the LA shall be of porcelain, having adequate mechanical strength and rigidity for satisfactory operation under climatic conditions obtaining at site. Porcelain shall be finely glazed and shall be free from imperfections.

LA shall incorporate anti-contamination feature to prevent arrester failure, consequent to uneven voltage gradient in the event of contamination of the arrester housing.

LAs shall be complete with insulating base with a provision for bolting to flat surface of supporting structure.

LA shall be complete with line and earth terminals. The terminal clamps/connectors on the earth terminal of the arresters and the discharge counter incoming and outgoing terminals shall also be provided.

The specific technical particulars of the LA shall be as given in the table below.

Sl. No.	Description	Particulars
1	Type	Metal Oxide (Gapless)
2	Rated voltage	9.6 kV
3	Rated frequency	50 Hz
4	Nominal discharge current 8/20 Micro Sec current wave	10 kA (peak) /conform to IS
5	High current impulse 4/10 Micro Sec current wave	100 kA (peak) /conform to IS
6	Residual voltage corresponding to steep current impulse of 10 kA (peak)	108 kV (peak) /conform to IS
7	Long duration line discharge capability	Class 2
8	Lightning impulse withstand voltage of housing 1.2/50 Micro Sec current wave	75 kV (peak) /conform to IS
9	Total creepage distance of housing	900 mm /conform to IS

6.46. Insulators

The porcelain post insulators shall conform to IS 2544 and IEC 60273, the insulators for overhead lines shall conform to IS 731 and IEC 60305, 433 and the insulator fittings shall conform to IS 2486.

Porcelain used for the manufacture of insulators shall be homogeneous, free from flaws or imperfections that might affect the mechanical or dielectric quality. They shall be thoroughly vitrified, tough and impervious to moisture. The glazing of the porcelain shall be of uniform brown color, free from blisters, burns and other similar defects. The porcelain shall be sound, free from defects and smoothly glazed. Insulators shall have compression type glaze with a good lustre.

Insulators shall be designed to avoid excessive concentration of electrical stresses in any section or across leakage surfaces. Design features, which increase radio influence level, shall be avoided.

All metal parts shall be made of commercial grade malleable iron or open hearth or electric furnace steel, hot dip galvanised to relevant standards. Castings, if any shall be free from blow holes, cracks and such other defects.

The specific technical particulars of insulator shall be as given in the table below.

SI.No.	Description	Particulars	
1.	Type	Strain	Post
2.	Rated voltage	11 kV	11 kV
3.	Type of insulators	Disc	Stack
4.	No. of insulators	3 per string	2 no.
5.	Impulse withstand voltage of 1.2/50 micro sec. wave	75 kV (peak)	75 KV (peak)
6.	Power frequency voltage withstand	28 kV rms / conform to IS	28 kV rms / conform to IS
7.	Dry Wet	28 kV 28 kV	28 kV 28 kV
8.	Visible discharge power frequency test	27Kv / conform to IS	27kV / conform to IS
9.	Total creepage distance	900 mm/ conform to IS	900 mm/ conform to IS

6.47. Drop-out Fuses

Drop-out fuse assembly shall be complete with fuse carrier, post insulator, jaw and hinge, live parts, terminals, channel base, fixing bolts, nuts and washers. Fuse links shall also be supplied.

All materials used in the manufacture of drop-out fuses shall be suitable for conditions specified and shall withstand variations of temperature and atmospheric conditions without deterioration or distortion of any kind in any part. All non-metallic parts of fuse carrier shall be of tough, non-ignitable insulating materials.

Mounting of drop-out fuses shall be such that its isolation/removal/replacement is easy. It shall have positive guides for this purpose.

Bird proof constructional features shall be provided.

It shall be possible to adjust spring pressure of the top contact to ensure consistent performance

All current carrying parts shall be of copper alloy. The contacts shall be of gun metal brass or phosphor bronze. The contact surface shall be silver plated to ensure low contact resistance.

Fuse links shall be of such construction as to prevent danger from overheating, arcing and scattering of hot metal or powder or emission of flame, when operating in service.

When the fuse link ruptures or when the fuse carrier is pulled downwards, the carrier shall swing free to an inverted position. The carrier shall be brought to a cushioning stop to eliminate shock on the carrier and lower insulator unit.

The base channel and all ferrous parts shall be hot-dip galvanised as per the applicable standards.

Drop-out fuse base channel shall bear a name plate describing the major technical particulars.

Fuse base, fuse link and fuse carrier shall bear the markings as per IS.

An operating rod with provision at the top for switching and removing fuse carrier shall be provided. The rod shall be minimum 6.0 m long unless otherwise stated.

Multi-bolt (bi-metallic) terminal clamps shall be provided at the top and bottom of fuse base contacts suitable for connection to the ACSR conductor.

Fuse kit shall be supplied, consisting of fuse-link assembly, refusing tool and any other item necessary to restore the fuse units to service after an operation.

Drop-out fuse frame shall have two earthing terminals. The specific technical parameters of drop-out fuse shall be as given below.

Sl.No.	Description	Particulars
1.	Installation	Outdoor
2.	Rated Voltage	11 kV
3.	Rated Frequency	50 Hz
4.	Rated Current of contacts	40 Amp/ as per approved SLD
5.	Rated current of fuse links	10 A /as per approved SLD

6.48. Lighting System

6.6 Scope

This covers supply, installation and commissioning of all equipment necessary for a complete lighting and receptacle system. The type of lighting fixtures and receptacles shall be as specified. The quantity required shall be as per the approved lighting layout drawings to be submitted by the contractor. Equipment shall include lighting panels, lighting fixtures, lighting fixture supports, street lighting poles, switches, receptacles, ceiling fans, exhaust fans, conduits, wires, cables, and miscellaneous accessories as necessary for a complete system.

6.49. Lighting Fixtures

The lighting fixtures offered shall comply with the following requirements.

- a) *The fixtures shall be suitable for operation on a nominal supply of 240 V, single phase, 50 Hz, AC with a voltage variation of + 10 %.*
- b) *All lighting fixtures shall be supplied complete with lamps and all necessary accessories such as ballast, capacitor, etc. for their satisfactory operation.*
- c) *Starter of the fluorescent light fixture shall be replaceable without disturbing the reflector or lamps and without the use of any tool.*
- d) *The capacitor of the lighting fixture shall have adequate value of capacitance to correct the power factor of its fixture to 0.98 lag.*

- e) *Lamp holders for fluorescent tubes shall be of the spring loaded, low contact resistance, bi-pin rotor type, resistant to wear and suitable for operation at the specified temperature, without deterioration in insulation value, contact resistance or lamp holding quality.*
- f) *Lamp-holders for HPSV lamps shall be of GLS type, manufactured in accordance with the relevant standard and designed to give long and satisfactory service.*
- g) *Lighting fixture reflectors shall generally be manufactured from steel or aluminum sheet of not less than 20 SWG thickness.*
- h) *Polystyrene or aluminum egg-box type louvres shall be provided wherever specified.*
- i) *Each fixture shall be complete with a four way terminal block for connection and looping of incoming and outgoing cables. Each terminal shall be able to accept two 2.5 mm² copper stranded conductors.*
- j) *Each lighting fixture shall be provided with an earthing terminal suitable for connecting 16 SWG copper stranded conductor.*
- k) *All metal or metal enclosed parts of the housing shall be bonded and connected to the earth terminal to ensure satisfactory earthing continuity throughout the fixture.*
- l) *The enamel finish shall have a minimum thickness of 2 mils for outside surface and 1.5 mils for inside surfaces. The finish shall be non-porous and free from blemishes, blisters, and fading.*
- m) *All reflectors and louvers shall be finished to the same standard as the fixture housing.*
- n) *The lighting fixtures with lamps shall be preferably of LED type being of long life and low electricity consumption*

6.50. Receptacle Units

Decorative and industrial type receptacle units of 5 A, 15/16 A and 32 A rating with switches/MCBs shall be supplied. The units shall be suitable for mounting flush on GS sheet boxes. Receptacles in the chlorine house shall be of corrosion proof type.

The receptacle shall be suitable for 240 V, 1 Ph, (or 415 V, 3 Ph), 50 Hz AC supply. Single phase decorative receptacle shall be provided with a switch of the same current rating while Single phase industrial receptacle shall be associated with a MCB of the same current rating, housed in the same enclosure. Two phase receptacles shall be associated with a MCB of the same rating, housed in the same enclosure. The enclosure for all outdoor receptacles shall be provided with degree of protection of IP55.

6.7 Applicable Standards

All standards and codes of practice referred to below shall be the latest edition including all official amendments and revisions.

Industrial luminaire with metal reflector	:	IS 1777
Ballast for fluorescent lamp	:	IS 1534
3 pin plugs & sockets	:	IS 1293
General safety requirements for luminaires	:	IS 1913

Luminaires for street lighting	:	IS 10322
Fitting for rigid steel conduits for electrical wiring	:	IS 2667
Code of practice for interior illumination	:	IS 3646 & IS 6665
Switches for domestic & similar purposes	:	IS 3854
Electric ceiling type fans & regulators	:	IS 374
Code of practice for electrical wiring installation	:	IS 732

6.51. Tests and Test Reports

Type tests, acceptance tests and routine tests for the lighting fixtures, accessories and receptacles covered by this specification shall be carried out as per the relevant standard.

Manufacturer's type and routine test certificates shall be submitted for tests conducted as per relevant standards for the fixtures, accessories and receptacles.

The following routine tests shall be conducted as per the relevant Indian Standards.

1. Each fixture shall be tested at 1500 Volts (rms), 50 Hz, AC for one minute and no flash over or breakdown shall occur between current carrying parts and ground.
2. Insulation resistance of each fixture shall be tested at 500 V DC and the insulation resistance so measured shall not be less than 2 megaohms between all current carrying parts and ground.
3. All luminaires provided with glass covers shall be subjected to thermal shock-proof test. This test shall be conducted to ensure that the cover glass will withstand sudden variation in surface temperature due to rainfall or splashing water when the lighting fixture is lit. The cover glass shall be heated in an oven to attain a steady temperature of 1000 C and then plunged into cold water. No crack should develop.
4. Contractor shall ensure use of calibrated test equipment having valid calibration test certificates from standard laboratories traceable to National Standards.

6.52. Drawings/Documents

1. The bidder shall furnish with the bid, relevant descriptive and illustrative literature on lighting fixtures, accessories and receptacles as well as preliminary details of lighting panels, conduits, cables, etc.
2. The following drawings/documents shall be furnished after the award of contract for approval of Engineer's representative:
 - i. Dimensional drawings of lighting fixtures
 - ii. Mounting details, cable entry facility and weights of lighting fixtures
 - iii. Light distribution diagrams (zonal and isocandela) of lighting fixtures
 - iv. Utilization factor tables of lighting fixtures
 - v. Design calculation for lighting system, lighting and receptacle layout and circuiting diagram
 - vi. One line diagrams of lighting panels including rating of all equipment

6.53. Lighting System Installation

The Contractor shall supply, install, test and commission the complete system of lighting and receptacles in accordance with the approved lighting drawings and documents and in accordance with relevant Indian Standards, codes of practice, Indian Electricity rules and safety codes in the locality where the equipment/system is to be installed. Nothing in this specification shall be construed to relieve the contractor of this responsibility.

6.54. Installation of Lighting Panel, Lighting Fixtures & Receptacles

The scope of installation work shall include mounting of lighting panel, lighting fixtures and receptacles at locations as per the approved drawings. All work associated with installation such as providing and fixing of wooden blocks, ball sockets, hooks, etc., as required, drilling holes in walls, ceilings, etc., or any civil work including scaffolding, provision of ladders, etc., together with supply of hardware shall form part of the Contractor's work. All work items necessary for completing earthing connections shall be included in the scope of work.

6.55. Wiring

a) The work shall comprise wiring in heavy gauge (minimum 16 SWG) GI conduits, fixed and supported at intervals of 500 mm on walls, ceiling etc.; installation of light control switches and receptacles housed in GS boxes; earthing with 16 SWG copper wire run along the conduit and clamped to it at every 500 mm; and termination of cables/wires at lighting panels, light control switches, receptacles, lighting fixtures etc., as required. The minimum size of conduit shall be 20 mm. Space factor (ratio of total wire area to internal conduit area) shall be 40 %.

b) Supply of all the items of work detailed above including 650 V grade, 2.5/4 sq. mm stranded copper conductor PVC insulated cables; 5 / 10 switches; GS conduits and accessories (such as junction boxes, tees, elbows, etc); 16 SWG GS boxes complete with gasket, knockouts for

conduit entries, earthing terminal with bolts, nuts and washers; 16 SWG copper earthing wire; flexible conduit etc. shall be included in the Contractor's scope. All work necessary for fixing boxes, conduits etc., together with supply of necessary accessories hardware, shall also be included in the Contractor's work.

c) All light control switches and receptacle units (connected on the same phase) at one location (such as room entrance), shall be housed in one common GS sheet steel box.

6.56. Lighting Fixtures

Receptacle and lighting fixtures shall be fed from different circuits and wiring for the same shall be done in different conduits. The maximum load on any circuit shall not exceed 1800 Watts. In large rooms, the lighting system shall be distributed over two phases. Switches/receptacles wired on different phases shall be separated by a minimum distance of 1.8 m. Wires belonging to different phases shall not be run in the same conduit. However, more than one circuit on the same phase can be run in the same conduit. For every phase wire, a separate neutral wire shall be run. Neutral wire shall not be looped. Size of wire chosen shall be such as to limit the voltage drop to within 3 %. Minimum area of conductor shall be 2.5 sq mm stranded copper for lighting and receptacle circuits, and current density shall not exceed 2.5 A/sq mm. Generally, not more than 8 to 10 lighting points shall be wired in one circuit. For calculating connected loads of various circuits, a multiplying factor of 1.25 shall be assumed on the rated lamp wattage for sodium vapour and fluorescent lamp fixtures to take into account the losses in the ballast. A loading of 100 watts and 500 watts shall be assumed for each, single phase 5 amps and 15 amps receptacles respectively.

For street lighting, steel tubular poles complete with fixing brackets shall be used. These poles shall be coated with bituminous preservative paint on the inside as well as on the embedded outside surface. Exposed outside surface shall be painted with one coat of red oxide primer. After completion of installation, two coats of aluminium paint shall be applied. Contractor shall supply and erect the poles (including foundation work), mount the assembled fittings, and install the necessary cabling. The Contractor's scope includes supply and installation of cables required between lighting panel and 14 SWG GS junction box mounted on the street lighting pole and between junction box and metal enclosed control gear box. Contractor shall earth street light pole and junction box with 8 SWG GS wire tapped off from the 8 SWG GS wire to be laid along the street lighting cable. The Contractor shall interconnect this earthing grid to plant main earthing grid. Height and type of pole shall be subject for an engineer's approval.

Before a completed installation is put into service, installation tests stipulated in the latest edition of IS: 732 and other codes of practices shall be carried out by the Contractor in the presence of the Engineer's Representative.

6.57. DG Set

Silent DG set (As per CPCB norms) complete with 1500 RPM Diesel Engine of suitable BHP & AC Brush less SPDP Alternator mounted on a common base frame & coupled through a flexible coupling or close coupled. Alternator shall be self-regulated with standard Alternator Protection

(Over Voltage, Over Speed & under voltage, under speed warning & shutdown). Engine shall have residential silencer, up to 3 M Exhaust piping, electronic/Mechanical governor, Manual & electric start, Batteries, Engine instrument panel, AVM and with Weatherproof, powder coated Acoustic enclosure for DG set for sound attenuation fabricated from 1.6mmCRCA sheet steel (structure) with side wall fabricated from 1.6mm CRCA sheet & filled with 100mm thick glass wool (96kg/m3) /Foam as per IS 8183 or equivalent foam thickness and pressure, the doors are fabricated from 1.6 mm CRCA sheet packed with acoustic material, floor of MS chequered plate 5.0mm thick, canopy fixed with axial flow fan of alstom, CG, almonard make. All doors/opening are sealed with neoprene/EPDN gaskets. The enclosure has built in fuel tank, residential silencer (isolated from main DG chamber) with protection and tripping of DG set against temperature of more than 50 degree centigrade. All controls for operation of DG set are from outside the enclosure with DG control panel having Microprocessor based GenSet monitoring & control system, MCCB, Ammeter, Voltmeter, PF meter, frequency meter, KWH meter, Ind lamps etc. mounted inside enclosure, visible and accessible from outside. The enclosure should be suitable for designed capacity DG set and alternator. Noise level shall be less than 75db(A) at a distance of 1 m duly certified by authorized agency complete in all respect. The DG set shall be Air cooled & naturally aspirated up to 30 KVA rating and Radiator cooled & turbo charged for rating above 30KVA.

6.8 Important Note (To be strictly adhered to by the contractor)

- (1) The work shall be carried out in the best manner, in conformity with the specification, drawings, standards, BOQ and the code of practice of IS as well as to the instruction of the Engineer-in-charge.
- (2) In addition, the work shall conform to the requirements of the following:
- (3) Indian Electricity Act and rules & regulations framed there under.
- (4) Fire insurance regulations
- (5) Rules and regulations laid down by the Chief Electrical Inspector and other statutory authorities like Utility authorities etc.
- (6) All materials, fittings, equipment/items, erection hardware and accessories etc to be supplied by the Contractor shall be of the best quality and shall conform to specification and drawings. These shall be manufactured & supplied in accordance with the latest revision of the IS.
- (7) The Contractor shall be a valid license holder of Agra to carry out the electrical installation work and documentary evidence to this effect shall be furnished by him before commencement of work.. Similarly the skilled workmen / Electricians / Supervisors deputed by the Contractor should also hold valid license issued or recognized by the electrical licensing board of the respective state.
- (8) The Contractor shall provide in due time, in adequate number, and in appropriate sequence all services, materials, equipment, fabrication & erection plant/ Rigs / Tools and tackles,

adequate competent manpower as required for erection and any incidental work, for satisfactory execution and completion of the works covered under this specification, strictly within the agreed time schedule.

(9) Any equipment, materials or fittings not specifically mentioned in this specification or drawings, but are genuinely necessary for the safe and efficient operation and maintenance of the works as per sound engineering practice and current statutory requirement shall also be supplied / fabricated / erected / tested / commissioned by the Contractor, and it is specifically agreed and understood that such items are also deemed to be included in the scope of work of the Contractor within the quoted price and no extra payment will be made on this account.

(10) All safety procedures and practices shall be kept in view during execution of work in accordance with good practice. (Refer IS: 5216 – 1969 – guide for safety procedures and practices in electrical work).

(11) The electrical Contractor shall take care of existing services and co-operate with other such contractor at site and shall coordinate his works with works of other contractors with the least amount of damage and interference to their works.

(12) At any point of time one responsible person should be kept from the beginning to end of the job on full time basis.

(13) All meters have to be calibrated in an approved testing laboratory before energisation and test report should be furnished to this effect.

(14) All rates quoted shall be inclusive of all sundry materials like hardware, clamps, cleats, nuts and bolts, cement and sand, coke and salt, solders, fluxes including all consumables like electrodes, gases etc.

(15) The Contractor shall put up temporary structure to store his materials. Materials supplied by the Owner, if any, shall also be kept in the stores. Security of the materials, insurance etc. for the stores shall be in the Contractor's scope.

(16) On completion of the job all wooden crates, small pieces of cable/ wire etc. shall be removed by the Contractor.

(17) All works carried out by the Contractor shall have to be guaranteed for twelve months from the date of completion.

(18) All the approvals connected with drawings, installation etc. to be obtained from utility/Engineer before start of the job and in full conformity to their requirement. Proper coordination with utility and payment of supervision charges as applicable shall also be paid to the utility by the Contractor which shall be reimbursed by the Owner on reproduction of the original receipt.

(19) After completion of all activities described in the B.O.Q. and specification to the entire satisfaction of utility Engineer, the Contractor shall hand over the same after energizing,

testing & commissioning of the system as a whole along with “As built” drawing.

6.58. Inspection Requirement

General

- 1.** All inspection and testing shall be carried out in accordance with the Specification and in absence of Specification relevant Indian Standard or internationally approved equivalent standard.
- 2.** The Contractor shall carry out at the place of manufacture tests of the Plant / Equipment at any part of the Works.
- 3.** The Employer shall be entitled to attend the aforesaid inspection and/or tests by his own duly authorised and designated representatives.
- 4.** The Employer and his duly authorised representative shall have access to the Contractor's premises at all suitable times to inspect and examine the material and workmanship of the mechanical and electrical plant and equipment during its manufacture there. If part of the plant and equipment is being manufactured on other premises, the Contractor shall obtain permission for the Employer or his duly authorised representative, to inspect as if the plant and equipment was manufactured on the Contractors own premises. Testing (including testing for chemical analysis and physical properties) shall be carried out by the Contractor and certificates submitted to the Engineer's Representative who will have the right to witness or inspect the above mentioned inspection / testing at any stage desired by him.
- 5.** The procedure for the testing and inspection to be carried out during or following the manufacture of the materials to ensure the quality and workmanship of the materials and to further ensure that they conform to the Contract in whatever place they are specified shall be as described below.
- 6.** The Contractor shall give the Employer at least 21 clear days' notice in writing of the date and the place at which any plant or equipment will be ready for inspection / testing as provided in the Contract. The Employer or his duly authorized representative shall thereupon at his discretion notify the Contractor of his intention either to release such part of the plant and equipment upon receipt of works tests certificates or of his intention to inspect. The Employer shall then give notice in writing to the Contractor, and attend at the place so named the said plant and equipment which will be ready for inspection and/or testing. As and when any plant shall have passed the tests referred to in this section, the Engineer's Representative shall issue to the Contractor a notification to that effect.
- 7.** The Contractor shall forward to the Employer 3 duly certified copies of the test certificates and characteristics performance curves for all equipment.
- 8.** If the Engineer's Representative fails to attend the inspection and/or test, or if it is agreed between the parties that the Engineer's Representative(s) shall not do so, then the

Contractor may proceed with the inspection and/or test in the absence of the Engineer's Representative and provide the Employer with a certified report of the results.

9. If any materials or any part of the works fails to pass any inspection / test, the Contractor shall either rectify or replace such materials or part of the works and shall repeat the inspection and/or test upon giving a notice. Any fault or shortcoming found during any inspection or test shall be rectified to the satisfaction of the Engineer before proceeding with further inspection of wiring of that item. Any circuit previously tested, which may have been affected by the rectification work, shall be re-tested.

10. Where the plant and equipment is a composite unit of several individual pieces manufactured in different places, it shall be assembled and tested as one complete working unit, at the maker's works.

11. Neither the execution of a inspection test of materials or any part of the works, nor the attendance by the Engineer's Representative(s), nor the issue of any test certificate shall relieve the Contractor from his responsibilities under the Contract.

12. The test equipment, meters, instruments etc., used for testing shall be calibrated at recognized test laboratories at regular intervals and valid certificates shall be made available to the Engineer's representatives at the time of testing. The calibrating instrument used as standards shall be traceable to National / International standards. Calibration certificates or test instruments shall be produced from a recognized Laboratory for the Engineer's consent in advance of testing and if necessary instruments shall be recalibrated or substituted before the commencement of the test.

13. The Contractor shall not pack for shipment any part of the Plant until he has obtained from the Employer or his authorized representative his written approval to the release of such part for shipment after any tests required by the Contract have been completed to the Employer's satisfaction.

14. The following Testing shall be carried out for all the equipment as applicable

- a) *Visual Inspection.*
- b) *Material Certificates for all the specified material shall be furnished.*
- c) *Welding Qualifications*
- d) *Dimension Checking*
- e) *Stage Inspections (in process inspection)*
- f) *Dynamic balancing for all rotating parts*
- g) *Hydrostatic / Leak testing for all pressure parts, Pneumatic Leak Test wherever applicable*
- h) *Operation check*

- i) *Liquid penetration tests or magnetic particle tests for all machined surfaces of pressure parts.*
- j) *Ultrasonic test for forging materials viz.,*
- k) *Plates of thickness 20mm and above for pressed / formed parts such as heads, etc.*
- l) *Plates, flanges and bars of thickness / dia 40mm and above used for fabrication of pressure and load bearing members and rotating parts.*
- m) *Radiographic testing for all but welded parts, as per applicable codes.*
- n) *Hardness tests for all Hardened surfaces.*

15. The Contractor shall maintain proper identification of all materials used, along with reports for all internal / stage inspection work carried out, based on the specific job requirement and or based on the data sheets / drawings / specifications.

TECHNICAL SPECIFICATION

CHAPTER – 7

APPURTENANCES

A. SLUICE VALVES

7.1. GENERAL:

All valves shall be double – flanged valves of Indian manufacture and in the size range to 300mm and above conforming to IS:14846 – 2000 or any other national standard equivalent or higher than the Indian Standards mentioned. The materials used in construction, the design and all other relevant features shall be such that the valves are entirely suitable for use of force mains. Valves shall be of suitable pressure rating which shall not be less than twice the normal operating pressure.

DESIGN:

The design of the valves will be such that erosion, cavitation, vibration and head loss (in the fully open position) shall be a minimum.

7.2. SLUICE VALVES:

Sluice valves shall generally conform to IS: 14846 – 2000. Valves should close with clockwise rotation of the hand wheel. The direction of closing should be marked on the hand wheel. Valves shall be flanged (flat faced) and drilling shall conform to IS: 1537.

7.3. MATERIALS OF CONSTRUCTION:

Body	-	C.I to IS: 210 Gr. FG 200 Wedge-	C.I. to IS: 210 Gr. FG 200
Seat Rings	-	Bronze / SS 304 Channel lining	- Gun Metal
Shoe	-	Gun Metal	
Spindle	-	SS AISI 431	

Parameters:

Quantity	-	As per Bill of Quantities
Size	-	As per Bill of Quantities
Rating	-	10 Bar (PN 1.0)

Shop Testing Witnessing:

Seat leakage test	-	10 bar (1.0 M)
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7.4. VALVE BODIES:

A. Castings:

The structure of the castings shall be homogeneous and free from non-metallic Inclusions and other injurious defects. All surface of casing which are not machined shall be smooth and shall be carefully field to remove all foundry irregularities.

B. Forgings:

All major stress bearing forgings shall be made to a standard specifications, which shall be submitted if required to the Engineer for approval before work is commenced. Forgings shall be subjected to non-destructure tests to detect flaws if any. Forgings shall be heat treated for the relief of residual stresses. The name of the maker and particulars of the heat treatment proposed for such forging shall be submitted to the CMWSSB. The Executive Engineer or his inspector may inspect such forgings at the place of manufacture with a representative of the Contractor.

C. Workmanship:

Workmanship and general finish shall be of first class commercial quality and in accordance with best workshop practice.

All similar items of the valve and their component parts shall be completely interchangeable. Spare parts shall be manufactured from the same materials as the originals and shall be accurate and to specified tolerances so that replacements made to manufacturer's drawings may be readily installed.

All parts, which can be worn or damaged by dust, shall be totally enclosed in dust proof housings.

Protective Coating:

Protective coating shall comply with IS:14846 2000.

7.5. LUBRICATION:

All the points where lubrication is needed, the Contractor shall furnish full details of the method to be employed. The supply of the requisite lubricating equipment and lubricants for commissioning and operating and maintaining the valves shall be furnished.

7.6. FLANGES:

Valves of sizes 80mm – 300mm shall have flat flanges as per IS:1538 Part IV Table – 1. The flange – to – flange distances shall be as per IS 14846.

7.7. JOINTING MATERIALS:

Each valve shall be supplied under this contract, with all requisite joint rings, nuts, bolts and washers for making the joints on all the valves to be installed under this contract. Jointing material between the connecting flanges shall conform to the relevant IS code. Unless otherwise specified bolting used for jointing exposed connections shall be of carbon steel, conforming to IS 210 Grade 20 Grade B, with galvanized finish.

7.8. FACTORY TESTS:

All the valves shall be tested at the factory for smooth, trouble free operation and operating torque requirements by operating between fully open and fully closed position three times.

The hydrostatic tests shall consist of Closed End Tests where valve is held on both sides. Each valve is subjected to three hydraulic testes.

- a) Wedge open and pressure applied for 5 minutes to the whole body of the valve pressure given in Section 19.4.
- b) Second Test shall be applied to one face with pressure given in Section 19.4
- c) Third Test shall be similar to second, but pressure applied to the other side of the wedge with same pressure.

For valves having terminal position shall be subjected to open- end test. Testing for valves from Foreign Manufactures:

- **Sampling:** Each valve is recommended to be tested.
- **Testing and Inspection:** For foreign manufacturer: The testing and inspection procedure in this case shall confirm with respective equivalent code.

B. AIR VALVES

7.9. CONSTRUCTIONAL FEATURES:

Double ball air valves shall be of the kinetic, double orifice type able to release air in small quantities under pressure and in large quantities during filling. They have to allow for large inflow of air during emptying. The type and locations shall be fixed according to the detailed

design and after approval by the Engineer in charge. 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 20 m/s

Materials of Construction and Pressure Rating : Pa) Body Hydrostatic test-15 bar

(1.5 M Pa) Back Seat Leakage test- 15 bar (1.5 M Pa

Body	CI to IS Gr. FG 200
Cowl	CI to IS Gr. FG 200
Valve seat, nut	Leaded tin bronze
Spindle	SS. AISI 304
Orifice	SS. AISI 304
Ball	Seasoned teak wood, covered with neoprene rubber
Ball seat	Anti-stick material such as nitrile rubber or equivalent
Pressure	Suitable for 16 Kg / sq.cm, Working Pressure
Ball seat	Anti-stick material such as nitrile rubber or equivalent
Pressure	Suitable for 16 Kg / sq.cm, Working Pressure

7.10. FIXING OF VALVES:

General:

The specification lays down the requirement for lowering, laying and jointing Sluice Valves.

Preparation:

The sluice valves and tailpieces shall be examined before laying for cracks and other flaws. Only undamaged S.S. shall be used.

The sluice valve shall be operated and checked before laying. All grit and foreign material shall be removed from the inside before placing. All the four faces shall be thoroughly cleaned and coated with a thin layer of mineral grease. The tightening of gland shall be checked with a pair of inside calipers. Clearance between the top of stuffing box and the underside of the gland shall be uniform on all sides.

Jointing Materials:

The Contractor shall provide all the necessary jointing materials such as nuts, bolts, rubber packing, white zinc, jute, lead wool et., at is cost. All tools and plant required for installation of sluice valve shall be provided by the Contractor at his cost. All the jointing materials shall be got approved from the Engineer in charge before use. The nuts and bolts shall confirm to IS:1364 and the rubber packing shall confirm to IS:638.

Installation:

The sluice valve shall be lowered into trench carefully, so that no part is damaged during

lowering operation. If necessary tailpieces shall be fitted with sluice valve first outside the trench and then lowered into the trench.

The rubber packing shall be three ply and of approved thickness. The packing shall be of full diameter of the flange, with necessary holes and the sluice valve bore. It shall be even at both the inner and outer edge. The flange faces shall be thoroughly greased. If flanges are not free the Contractor shall use thin fibres of lead.

After placing the packing, nuts and bolts shall be inserted and tightened to make the joint.

The valve shall be tightly closed being installed to prevent any foreign materials from getting in between the working parts of the valve.

Each flange bolt shall be tightened a little at a time taking care to tighten diametrically opposite bolts alternately.

The sluice valve shall be installed in such a way that spindle shall remain in truly vertical position. The other end of the tailpiece shall be fitted with pipes so that continuous lines can work. Extra excavation necessary to facilitate the lowering and fixing of sluice valve shall not be paid for. work. Extra excavation necessary to facilitate the lowering and fixing of sluice valve shall not be paid for

Testing:

After installation of sluice valve the same is tested to 1 ½ times of its test pressure. The joints of sluice valve shall with stand the test pressure of pipelines.

Defects noticed during test and operation of sluice valve shall be rectified by the Contractor at his own cost, without any extra claim, to the entire satisfaction of the Engineer in charge.

Mode of Measurement and Payment:

The measurement shall be taken per number of sluice valves of specified size and payment shall be on number basis for providing and fixing.

7.11. Fixing of Air Valves:

General:

The specification placed down requirement for lowering laying and fixing Air Valves.

Preparation:

The air valves and the isolating valves shall be examined before laying for cracks and other flaws. Only undamaged air valve shall be used. The air valves shall be opened and

shaken for the air opening below the vulcanite balls on the bronze seats of the balls before fixing. All grid and foreign material shall be removed from the inside before placing. The flanged face shall be thoroughly cleaned and coated with a thin layer of mineral grease. In case of screw down type, the threads shall not be in damaged condition.

Jointing Materials:

The contractor shall provide all the necessary jointing materials, such as nuts, bolts, rubber packing, white zinc jute, lead wool etc., at his cost. All tools and plant required for installation of air valve shall be provided by the Contractor at his cost. All the jointing materials shall be got approved from Engineer in charge before me. The nuts and bolts shall conform to IS: 1364 and the rubber packing shall conform to IS:638.

Installation:

The air valves shall be fixed on a branched flange Tee on the main pipe line. the air valve and isolating sluice valve shall be housed in a chamber.

Testing:

The specification pertaining to sluice valve shall also apply to air valves.

Mode of measurement and payment:

The measurement shall be taken per number of air valves of specified size and payment shall be on number basis for providing and fixing.

7.12. Fixing of C.I. M.H. Frame and Cover in RCC slab:

General:

The specification includes all requirements of fixing C.I. M.H. frame and cover of specified size and weight in the RCC slab with locking arrangement. For Fixing the C.I. M.H. frame and cover of specified size and weight, the frame shall be fixed generally at the time of casting RCC slab with proper anchoring.

After fixing the M.H. frame and cover locking arrangement shall be provided as per following unless specified in the wording of the item. The size of the M.S. flat shall be 50 x10mm with MS bar U shape of 16mm diameter. The U shape M.S. bars shall be properly embedded in the RCC roof slab and anchored. The C.I. M.H. frame and cover and the locking arrangement after fixing shall be painted with anticorrosive black paint. The work shall be done to the entire satisfaction of the Engineer in charge.

Mode of measurement and payment:

The item shall include:

- a) All labour for fixing M.H. frame and cover
- b) All material and labour of locking arrangement
- c) Painting of the frame, cover and locking arrangement.

7.13. PRESSURE GAUGES:

Material:

The brief specifications for pressure gauges are as follows:

The pressure gauges shall be of Bourdon type having a range between 0 to 9 kg/ sq.cm. The diaphragm material should be of 316 SS. Accuracy of the pressure gauge shall be 1% with a dial diameter of 150mm. The case shall be of IP 65, die cast Al. The pressure gauge shall be directly mounted with connection of ½" N.P.T.M.

Erection:

The pressure gauges shall be, mounted as near to the process as possible. Impulse tubing / piping length shall be minimum possible. The pressure gauges shall be mounted in a vibration free location. They shall be readily accessible from grade, platform, fixed walkway or fixed ladder and shall be visible from where related equipment is operated.

The pressure gauges shall have one isolating valve and one drain / vent valves for depressurizing. The drain / vent valve shall be plugged. The valves used shall be having ½ "NPTF connections and the material shall be ASTM A 216 GR. WCB or ASTM A 105 unless otherwise specified. The trim shall be AISI 410 unless otherwise specified. All connection shall be made using thread seals preferably

PTFE tape

Right tools shall be used and any limits regarding torque for tightening shall be strictly adhered to. Impulse piping shall be done using ½" O.D. seamless annealed SS tubing to ASTM A 269 GR. TP –

136 L with minimum wall thickness of 1.65mm. Compression fittings shall be used. The impulse piping must be supported by an angle of channel and strapped at every meter length. The angle / channel itself must be supported by welding it to some structure. The pressure gauge shall be covered with box

TECHNICAL SPECIFICATIONS

CHAPTER 8

MAINTENANCE PERIOD

1. It is the sole responsibility of the contractor to Operate and maintain the entire system up to Overhead Tanks to assure the designed quantity and quality successfully for the maintenance period of 60 calendar months
2. The following measures are to be taken essentially by the contractor
 - Necessary maintenance crew with supervisory staff shall be deployed. The staff pattern proposed by the contractor for the maintenance of the completed project should be got approved by the Employer one month before the issue of completion certificate. The entire strength of maintenance crew with the supervisory personnel should be available from the first day of the maintenance period.
 - The contractor should keep all spares required for replacements at the head works, pumping main, distribution system, pump sets etc readily available to ensure uninterrupted water supply to the beneficiaries.
 - All the equipment that goes out of order during the course of the maintenance period shall be rectified/replaced immediately to ensure uninterrupted water supply. If any equipment/machinery is found to be defective either due to manufacture or due to unsatisfactory maintenance, the same should be replaced by the contractor at his cost.
 - The contractor is responsible for the incidence of any theft; malpractice etc within the project area during the maintenance period and the contractor shall keep the Employer indemnified.
 - During the period of maintenance, all costs towards labour, spares, consumables, chemicals, repairs and renewals shall be borne by the firm / Contractor.
 - The electrical energy charges payable to TNEB during the maintenance period shall be borne by the Employer
 - The contractor shall ensure complete quality service during the maintenance period.
 - Necessary log books indicating the quantity of water pumped, and maintenance carried out and repairs attended with details of spares changed shall be maintained by the contractor on a day to day basis and produced to the Engineer in charge whenever called for

TECHNICAL SPECIFICATION

CHAPTER 9- ENVIRONMENTAL MANAGEMENT PLAN - Water Supply

PRE - CONSTRUCTION PHASE MITIGATION MESURES

Sl. No.	Potential Negative Impacts	Mitigation Measures	Time frame	Responsible agencies
PRE-CONSTRUCTION STAGE				
1	Clearances	All clearance required for Environmental aspects during construction shall be ensured and made available before start of work.	Before construction	ULB / PIA / Concerned Departments & agency /
2	Tree Cutting	<ul style="list-style-type: none"> i) Try to save the trees by changing the alignment ii) Provide adequate protection to the trees to be retained with tree guards (e.g. Masonry tree guards, Low level RCC tree guards, Circular Iron Tree Guard with Bars) as required. ii) Identify the number of trees that will be affected with girth size & species type along the sewer mains, pumping / lifting station sites and sewerage treatment plant site. The details to be indicated in a strip map plan. iii) Trees shall be removed from the construction sites before commencement of construction with prior permission from the concerned department. iv) Undertake afforestation in nearby areas. v) Compensatory plantation by way of Re-plantation of at least twice the number of trees cut should be carried out in the project area. 	Pre-construction construction phase	& Contractor / PIA

Sl. No.	Potential Negative Impacts	Mitigation Measures	Time frame	Responsible agencies
3	Utility Relocation	i) Identify the common utilities to be affected such as: telephone cables, electric cables, electric poles, water pipelines, public water taps, etc ii) Affected utilities shall be relocated with prior approval of the concerned agencies before construction starts.	Pre-construction & construction phase	PIA /Concerned departments
4	Baseline parameters	Adequate measures shall be taken and checked to control the Baseline parameters of Air, Water and Noise pollution. Base line parameters shall be recorded and ensured conformance till the completion of the project.	Pre-construction, construction & post-construction phase	Prospective contractor / PIA
	Planning of temporary Traffic arrangements	i) Temporary diversion will be provided with the approval of the Engineer. Detailed traffic control plans will be prepared and submitted to the Engineers for approval, one week prior to commencement of works. ii) The traffic control plans shall contain details of temporary diversion, details of arrangements for construction under traffic, details of traffic arrangement after cessation of work each day, SIGNAGES, safety measures for transport of hazardous	Pre-construction & construction phase	Prospective contractor / PIA
6	Disposal of waste water.	i) The waste water quality shall comply with the standards of TNPCB to let out into the stream / nullah /open land /irrigation purposes, and necessary permission to be obtained from the concerned department. ii) Ensure efficient working condition of treatment	Pre-construction & construction phase	PIA
7	Storage of materials	The contractor shall identify the site for temporary use of land for construction sites /storage of construction materials, etc.	Pre-construction & construction phase	Prospective contractor / PIA

8	Construction of labour camps	<p>Contractor shall follow all relevant provisions of the Factories Act, 1948 and the Building and the other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996 for construction and maintenance of labour camp.</p> <p>The location, layout and basic facility provision of each labour camp will be submitted to Engineer prior to their construction.</p> <p>The construction will commence only upon the written approval of the Engineer.</p> <p>The contractor shall maintain necessary living accommodation and ancillary facilities in functional and hygienic manner and as approved by the Engineer.</p> <p>All temporary accommodation must be constructed and maintained in such a fashion that uncontaminated water is available for drinking, cooking and washing.</p> <p>The sewage system for the camp must be planned. Adequate health care is to be provided for the work force. The layout of the construction camp and details of the facilities provided should be prepared and shall be approved by the Engineer.</p>	During construction the	Prospective contractor
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**ENVIRONMENTAL MANAGEMENT PLAN –
WATER SUPPLY PROJECTS CONSTRUCTION & OPERATION PHASE MITIGATION MESURES**

	ms / Impacts	Action to be taken	sible agencies	ame for
3	Distribution Network and OHTs			
3.1	Shifting of community utilities	Ensure community consensus and minimum impact to community utilities like telephone cable, electric cables and electricpoles, water taps. Proper clearance to be obtained from the concerned authorities and sent to the	Prospective contractor	Pre-construction and Construction
3.2	Laying of distribution pipelines	i) Traffic regulation: Adequate actions to direct and regulate traffic shall be taken in consultation with PIA, Dept. of Police to prevent jamming of roads during construction. While planning alternative routes, care to be taken to minimize congestion and negative impacts at sensitive receptors such as Schools & hospitals. ii) Adequate precautions should be taken while laying the water distribution lines to avoid	Prospective contractor	During construction
3.3	Using of modern	Using of modern machineries such as JCBs, backhoes etc, shall be used to minimize the construction period.	Prospective	During construction
3.4	Disposal of construction debris and excavated materials.	i) A suitable site should be identified for safe disposal, in relatively low lying areas, away from the water bodies, residential and agricultural fields etc., and got approved by the Engineer. ii) Care should be taken that dumped material does not affect natural drainage system. iii) Minimize the construction debris by balancing the cut and fill requirements.	Prospective contractor	During construction
3.5	Dust Pollution near settlements	i) Unpaved haul roads near / passing through residential and commercial areas to be watered thrice a day. ii) Trucks carrying construction material to be adequately covered to avoid the dust pollution	Prospective contractor	During construction

3.6	Vehicular pollution residential sensitive receptors.	noise at /	<p>i) Idling of temporary trucks or other equipment should not be permitted during periods of loading / unloading or when they are not in active use. The practice must be ensured especially near residential / commercial / sensitive areas. Construction activity induced noise level shall be mitigated at the residential and sensitive receptors. The Contractor shall employ mitigation measures as directed by the PIA.</p> <p>ii) Stationary construction equipment will be kept at least 500m away from sensitive receptors. iv) All possible and practical measures to control noise emissions</p>	Prospective contractor	During construction
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SI.No.	Systems / Impacts	Action to be taken	Responsible agencies	Time frame for
3.7	Protection of residential sensitive receptors.	<ul style="list-style-type: none"> i) Noisy construction operations in residential and sensitive areas should be restricted between 7.30 am and 6.00 pm. ii) Preventive maintenance of construction equipment and vehicles to meet emission standards and to keep them with low noise. iii) Provision of enclosing generators and concrete mixers at site. iv) Sound barriers in inhabited areas shall be installed during the construction phase. v) Adequate barricading / other measures to protect dust pollution near sensitive 	Prospective contractor	During construction
3.8	Barricading site	The construction site should be barricaded at all time in a day with adequate marking, flags, reflectors etc. for safety of general traffic movement and pedestrians	1.0 prospective	P2.0 During construction
3.9	Safety Aspects	<ul style="list-style-type: none"> i) Adequate precautions shall be taken to prevent the accidents and from the machineries. ii) All machines used shall conform to the relevant Indian standards Code and shall be regularly inspected by the PIA. iii) Provide temporary crossing / bridges wherever necessary to facilitate normal life and business iv) Where loose soil is met with, shoring and strutting shall be provided to avoid collapse of soil. v) The contractor shall supply all necessary safety appliances such as safety goggles, helmets, safety belts, ear plugs, mask etc to workers and staffs. vi) A readily available first aid unit including an adequate supply of sterilized dressing materials and appliances as per the Factories Rules in every work zone 	3.0 prospective contractor	P4.0 During construction
4.0	Environmental enhancement and special issues:		Implementing Agency	Location

4.1	Flora and Chance found Fauna	The contractor will take reasonable precaution to prevent his workmen or any other persons from removing and damaging any flora (plant/vegetation) and fauna (animal) including fishing in any water body and hunting of any animal. If any wild animal is found near the construction site at any point of time, the contractor will immediately upon discovery thereof acquaint the Engineer and carry out the Engineer's instructions for dealing with the same. The Engineer will report to the nearby forest office (range office or divisional office) and will take appropriate steps/ measures, if required in	Prospective contractor	Project area
Sl.No.	Systems /Impacts	Action to be taken	Responsible agencies	Time frame for
4.2	Chance Found Archaeological Property	All fossils, coins, articles of value of antiquity, structures and other remains or things of geological or archaeological interest discovered on the site shall be the property of the Government and shall be dealt with as per provisions of the relevant legislation. The contractor will take reasonable precautions to prevent his workmen or any other persons from removing and damaging any such article or thing. He will, immediately upon discovery thereof and before removal acquaint the Engineer of such discovery and carry out the SC's instructions for dealing with the same, waiting which all work shall be stopped. The Engineer will seek direction from the Archaeological Survey of India (ASI) before instructing the Contractor to recommence the work in the site.	Prospective contractor	Project area
4.3	Monitoring environment parameter	The contractor shall undertake seasonal monitoring of air, water, noise and soil quality through an approved monitoring agency. The parameter to be monitored, frequency and duration of monitoring plan shall be prepared	Prospective contractor	Corridor of Impact

6.8.1.1.1 **Environmental Monitoring Plan**

To monitor the extent of environmental impact of the proposed /implemented project, the contractor has to periodically monitor the ambient environmental quality along the proposed project area. The monitoring requirement for the different environmental components is presented in table below

Environmental Monitoring Plan

Air Quality Monitoring	
Project stage	Pre Construction , Construction & operation period (as agreed)
Parameter	SPM, RPM, SO ₂ , NO _x , CO and Pb
Sampling Method	Use method specified by CPCB for analysis
Standards	Ambient Air Quality Standards, CPCB, 1994, Air (Prevention and Control of Pollution) Act,1981
Frequency	Once before start of work & once every season of the year during construction period & upto 18 months (operation Period)
Duration	Continuous 24 hours / or for 1 full working day
Location	Sensitive locations, especially in the downwind direction along the pipe laying work, pumping / lifting station locations, WTP site.
Measures	Wherever air pollution parameters increase above specified standards, additional measures as decided by the Engineer shall be adopted
Implementation	Contractor through approved monitoring agencies
Supervision	Implementing agency
Water quality Monitoring	

Project stage	Pre Construction, Construction & Operation period (as agreed)
Parameter	<ul style="list-style-type: none"> • pH, BOD, COD, DO, TDS, Pb, Oil & Grease and Detergents for Surface water. • Water pH, TDS, Total hardness, Sulphate, Fluorides, Chloride, Fe, Pb for groundwater. In addition to parameters (E.coli) determining drinking water quality.
Sampling Method	Grab sample collected from source and analysis as per Standard Methods for Examination of water and Waste water.
Standards	Indian standards for Inland Surface Water (IS; 2296, 1982) and for Drinking water (IS; 10500,1991)
Frequency	Twice a year (pre monsoon and post monsoon seasons) during the construction period
Duration	Grab sampling
Location	Locations representing water quality at <ul style="list-style-type: none"> •source & surface water quality in the vicinity •transmission lines •storage points, •distribution at representative locations including tail end.
Measures	At locations of variation in water quality/increased pollution, remedial measures to be adopted /all inflow channels shall be checked for pollution loads and channels delivering higher pollution load to the source shall be terminated from feeding the water source.
Implementation Supervision	Contractor through approved monitoring agencies Implementing agency

Noise Level Monitoring	
Project stage	Pre Construction , Construction & operation period (as agreed)
Parameter	Noise levels on dB (A) scale.
Special guidance	<ul style="list-style-type: none"> • Free field at 1 m from the equipments whose noise level are being determined. • Equivalent noise levels using an integrated noise level meter kept at a distance of 15m from edge of pavement
Standards	National Ambient Air Quality Standards in respect of Noise, Noise Pollution (Regulation and Control) Rules, 2000
Frequency	Once every season (except monsoon) for each year of construction
Duration	Reading to be taken at 15 seconds interval for 15 minutes every hour and then averaged
Location	<ul style="list-style-type: none"> • Wherever the contractor decides to locate the equipment yard. • At sensitive locations such as school, hospitals etc
Measures	In case of noise levels causing disturbance to the sensitive receptors, management measures as suggested in the EMP shall be carried out.
Implementation	Contractor through approved monitoring agencies
Supervision	Implementing agency
Soil Quality Monitoring	
Project stage	Pre Construction, Construction & Operation (as agreed)
Parameter	Monitoring of Pb, SAR and Oil & Grease

Sampling Method	• Sample of soil collected to be acidified and analysed using absorption spectrophotometer
Standards	Threshold for each contaminated set by IRIS database of USEPA until national standards are promulgated
Frequency	• During the pre monsoon post monsoon seasons each year for the entire construction and operation phase
Duration	Grab sampling
Location	• At pumping / lifting station, WTP locations, OHT/distribution points etc
Measures	At location of increased in pollution levels, source shall be identified and shall be diverted.
Implementation	Contractor through approved monitoring agencies
Supervision	Implementing agency

Apart from the above mentioned monitoring requirements, any major accidents /spillage during bulk transport of hazardous materials by the contractor, depending on the type of spillages / accidents, the parameters to be monitored will be decided by the Engineer and should be carried out by the contractor through approved monitoring agencies and supervised by the Implementing agency at their own cost.

FORMATS FOR REPORTING:

Formats for reporting / monitoring the progress / parameters achieved will be finalized in consultation with the successful bidder.

Environmental Compliance Report

The contractor shall submit a monthly progress report as per the reporting format approved by the Engineer, on the status of the implementation of the EMP, and get it duly approved by the Engineer for its compliance and for proceeding with the work. The Engineer and the Environmental and Social Safeguard (ESS) Manager, who will have access and authority to monitor the status based on the same and for which necessary facilities shall be made by the contractor.

TECHNICAL SPECIFICATONS

CHAPTER 10

REFERENCE /CODE OF PRACTICE (Latest Version shall apply)

Description	BIS No.
Ordinary Portland Cement (33 Grade)	269-1976
43 Grade Ordinary Portland Cement	8112-1989
Pozzolona Portland Cement	1489-1991
Hydrophobic Portland Cement	8043-1978
Rapid Hardening Portland Cement	8041-1990
Low Heat Portland Cement	12600-1989
Standard sand for testing of cement	650-1966
Methods of Test for Pozzolonic Materials	1727-1967
Methods of sampling and test for water & waste water (Physical & chemical)	3025-1984 (Part 1 to 37)
Methods of Sampling hydraulic Cement	3535-1986
Methods of Physical tests for hydraulic Cement	4031-1988 (1 to 14)
Methods of Chemical analysis of hydraulic cement	4032-1985
Aggregates coarse & Fine from Natural resources	383-1970
For concrete.	4082/1977
Sand for Masonry Mortar	2116-1965 and 1542/1977
Methods of tests for aggregates for concrete	2386-1963 (Part 1 to 8)
Part 1-Particle size and shape	2386-1963 (Part-1)
Part II-Estimation of deleterious Materials & Organic impurities	2386-1963 (Part-II)
Part III – Soundness	2386-1963 (Part-III)
Agra Smart City Ltd.	122

Methods for sampling of aggregates for concrete	2430-1986
Specifications for test sieves	460-1978
Part-1-Wire cloth test Sieves	(Part-I)
Common Burnt clay building bricks	1077-1976

Mild Steel and Medium tensile steel bars and hard

Drawn steel wire, concrete reinforcement, Part-I-Mild Steel & Medium tensile steel Bars Part-II-Hard drawn steel wire	432-1982	
High Strength deformed steel bars and wires for Concrete reinforcement	1786-1985	
Bending and flexing of bars for concrete reinforcement	2502-1969	
Recommendations for detailing of reinforcement in reinforced concrete works	5525-1969	
Method for tensile testing of steel wire	1521-1972	
Method of test for determining modulus of elasticity	2854-1964	
Glossary of terms relating to cement concrete	6461-1972 (Part 1 to 12)	
Methods of test for strength of concrete	516-1959	
Methods of sampling and analysis of concrete	1990-1959	Methods of
testing bond in reinforced concrete Pull out test	2770-1967	
Methods of test for permeability of cement Mortar and concrete	3085-1965	
Methods of test for splitting tensile strength Of concrete cylinders	5816-1970	
Methods of tests for determining setting time of Concrete by penetration resistance	8142-1976	
Code of practice for construction of	2911 (Part I)	
Pile foundations (concrete piles)	Sec-1-1979	
Driven cast-in-situ concrete piles	Sec-2-1979	
Bored cast –in-situ piles	Sec-3-1979	
Driven pre-cast concrete piles	Sec-4-1984	
Bored pre-cast concrete piles		
Code of practice for construction of raft foundation	2950-1981	
Design Aids for reinforced concrete	SP 16-1980	Explanatory
Hand Book on Codes for earth Engineering	SP 22-1982	Explanatory
Hand Book on IS Code 456-19	SP24-1983	

Hand Book on causes and prevention of cracks in buildings	SP 25-1984
Hand Book on concrete reinforcement & detailing	SP 34-1987
Brick Masonry	2212-1962

Construction of Stone Masonry	1957-1967
Water, gas and sewage including fittings	1536-1989
Specifications for Centrifugally Cast (Spun) D.I Pipes for Water, Gas and Sewage	9523-1980
DI Fittings for pipes for water, gas & sewerage	9523-1980
Dimensional requirements of rubber gaskets for Mechanical joints and push on joints for the use With C.I / D.I. Pipes	
C.I. Specials for Mechanical and push on flexible joints for pressure pipe lines for water, gas & sewage	
Horizontally cast iron double flanged pipes for water. Gas and sewage	
Cast iron fittings for pressure pipes for water, gas And sewage	1538-1976 (Part 1 to 24)
Rubber rings for jointing C.I. Pipes, RCC Pipes & AC	5382-1969
Pig Lead (caulking lead)	782-1978
Hemp yarn	6587-1966
Rubber Insertion to be used in jointing CI D/F pipes	638-1979
Bolts & Nuts to be used in jointing CI D/F Pipes	1363-1967
Unplasticized PVC Pipes for potable water supplies.	4985-1988
Injection moulded PVC socket fittings with Solvent cement joints for water supplies.	7834-1987 (Part 1 to 8)
Fabricated PVC fittings for potable water supplies	10124-1988 (Part 1 to 13)
Methods of test for unplasticized PVC pipes for Potable water supplies	12235-1986 (Part 1 to 11)
Sluice valves for water works purposes (50 to 300 mm Dia size)	
Sluice valves for water works purposes (300 to 1200mm Dia size)	
Surface boxes for sluice valves	3950-1979
Manhole covers for sluice valves	1726-1974
Laying of Cast-Iron Pipes	3114-1985
Laying of DI Pipes	12288-1987

Laying and jointing of unplasticized PVC Pipes	7634-1975 (Part 3)
Batch type concrete mixer	1791-1968
Sheep foot roller	4616-1968
Safety code for excavation works scaffolds and ladders	3764-1966 Safety code for
Part-I Scaffolds	3696-1966 (Part I)
Part II-Ladders	3696-1966 (Part-II)
Safety code for piling and other deep foundations	5121-1969
Safety code for working with construction machinery	7293-1974
Tamil Nadu Building Practice	Volume-I & Volume-II
Government of India Manual on Water Supply and Treatment	May 1999 (Revised)
Gravel for packing	4091-1967
Hard drawn Steel Wire	1785-1983 (Part I and II)
Structural Steel	226-1975
Hard rolled mils steel for concrete	1139-1966
Hard drawn Steel Wire	1566-1982
American Society for Testing of Materials	
British Standard	2494-1955 (Part I)
Welding Electrodes	814-1970
Steel Sheets	225-1975
Guinitting	7322-1994
Welded Joints	3589-1966 and 2041-1962
Tensile Test	223-1950
Mechanical and Electrical Works	
Submersible Pump	8030-1976
Submersible Motor	9283-1979

Providing 24 x 7 water supply to ABD area
with smart water meters and SCADA

Earthing

3043-1966

Transformer

1180-1964

Generator 22 53-4722

ADDITIONAL SPECIFICATION

1. The arrangements of MS rods for all RCC works shall be in accordance with the working drawing supplied.
2. (i) Payments for centering works for all RCC items shall be made only after the concrete is laid, even though separate items for centering works are included in the schedule. The centering and form work shall be provided to the extent and area ordered by the Executive Engineer during execution.
(ii) All cement concrete for RCC works shall be machine mixed and vibrated.
(iii) All lime mortar shall be ground in mortar will be as per TNBP.

CEMENT

The contractor has to make his own arrangements for the procurement of Cement of required Specifications for the works subject to the followings:

- (a) The contractor shall procure cement required for the works only from reputed cement factories (main producer of their authorized agents, manufacturing cement to ISI standard) acceptable to the Engineer – in – charge. The Contractor shall be required to furnish to the Engineer – in – charge bills of payment and cost certificates issued by the manufacturers or their authorized agents to authenticate procurement of quality cement from the approved cement factory. The contractor shall make his own arrangement for safe haulage and adequate storage of cement.
- (b) The contractor shall procure in standard packing of 50kg per bag from the authorized manufacturers. The contractor shall make necessary arrangement at his own cost to the satisfaction of Engineer – in – charge for actual weightment of random sample from the available stock and shall conform to the specification laid down by the Indian Standard Institution or other standard foreign institution as the case may be. Cement shall be go tested for all the tests as directed by the Engineer–in–charge atleast one month in advance before the use of cement bags brought and kept at site godown.
- (c) The employer will furnish air recraing agents and admixtures required to the contracts free pf cost at the employer stores. The use of such admixtures and agents shall be made as per the instructions of the Engineer–in–charge. The cost of cartage / storage handling, batching mixing shall be borne by the Contractor and shall be included by him to unit rate tendered for concrete.
- (d) The contractor should store the cement of 60 days requirement atleast one

month advance to ensure the quality of cement to brought to site and shall not remove the same without the written permission of Engineer-in-charge.

The contractor shall forthwith remove from the works area, and the cement that the Engineer-in-charge may disallow for use on account of failure to meet with required quality and standard.

- (e) The contractor will have to construct sheds for storing cement having capacity not less than the cement required for 90 days use, at approved locations. The Engineer- in-charge or the representative shall have free access to such store at all times.
- (f) The contractor shall further at all times satisfy the Engineer-in-charge on demand by production of records and test books or by submission of returns and other proofs as directed that the cement is being used as tested and approved by the Engineer-in- charge for the purpose and the contractor shall at all times, keeps his record upto date and enable the Engineer – in – charge to apply such checks as he may desire.
- (g) Cement which has been unduly long in storage with the contractor or alternatively has deteriorated due to inadequate storage and thus become unfit for use on the works will be rejected by the Department and no claim will be entertained. The contractor shall forth with remove from the work area any cement the Engineer – in – charge may disallow for use of work and replace it by cement complying with the relevant Indian standards.

STEEL

The contractor shall provide mild steel (MS) reinforcement basis, High Yield strength deformed (HYSD) bars, rods and structural steel etc., required for the works, only from the main and secondary producers manufacturing steel or other authorized agents to the prescribed specifications. Bureau of Indian standards requirements and licensed to affixing ISI set certificate issued by the Government approval laboratory certification are to be produced to Engineer-in - charge before use on works.

The Diameters and weight of steel should be as follows:-

	Rod	Sectional Weight in kg per running meter
	rs	-
	rs	-
	rs	-
	rs	0.89

	ers	0.21
	ers	1.58
	ers	2.09
	ers	2.47
	ers	2.98
	ers	3.85
	ers	4.83
	ers	6.35
	ers	4.03
	ers	6.31
	ers	6.71
	ers	7.99
	ers	8.06
	ers	10.88

Note: - If any rods other than those specified above are used the weight shall be as per standard steel tables.

Providing 24 x 7 water supply to ABD area
with smart water meters and SCADA

**SPECIFICATIONS FOR
INSTRUMENTATION, AUTOMATION AND SCADA
FOR**

**Providing 24 x 7 water supply to ABD area
with water meters and SCADA system**

PART B

Volume – II

LIST OF ABBREVIATIONS

AI	:	Analogue Input
AO	:	Analogue Output
CPU	:	Central Processing Unit
DI	:	Digital Input
DO	:	Digital Output
GPRS	:	General Packet Radio Service
GSM	:	Global System for Mobile Communication
HMI	:	Human Machine Interface
I/O	:	Input / Output
ICP	:	Instrument Control Panel
LCC	:	Local Control Centre
LPU	:	Lightning Protection Unit
mA	:	milli Amp.
MB	:	Mega Byte
MCC/MCS	:	Master Control Center/Station
MHz	:	Mega Hertz
OHT	:	Over Head Tank
PC	:	Personal Computer
PF	:	Power Factor
PLC	:	Programmable Logic Controller
RTU	:	Remote Terminal Unit
SCADA	:	Supervisory Control and Data Acquisition
SMS	:	Short Message Service
UHF	:	Ultra High Frequency
UPS	:	Uninterruptible Power Supply
V SAT	:	Very Small Aperture Terminal
VDU	:	Visual Display Unit
VHF	:	Very High Frequency

INSTRUMENTATION, CONTROL AND SCADA SYSTEM

I. INSTRUMENTATION

1.0 DESIGN REQUIREMENTS

General:

- (a) Instrumentation and Control system shall be designed, manufactured, installed and tested to ensure high standards of operational reliability. Instruments mounted in field and on panels shall be suitable for continuous operation. All electronic components shall be adequately rated and circuits shall be designed so that change of component characteristics shall not affect plant operation.
- (b) All the equipment shall be new, of proven design, reputed make, and shall be suitable for continuous operation. Unless otherwise specified, all instruments shall be tropicalised. The outdoor equipment shall be designed to withstand tropical rain. Wherever necessary space heaters, dust and water proof cabinets shall be provided. Instruments offered shall be complete with all the necessary, mounting accessories.
- (c) Electronic instruments shall utilise solid state electronic components, integrated circuits, microprocessors, etc., and shall be of proven design.
- (d) No custom made hybrid type ICs [Integrated Circuits] shall be used in any circuit in Instrumentation and SCADA equipment.
- (e) All field instruments such as DP, level, pressure transmitter shall have capability of digital communication with control room instrument such as HART, Foundation Fieldbus, Profibus etc. It shall be possible to calibrate field instrument remotely using a suitable calibrator. Contractor shall supply such calibrator with the system. All analytical instruments shall have RS485 port for connectivity with control room. Electric actuators shall have RS485 port for communication. Contractor may use 4-20 mA signal for connecting field instruments with control room, however digital communication capability is a must & shall be used as much as possible. All field instruments shall have local indication.
- (f) Unless otherwise stated, overall accuracy of all measurement systems shall be $\pm 1\%$ of measured value and repeatability shall be $\pm 0.5\%$.
- (g) Unless otherwise specified, the normal working range of all indicating instruments shall be between 30% and 80% of the full scale range.
- (h) After a power failure, when power supply resumes, the instruments and associated equipment shall start working automatically.
- (i) The instruments shall be designed to permit maximum interchangeability of parts and ease of access during inspection and maintenance.
- (j) The field instruments i.e. the instruments mounted outside the control panel shall be mounted at a convenient height of approximately 1.2 meters above grade platform.
- (k) Unless otherwise stated, field mounted electrical and electronic instruments shall be weatherproof to minimum degree of weather proof protection of IP 65.

- (l) The instruments shall be designed to work at the ambient conditions of temperature, humidity, and chlorine contamination that may prevail. The instruments shall be given enough protection against corrosion.
- (m) Lockable enclosure shall be provided for all the field mounted instruments.
- (n) All field instruments, and cabinets/panel mounted instruments shall have tag plates/name plates permanently attached to them.
- (o) The performance of all instruments shall be unaffected for the specified power supply system voltage and frequency variation.
- (p) All wetted parts of sensors shall be made out of non-corrosive material capable of working with chlorine content of 5 ppm.
- (q) For all instruments installed in the field, lightning protection units (LPU) shall be provided at both ends of the connecting cables (signal and power) for the protection against static discharges/lightning and electromagnetic interference.
- (r) Individual pair screened, overall screened armoured cables shall be used for analog signal transmission. Armoured, unscreened cable shall be used for power supply to instruments mounted outside the control panel.
- (s) Unless otherwise specified, double compression glands shall be used for glanding the cable in field instruments and instrument control panel.
- (t) Two wire transmitters shall be provided with on-line test terminals.
- (u) All instruments of the same type shall be of the same make in order to reduce inventory, facility of swapping and training for O&M.
- (v) All transmitters and indicators shall be provided with RS-485 type communication port.

2.0 Reference Standards

Unless otherwise approved, instrumentation shall comply with relevant quality standards test procedures and codes of practice collectively referred to as Reference Standards including those listed below in accordance with the requirements detailed elsewhere in this specification.

BS 89-2:1990, EN 60051-2:1989, IEC 60051-2:1984	Direct acting indicating analogue electrical measuring Instruments and their accessories.
BS 1042 (Various)	Measurement of fluid flow in closed conduits.
BS 1646-1:1979, ISO 3511/I-1977	Symbolic representation for process measurement control Functions and instrumentation. Basic requirements
BS EN 837-1:1998	Pressure gauges. Bourdon tube pressure gauges. Dimensions, metrology, requirements and testing
BS EN 60751:1996, IEC 60751:1983	Industrial platinum resistance thermometer sensors
BS 3680 (Various)	Measurement of liquid flow in open channels.
BS 3693:1992	Recommendations for design of scales and indexes on analogue indicating instruments
BS EN 60770-1:1999, IEC 60770-1:1999	Transmitters for use in industrial-process control systems. Methods for performance evaluation
BS 4675-2:1978, ISO 2954-1975	Mechanical vibration in rotating machinery. Requirements for instruments for measuring vibration severity
BS EN 60584-1:1996, IEC	Thermocouples. Reference tables

60584-1:1995	
BS 5308 (Various)	Instrumentation cables
BS EN 60529:1992	Specification for degrees of protection provided by enclosures (IP code)
BS ISO 11631:1998	Measurement of fluid flow. Methods of specifying flowmeter performance
BS 5863-1:1984, IEC 60381-1:1982	Analogue signals for process control systems. Specification for direct current signals
BS 5863-2:1980, IEC 60381-2:1978	Analogue signals for process control systems. Specification for direct voltage signals
BS EN 60654-1:1993, IEC 60654-1:1993	Industrial-process measurement and control equipment. Operating conditions. Climatic conditions
BS 6739:1986	Code of practice for instrumentation in process control systems: installation design and practice
BS EN 60073:2002	Basic and safety principles for man-machine interface, marking and identification. Coding principles for indicators and actuators
BS 1553 (Various)	Specification for graphical symbols for general engineering
ISA-5.1-2009	Instrumentation Symbols and Identification
ISA-5.4-1991	Instrument Loop Diagrams
ANSI/ISA-7.0.01-1996	Quality Standard for Instrument Air
ANSI/ISA-18.1-1979 -(R1992)	Annunciator Sequences and Specifications
ISA-26-1968	Dynamic Response Testing of Process Control Instrumentation
ISA-37.1-1975 - (R1982)	Electrical Transducer Nomenclature and Terminology
ISA-37.3-1982 - (R1995)	Specifications and Tests for Strain Gage Pressure Transducers
ANSI/ISA-50.00.01-1975 (R2002)	Compatibility of Analog Signals for Electronic Industrial Process Instruments
ANSI/ISA-51.1-1979 - (R1993)	Process Instrumentation Terminology
ISO 9000 and 09004	Quality Systems
IEEE 60587	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
IEC-8705101	Modbus Protocol Conversion

IEEE 472-1974	Surge protection.
NEMA	National Electrical Manufacturers Association

3.0 FLOW MEASURING SYSTEM

General

Flow measuring system shall consist of flow sensor / transducers, flow integrator and flow transmitter, digital flow indicator and integrator and any other item required to complete the system.

Flow transducers shall be rugged in construction and shall be suitable for continuous operation. Flow transducers shall have waterproof construction and shall be suitable for installation on underground / above ground pipe lines.

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 sensor shall be provided, as required by the flow meter manufacturer. Contractor shall finalize the exact location of flow transducers in consultation with Project Manager.

The flow transmitter shall be suitable for field mounting and shall accept input from the flow transducer. It shall process the input signal and provide 4-20 mA DC output proportional to flow rate. Flow transmitter shall have LCD display to indicate instantaneous flow rate. The flow range shall be adjustable. The flow meters shall be suitable for measuring flow at velocities of water from 0 to 3 m/sec.

The flow computer shall be microprocessor based and shall have self-diagnosis facilities.

Volumetric Testing of the meters must be performed and approved prior to shipment. The complete meter assembly and signal converter must be wet accuracy tested and calibrated as a unit near minimum, intermediate, and maximum specified flow ranges of the meter (full range of flow).

The overall uncertainty of the calibration rig shall be at least three times better than the uncertainty of the full bore electromagnetic flow meter.

The competent government authority such as FCR/NABL must certify the test facility. All the meters shall be calibrated for a minimum of 3 points.

The manufacturer shall have an ISO 9001 certification. The magnetic flow meter shall perform within the required accuracy of measured value without being affected by change in pressure due to demand fluctuation.

Supplier shall have a in-house calibration facility and shall give calibration certificate for all the flow meters. The flow meter shall have grounding rings or electrode. Calibration of each meter shall be tested at in house facility of manufacturer for the sizes for which manufacturer has this facility. The test bench of such manufacturer shall be certified by a reputed government organization like FCRI or NABL.

If manufacturer has no in house facility for calibration then each meter shall be tested from FCRI. Wet calibration of all the flowmeters shall be witnessed by the purchaser or it's nominated inspection agency at FCRI Palghat, in case the supplier / manufacturer does not have the testing facility.

Supplier must have test facilities, spare parts, and personnel to maintain, instruct, train or whatever is necessary to assure that meters shall be maintained throughout the guarantee / maintenance contract period.

3.1 Electromagnetic Flow Meter (Full Bore)

General

The Electromagnetic Flow Meters shall be installed in RCC chambers / open pits or buried for indication of flow rate and total consumption of water in a transmission or distribution pipe work of water supply system.

The Electromagnetic Flow Meters shall withstand maximum working temperature of about 60°C and working pressure of 10 kg/cm² (1.0 Mpa), unless specified otherwise.

Electromagnetic Flow Meter

Full bore electromagnetic flow meters shall be designed, manufactured and calibrated to ISO standard.

General Specification

Electromagnetic Flow Meter shall be a velocity sensing electromagnetic type, microprocessor based signal converter, sealed housing, flanged tube meter for 1.0 Mpa working pressure. The meter shall be manufactured to highest standard available for mag-meters. The meter shall be equipped with minimum six digit digital totalizers, reading in units of kiloliters and shall be accurate within 0.5% of actual flow rate. The accuracy shall be inclusive of linearity, hysteresis, repeatability, temperature and pressure effects. The meter assembly shall operate within a range of 0.3 m/sec to 4 m/sec and be constructed as follows:

Meter Tube (Sensor) shall be fabricated from stainless steel tube and use class PN 10 flat face carbon steel flanges in accordance with IS 1538 or BS equivalent. The internal and external of the meter tube shall be blasted to near white and lined with P.U.

Meter tube shall have a constant nominal inside diameter offering no obstruction to the flow.

Signal Converter shall be pulsed DC coil excitation type with auto zeroing. The signal converter shall be remotely mounted away from the meter.

The converter shall indicate direction of flow and provide a flow rate indication and a total of flow volume for both forward and reverse directions.

The converter shall provide an isolated 4-20 mA output into minimum 600 ohm load and a frequency output of a maximum of 0-10 KHZ and a scaled pulse output.

The microprocessor based signal converter shall have a self-diagnostic test mode and backlit display that continuously displays 'Rate of Flow' and 'Total Volume'.

The converter shall be compatible with Microsoft Windows and other software programs with built in terminal communication capabilities of RS 485, HART or other protocols for interface.

The converter shall be remotely mounted maximum upto 200 m from the sensor, and shall be supplied with all calibration complete for desired requirements.

Converter shall be supplied with a programmable low flow drop out and empty pipe zero return. The signal converter housing should be die-cast aluminum with glass window.

The converter cum transmitter shall be fully programmable from the front facia.

The programming shall be user friendly, self-prompting menu driven.

The length of the sensor shall be strictly as per ISO upto DN 400 mm. Only, one manufacturer shall make all meter size and styles required for this contract.

Electromagnetic flowmeter above 300 mm ϕ shall be supplied and installed alongwith suitable flange adaptor.

Technical Specification

- A. Process Liquid
- a. Liquid Type : Potable water / raw water
- B. Operating Condition
- a. Operating pressure : As per flange rating
 - b. Operating temperature : 0°C to 50°C
- C. Flow Sensor
- a. Type : Pulsed DC excitation
 - b. System : Separate with cable output
 - c. Power supply : 230 V AC, 50 Hz
 - d. End connections : Flanges of Carbon Steel
 - e. Flange Rating :
 - PN 40 – from Size 25 mm to size 80 mm
 - PN 16 – from size 100 mm to size 150 mm
 - PN 10 – from size 200 mm to size 400 mm
 - f. Electrode material : SS 316 (Stainless steel) / Platinum / Tantalum
 - g. Meter tube : SS 304 (Stainless steel)
 - h. Electrode type : Self cleaning type
 - i. Lining material : P. U. (Poly Urethane)/EPDM
 - j. Protection category : IP 68
 - k. Measuring accuracy : Measuring accuracy
+ / - 0.5% of measured value inclusive of linearity, repeatability, pressure effect and hysteresis between 0.5 – 4 m/s velocity
 - l. Connection / Junction Box : SS 304
 - m. Earthing : Grounding Rings in SS 304 / or electrode
 - n. Fluid conductivity : > 20 μ Siemens / cm

o. Marking : Direction of flow with arrow, size, Sr. No., make

D. Flow Transmitter / Converter

a. Type : Microprocessor based, Modular Design, remote mounting

b. Display language : English

c. Ambient temperature : -2°C to +60°C

d. Display : Min 2 line back lit LCD for indication of actual flow rate, forward, reverse, sum totalizers

e. Outputs : One scaleable pulse output
One status output

f. Protection Category : IP 67

g. Enclosure : Die Cast Aluminum with polyurethane finish with glass window

h. Programming : Through key / keypad on front facia / optical touch key

i. Power Supply : 230 V AC, 50 Hz

j. Cable Gland : 1/2" NPTF (4 glands of double compression type)

k. Mounting : Wall mounted / Panel mounted

l. Interface : RS 485, based on EIA R 422/485 standard, or HART

m. Power failure mode : Provision of RAM / PROM to store parameter entered and measured flow data during power failure

n. Max. Separation : Upto 200 mtrs between sensor and transmitters

o. Terminals : Shock – Hazard – protected push lock terminals

p. Interchangeability : Fully interchangeable with all sizes of flow sensors

q. Safety classification : General purpose certification

r. Flow Indicator Totalizes : Internal, 5mm high, LED display with 8 digit LCD /

electromechanical totalizes

- s. Backup power : For 6 hours
- t. Password protection : Required
- u. Cable : Required
- v. Lightning protection : Required

4.0 LEVEL MEASURING SYSTEM

4.1 Ultrasonic Level Measuring System

(a) Ultrasonic type level measuring system shall comprise of a sensor/transducer, indicating transmitter, prefabricated integral cables connecting the sensor & transmitter, panel mounted digital level indicator and any other item required to complete the level measuring system.

(b) The level sensor/transducer shall be suitable for flange or bracket mounting as required and shall be weatherproof to IP 65 of IS 13947. It shall have ambient temperature compensation and adjustable datum setting facilities.

(c) The level transmitter shall be suitable for field mounting and shall be weatherproof to IP 65 of IS 13947.

(d) The design and application of the level measuring system shall take into account the reservoir construction, the material, size, shape, environment, process fluid or material, the presence of foam, granules etc.

(e) The installation shall avoid any degradation of instrument performance due to spurious reflections, absorption, sound velocity variations, sensor detection area, temperature fluctuations, specific gravity changes and condensation. Facilities shall be provided for rejection of spurious reflection.

(f) To remove the effect of water turbulence in the reservoir, averaging facility shall be provided in the transmitter unit.

(g) A cover shall be provided to protect the level sensor and lockable enclosure shall be provided for the level transmitter.

(h) The structure and the associated material required for supporting the level sensor shall be in the Contractor's scope.

(i) The transmitter shall be microprocessor based and shall use digital signal processing technique for signal conditioning. Possible to calibrate through universal HART calibrator for HART based transmitter.

(j) The transmitter shall have facilities for storing the echo profile, manipulation of the echo profile to remove noise, multiple profile averaging etc. as required.

4.1.1 Technical Particulars

- a) General:
 - Range : As per site requirement
 - Overall accuracy of measurement loop : $\pm 0.5\%$ of span or better

	Installation hardware and accessories	:	Required
b)	Level Sensor:		
	Type	:	Ultrasonic
	Sensor material	:	Non-corrosive
	Weather protection class	:	IP-65 as IS 13947
	Temperature compensation	:	Required
c)	Level Transmitter:		
	Type	:	Microprocessor based with backlit LCD/LED display
	Mounting	:	Wall/panel
	Programming facility with programmer	:	Required
	Input	:	From level sensor
	Output	:	4-20 mA DC isolated proportional to level
			Relay output for loss of echo alarm
	On line diagnostic facility	:	Required
	Facility to suppress echo from interfering structures	:	Required
	Facility for' averaging/dampening the readings due to water turbulence	:	Required
	Weather protection class	:	IP-65 as per IS 13947
	Accuracy	:	± 0.25% of span or better.
d)	Digital Level Indicator:		
	Type	:	Microprocessor based.
	Mounting	:	Front facia of Instrument Control Panel(ICP)
	Display	:	Back-lit LCD or LED
	Digit height	:	12.5 mm or higher
	No. of digits	:	4

Input	:	4-20 mA DC (isolated)
Zero & Span adjustment	:	Required
Engineering units for display	:	m
Weather protection class	:	IP-52 of IS 13947
Retransmission output	:	4-20 mA proportional to level.
Relay outputs	:	Required 2NO+2NC for high level alarm and 2NO+2NC for low level alarm
Communication port	:	RS-485 (With Modbus protocol) / HART
Accuracy	:	± 0.2% of span or better

Notes:

1. Digital level indicator shall provide 24 VDC / 48 VDC power supply to the level transmitter in case the transmitter is two wire system.
2. The contact rating of the relay outputs shall be 2A, 48VDC

4.2 Conductivity Type Level Switch

- (a) Level switches operating on the conductivity principle shall be provided with minimum three electrodes (two sensing and one reference) and level controller. More number of electrodes maybe provided as required. The electrodes shall be of stainless steel The electrodes shall be rod type for length upto three meters and maybe rope type for lengths above three meters. Perforated stilling pipes shall be provided to avoid effects of turbulence on measurement.
- (b) The electrodes shall be insulated such that only the tip of each electrode is exposed to the water at the operating level. Spacers shall be provided between electrodes at regular intervals. Electrodes shall be provided longer than necessary and cut-back at site if precise lengths cannot be established at time of order.
- (c) The level controller shall have adjustable sensitivity and shall be suitable for field mounting. The level controller shall be provided in an enclosure conforming to IP 65 of IS 13947.

4.2.1 Technical Particulars

a) General

Installation hardware and accessories : Required

b) Level probe

- Type :
- Rod type for probe lengths up to 3 metre.
 - Rope type for probe lengths above 3

metre.

Process connection flange material	:	SS 316.
Flange rating	:	ANSI B16.5,150 lb.
Probe material	:	SS 316.
Probe head material	:	Die cast aluminium
Probe insulation	:	Teflon.
Counter weight with rope type probe to keep it straight	:	Required.
Spacers between the probe to avoid entangling with each other	:	Required.
No. of electrodes	:	(Reference probe, probes for high high level, and low low level detection).
Weather protection class	:	IP-65 as per IS 13947

c) Level Controller

Mounting	:	Wall/panel
Weather protection class	:	IP-65 as per IS 13947
Alarm contacts	:	2NO+2NC per level
Contact rating	:	2A, 48 VDC
Material of enclosure	:	Die cast aluminium
Sensitivity adjustment	:	Required
Repeatability	:	± 1.0.% or better

5.0 PRESSURE MEASURING SYSTEM

5.1 Pressure Gauges

a) Pressure gauges and vacuum gauges shall comply with IS 3624 / BS 1780. Glycerine filled dial shall be provided where the gauge is subjected to pressure pulsation and / or vibrations. The internal parts of pressure gauge shall be stainless steel.

b) Pressure gauges shall be provided on discharge and on suction of each pump. Pressure gauges shall be bourdon type and calibrated for the required range. The gauge shall be supplied complete with impulse tubing, two valve manifold with drain cock, fittings etc.

c) The minimum diameter for pressure gauges shall be 150 mm. However, where the pressure gauge forms part of equipment, the equipment manufacturer's standard sizes will be acceptable.

i)	Accuracy	± 1% of full scale
ii)	Dial size	150 mm
iii)	Glass	Shatterproof
iv)	Measuring Range	As per Process Requirement
v)	Over range Protection	125% of maximum pressure
vi)	Housing Material	Die Cast Aluminium
vii)	Material of sensor and other wetted parts	SS 316
viii)	Accessories	2-valve manifold with drain cock, impulse tubing, snubbers and all installation hardware

5.2 Pressure Transmitter

a) Pressure measurement system shall consist of pressure transmitter to be installed close to the water transfer line and connected by impulse pipe. The output signal of the pressure transmitter shall be connected to panel mounted Digital Pressure Indicator.

b) The Contractors scope of work shall consist of supply, installation and demonstration of functioning of the pressure measuring systems after installation. The hardware required for Installation is in the Contractors scope.

c) The pressure measurement system shall be designed for continuous operation and capable of operating in the range of line pressures. The pressure transmitter shall be suitable for field mounting.

d) The pressure transmitter shall be of the diaphragm type. It shall be provided complete with isolation valve, impulse tube and two valve manifold.

1.	General	
i)	Service	Pump discharge
ii)	Accuracy of measuring loop	± 0.5% of reading or better
2.	Pressure Transmitter	
i)	Sensor	Diaphragm Sensor

ii)	Material of sensing diaphragm and other wetted parts	SS 316
iii)	Range adjustment	Adjustable over full span
iv)	Zero and span adjustment	Required
v)	Output	4-20mA, DC, 2 wire system and digital output with RS 232/ RS 485 communication interface.
vi)	Enclosure Protection	IP 68
vii)	Enclosure material	Die cast aluminium
viii)	Accessories	Isolation valves, Impulse tubing and all installation hardware
ix)	Over range protection	2 times the full range
3. Panel Mounted Digital Pressure Indicator		
i)	Type	Microprocessor based
ii)	Display	Digital, back-lit LCD/ LED display
iii)	Digit Height	14 mm or higher
iv)	No. of Digits (Minimum)	3 1/2
v)	Input	4-20 mA DC (Isolated) from pressure transmitter
vi)	Zero & Span Adjustment	Required
vii)	Engineering Units for pressure	Meters of water column (Programmable)
viii)	Enclosure material	Non corrosive
ix)	Enclosure Protection	IP-52
x)	Accuracy	±0.25% of span
xi)	Retransmission output	4-20 mA proportional to pressure
xii)	Alarm outputs Mounting	For high and low pressure alarms On control panel front facia
xiii)		

The data logger shall be battery powered with SMS/GPRS telemetry. It shall be suitable for flow/pressure in distribution. It shall utilize the latest advances in GPRS technology to provide rapid transmission at low cost, enabling data to be retrieved more frequently for analysis and responses.

The data shall be transmitted to a customer specific FTP site or modem or web based portal from which it can be viewed on any internet enabled device. Data shall also be downloaded locally via a convenient Infra-Red interface.

- It shall have facility of remote programming
- It shall have minimum two channels with one integral sensor for pressure measurement preferably based on strain gauge/piezo resistive principle
- It shall have replaceable internal batteries which shall power for five years minimum when data is transmitted every eight hours minimum
- It shall have internal pressure transducer with accuracy of 0.1%
- The memory can be programmed to read continuously or for a specific period of time
- It shall be compatible to third party SCADA Software

6.0 LIGHTNING PROTECTION UNIT (LPU)

Two numbers of lightning protection units shall be provided for each signal loop. Similarly two numbers of lightning protection units shall be provided for the instrument power supply. The lightning protection unit shall be suitable for withstanding the surge arising out of high energy static discharge/lightning strikes and prevent the instrument from any damage. LPU shall provide three stages of protection through a gas discharge tube, quick acting semiconductor like Tranzorb, zener diodes, varistors and an automatic disconnect and reset circuit. LPU shall be a passive unit and shall require no power for its operation. During a lightning strike it shall clamp on the allowable voltage and pass the excess voltage to the ground. LPU shall be of self-resetting type to minimize the down time of the measurement loop. LPU shall have a weather proof casing and shall be suitable for field/back of panel mounting. There should be total isolation between input, output and ground terminals. The earth terminal(s) of the LPU shall be connected to the panel earth.

6.1 Technical Particulars

Nominal voltage	:	12-110 VAC / VDC
Maximum operating voltage	:	26VDC
Operating current	:	25mA
Nominal discharge current	:	10KA
O/P voltage threshold with 1KV / micro second	:	<1.6 u _{max} / <=100ns.
Temperature range	:	0-50°C

7.0 DIGITAL FLOW INDICATOR CUM FLOW INTEGRATOR

Digital flow indicator cum flow integrators shall be modular in design. It shall consist of two separate dedicated displays for flow rate indication and total flow indication. It shall accept 4-20 mA DC isolated input. The flow integration shall be carried out in the Programmable Logic Controller (PLC). The flow indicator cum flow integrator shall provide 4-20 mA retransmission output proportional to flowrate. It shall have RS 485 communication port for connectivity to PLC. Battery shall be provided for retaining reading in the memory of integrator in case of supply failure, Battery backup period shall be 3 hours.

7.1 Technical Particulars

Type	:	Electronic (Combined unit)
Mounting	:	Front facia of Instrument Control Panel(ICP)
Display	:	Back-lit LCD or LED
Digit height	:	12.5 mm or higher
No. of digits for	-	
i. Flow rate indicator	:	4.
ii. Flow integrator	:	6.
Input	:	4-20 mA DC (isolated)
Zero and span adjustment	:	Required
Manual reset facility for flow integrator	:	Password protected
Engineering Units for Flow rate indicator	:	MLH
Flow integrator	:	ML
Power supply to transmitter	:	Required
Battery backup for integrator	:	Required
Retransmission output	:	4-20 mA proportional to flowrate
Alarm outputs	:	2NO+2NC for high and low alarms
Communication port	:	RS-485 (With Modbus protocol) for interfacing with PLC.
Weather protection class	:	IP-52 of IS 13947
Accuracy	:	± 0.25% of span or better

Notes:

1. The digital flow indicator and integrator shall be a combined unit.
2. The digital flow indicator and integrator shall provide 24 VDC/48 VDC power supply to the flow transmitter in case of two wire transmitters.
3. The contact rating of the relay outputs shall be 2A, 48VDC.

8.0 DIGITAL PANEL INDICATOR

Digital panel indicators shall be microprocessor based and modular in design. It shall accept 4-20 mA DC isolated input. The digital panel indicator shall provide an output of 4-20 mA DC proportional to input signal for retransmission. It shall have RS 485 communication port for connectivity to PLC.

8.1 Technical Particulars

Type	:	Microprocessor based.
Mounting	:	Front facia of Instrument Control Panel(ICP)
Display	:	Back-lit LCD or LED
Digit height	:	12.5 mm or higher
No. of digits	:	4
Input	:	4-20 mA DC (isolated)
Zero & Span adjustment	:	Required
Engineering units for display	:	As per site requirement
Weather protection class	:	IP-52 of IS 13947
Retransmission output	:	4-20 mA proportional to level.
Relay outputs	:	Required 2NO+2NC for high level alarm and 2NO+2NC for low level alarm
Communication port	:	RS-485 (With Modbus protocol)
Accuracy	:	± 0.2% of span or better

9.0 MULTI FUNCTION ENERGY METER (MFEM)

General

Quantity : 1 No. for each pump
 Purpose : Power and Energy Monitoring

It shall monitor voltage, current, kW, kVAR, kVA, power factor and frequency.

9.1 Technical Particulars

Intelligent Energy Meter Specifications

S. No.	Description	Specification
1.	Type	True RMS Microcontroller based design 4W/30 3W/30 Balance & unbalanced operation
2.	Accuracy class	1
3.	Suitable for	Multi parameter monitoring
4.	Panel Cut out size	92 x 92 mm
5.	Bezel Size	96 x 96 mm
6.	Display Size	16 x 1 LC display
7.	Key Pad	4 Functional keys to scroll through display pages for system values and programming parameter.
8.	Primary Memory Storage	256kb EEPROM
9.	Secondary Memory Storage	8MB Flash
10.	RTC	Time Stamped Data
11.	Auxiliary Supply	230 VAC +/- 20% to accommodate to Indian power conditions
12.	Voltage Input	415 V or 110 V AC (field configurable)
13.	Current Input	5A or 1A AC (field configurable)
14.	Load Range	120 % to 0.4% of rated CT primary
15.	Operating P.F.	ZERO LAG to UNITY to ZERO LEAD
16.	Communication Ports	Two Ports like: 1. RS485 2. R232
17.	Communication Protocols	MODBUS RTU or MODBUS ASCII
18.	Communication Port Isolation	Communication Port 1 should have 2500 VDC isolation for external device protection.
19.	Operating Temperature	0o to 60o C
20.	Storage Temperature	-20oC to +70o C

Energy meters shall be equipped with two communication ports with one port having full isolation.

10.0 Online Analytical Field Instruments

Online measuring Instruments for the measurement of water quality shall be selected from a range of proprietary manufactured items. They shall be selected to fulfil as many of the aforementioned instrumentation criteria as technically practical

Instrumentation shall be positioned in a covered location and shall receive its sample from a continuous fluid stream in order to obtain a representative sample of the fluid being monitored.

The Contractor shall provide all facilities necessary in order to obtain the samples. Where pumping is required in order to obtain a sample a single pump shall be provided except for raw water and combined filtrate where a duty / standby sampling pump arrangement shall be provided.

I. Online Residual Chlorine Analyzer

The Contractor shall provide on-line residual chlorine meters for measuring chlorine content.

- i) Residual chlorine (RCl) measuring system shall consist of RCl transducer, RCl transmitter, digital RCl indicator and any other item required to complete the RCl measuring system.
- ii) RCl transducer shall be rugged in construction and shall be suitable for continuous operation. RCl transducer shall work on Amperometric Principle. It shall also consist of an integral pH sensor for compensating against pH changes and integral temperature sensor for compensating against temperature changes.
- iii) A sampling system consisting of sampling pump / pressure reducing valves, flow regulator, rotameter, filter assembly etc. shall be provided. The sample water will be connected to a cabinet containing RCl analyzer equipment and RCl transmitter.
- iv) The RCl sensor enclosure shall be of such a design that it contains some water even when sampling flow is cut off and shall be provided with flow regulating devices.
- v) The RCl transmitter output shall be suitable for transmitting over long distance.
- vi) Technical Particulars of on-line Residual Chlorine Measurement

1. General		
i)	Overall accuracy of measurement loop	± 5% of measured value
2. Residual Chlorine Sensor		
i)	Type	Amperometric
ii)	Automatic Temperature Compensation electrode	Required
iii)	Automatic pH compensation electrode	Required
iv)	Range	Adjustable over full span
v)	Sensitivity	0.1 mg/lit
vi)	Standard Cable Connecting sensor and Transmitter	Required

3. Residual Chlorine Transmitter		
i)	Type	Indicating type having back-lit LCD/LED display
ii)	Mounting	Field
iii)	Input	From Residual chlorine sensor
iv)	Output	4-20 mA (isolated)
v)	Zero and Span Adjustment	Required
vi)	Enclosure material	Non corrosive
vii)	Enclosure Protection	IP-65
viii)	Range	Adjustable 0 to 5 ppm, 0 to 50 ppm.

II. On Line Turbidity Measuring System

- a) Turbidity measuring system shall consist of turbidity detector assembly, turbidity transmitter, digital turbidity indicator, and any other item required to complete the turbidity measuring system.

1. General	
Overall accuracy of measurement loop	±2%
2. Turbidity Sensor	
Type	Optical sensor
Material For Wetted Parts	Non corrosive
Cleaning Facility	Required
Bubble Trap	Required
Measuring Principle	Ratio-metric
Color Compensation	Required
Range setting	Selectable
Calibration Standard	Required, Standard Formazine solution or Glass cube.
Accessories Standard cable for connecting sensor and transmitter	Required
Standard Glass cube or formazine solution for calibration	Required
3. Turbidity Transmitter	
Type	Indicating with back-lit LCD /LED display
Mounting	Field

Input	From Turbidity sensor
Output	4-20 mA DC (Isolated)
Zero and Span Adjustment	Required
Enclosure material	Non corrosive
Enclosure Protection	IP-65 of IS 13947 Part I

- b) Turbidity detector shall operate on Nephelometric measurement principle. Turbidity detector shall have ratiometric measurement system and shall be suitable for insertion / flow through type mounting. It shall be possible to calibrate the turbidity meter at site, with a formazine standard or a glass cube.
- c) Turbidity detector shall be rugged in construction and shall be suitable for continuous operation. It shall have an integral bubble trap arrangement.
- d) Turbidity transmitter output shall be isolated and shall be suitable for transmitting over long distances.
- e) A sampling system consisting of sampling pump / pressure reducing valves, flow regulator, rotameter, filter assembly etc. shall be provided. The sample water will be connected to a cabinet containing Turbidity analyzer equipment and turbidity transmitter.

III. On-Line pH Measuring System

- a) The pH measuring system shall consist of a pH electrode, pH transmitter, digital pH indicator, electrode holder assembly and any other item required to complete the pH measuring system.
- b) The pH transducer shall be rugged in construction and shall be suitable for continuous operation. pH transducer shall include measuring electrode, reference electrode, and a temperature compensator electrode. All wetted parts of the transducers shall be of non-corrosive material.
- c) The pH transmitter output shall be isolated, and shall be suitable for transmitting over long distances.
- d) The electrode holder assembly shall be of such a design that it contains some water even when sampling pump is cut off and shall be provided with flow regulating device.
- e) A sampling system consisting of sampling pump / pressure reducing valves, flow regulator, rotameter, filter assembly etc. shall be provided. The sample water will be connected to a cabinet containing pH analyzer equipment and pH transmitter.

i)	General	
a)	Overall accuracy of measurement loop	±1% of measured value
b)	Standard pH solutions for onsite calibration	For pH 4,7 and 10 shall be provided
ii)	pH Sensor	
a)	Type	Encapsulated combined electrode
b)	Mounting	On flow through assembly
c)	Automatic temperature compensation	Required

d)	Standard cable for connecting sensor and transmitter	Required
iii)	pH Transmitter	
a)	Type	Indicating type with Back-lit LCD / LCD display
b)	Mounting	Field
c)	Input	From pH electrodes and temperature compensator
d)	Zero and span Adjustment	Required
e)	Enclosure material	Non corrosive
f)	Enclosure Protection	IP-65 of IS 13947 Part I
g)	Output	4 to 20 mA(Isolated) for connecting to pH indicator
iv)	Digital pH Indicator	: Required

11.0 CONTROL PANEL

11.1 Enclosure

- (a) Control Panels shall be machine prefabricated out of CRCA sheet steel of thickness not less than 2 mm, modular in construction, properly reinforced, powder coated and having rigid frame structure. Internal mounting plate including the gland plate shall be 3 mm thick. The control panel shall have dimensions as per system requirement. However, the height of the control panel shall not exceed 2200 mm.
- (b) Control panel shall be installed in a cabin/room for which requirements are given elsewhere in this specification.
- (c) The exterior corners and edges shall be rounded to give a smooth overall appearance with projections kept to a minimum.
- (d) Lifting lugs shall be provided for installation purposes and shall be replaced with corrosion resistant bolts after installation.
- (e) The Control panel shall be completely metal enclosed and shall be dust, moisture and vermin proof. Panel enclosures shall provide a degree of protection not less than **IP 52** in accordance with IS 13947.
- (f) The Control panel shall be free standing type as specified. There shall be sufficient reinforcement to provide level surfaces, resistance to vibrations and rigidity during transportation and installation.
- (g) Metal sills in the form of metal channels properly drilled shall be furnished along with anchor bolts and necessary hardware for mounting the Control panel. These shall be dispatched in advance so that they may be installed and leveled when concrete foundations are poured.
- (h) Cable entries to the panels shall be from the bottom with fire retardant spray compound sealing. The Control panel shall be provided with louvers along with SS wire mesh.

11.2 Mounting

- (a) All equipment on front of panel shall be mounted flush or semi-flush. In case of semi-flush mounting, only flange or bezel shall be visible from the front.

- (b) Equipment shall be mounted such that removal and replacement can be accomplished individually without interruption of service to adjacent equipment.
- (c) Equipment mounted inside the panel shall be so located that terminals and adjacent devices are readily accessible without the use of special tools. Terminal markings shall be clearly visible.
- (d) Cut-outs and wiring for free issue items, if any, shall be according to corresponding equipment manufacturer's drawing. Cut-outs, if any, provided for future mounting of equipment shall be properly blanked-off.
- (e) Wherever required, panels/desks shall be matched with other panels/desks in the control room in respect of dimensions, color, appearance and arrangement of equipment on the front.

11.3 Earthing for Instruments

- (a) The panel shall be equipped with a instrument earth bus securely fixed along the inside base of panel.
- (b) All metallic cases of relays, instruments and other panel mounted equipment shall be connected to the panel earth and cable shields shall be connected to the instrument earth.
- (c) Looping of earth connections, which would result in loss of earth connection to other devices when the loop is broken, shall not be permitted. However, looping of earth connections between equipment to create alternative paths to earth bus shall be provided.
- (d) The earth for instrumentation shall be separate from electrical station earth.

11.4 Frame Earthing

All metal parts other than those forming part of an electrical circuit shall be connected to a copper earth bar run along the inside bottom of the panel. The minimum section of the earth bar shall be 25 mm x 3 mm. A 15 mm diameter hole is to be provided at each end of the bar. Connection of the earth bar to the station earth shall be carried out by Contractor.

11.5 Space Heater

Strip type space heaters of adequate capacity shall be provided inside control panels to prevent moisture condensation on the wiring and panel mounted equipment when the panel is not in operation. The heaters shall operate on 230 V AC. Heaters inside the panels shall not be mounted close to the wiring or any panel mounted equipment. Heaters shall be complete with either miniature circuit breakers or with isolating switches, HRC fuse on phase and link on the neutral of the heater supply. The operation of heaters shall be controlled by thermostats.

11.6 Interior Lighting and Receptacles

- (a) Each panel shall be provided with a fluorescent lighting fixture rated for 20 watt, 230 V AC, 50 Hz supply for the interior illumination of the panel during maintenance.
- (b) Each panel shall be provided with 230 V AC, 50 Hz, combined 5 amps and 15 amps, 3 pin receptacle with a switch and neon indication. The receptacle with switch shall be mounted inside the panel at a convenient location.

11.7 Voltage Level and Power Supply Units

Voltage levels for control schemes and power supply for instruments in the panels, shall be limited to 48 VDC. In case the instruments require power supply other than 48 VDC, contractor shall provide necessary

transformers, converters, inverters and other associated hardware required to generate the requisite power supply. Critical hardware such as converters and inverters shall be in redundant configuration. The power supply distribution board for panel mounted and field mounted instruments shall be provided inside the Control panel. Power supply to all the instruments mounted outside the control panel shall be provided from the power supply units in the control panel. 48 VDC for the control panel shall be made available from the 48 V DCDB. Similarly AC power supply for internal lighting, receptacles, space heaters, etc. shall be made available from the ACDB.

11.8 Labels

(a) All the equipment mounted on the front facia of the Control panel as well as equipment mounted inside the panels shall be provided with individual labels with equipment designation & tag no. engraved. The labels shall be mounted directly below the respective equipment. Also the panel shall be provided at the top with a label engraved with panel designation.

(b) All the instruments and equipment mounted on the front facia shall be also provided at the rear with individual labels, engraved with tag numbers corresponding to the ones shown in the panel internal wiring to facilitate easy tracing of the wiring. These labels shall be mounted adjacent to the respective equipment and shall not be hidden by the equipment wiring.

11.9 Switches and Miniature Circuit Breakers (MCBs)

Each Control panel shall be provided with necessary arrangement for receiving, distributing, isolating and protecting of DC and AC supplies for various control, signaling, lighting and space heater circuits. The incoming circuits and sub circuits shall be separately provided with two pole Miniature Circuit Breakers (MCBs) with NO+NC contact for trip monitoring. Potential circuits for relaying and metering also shall be protected by MCBs.

11.10 ICP Internal Wiring

(a) Connections within Control panel, between panel mounted devices and terminal blocks or between two panel mounted devices shall be made by 660 volt grade, stranded copper conductor PVC insulated. The wires shall be shielded, wherever necessary. Pre-fabricated cables with moulded multipin connectors shall be used.

(b) ICP shall be supplied completely wired internally and ready for external cable connections at the terminal blocks. The following color coding scheme shall be used.

i.	AC phase wire	:	White
ii.	AC neutral wire	:	Black
iii.	DC (+) wire	:	Red
iv.	DC (-) wire	:	Black
v.	Analog (+) wire	:	Blue (with '+' ferrule)
vi.	Analog (-) wire	:	Blue (with '-' ferrule)
vii.	Earth wire	:	Green

(c) Wires within the panel shall be continuous i.e. without splicing. Internal wiring or wiring between the two assemblies shall be commensurate with mechanical safety.

(d) Wire termination shall be made with solderless crimping type of tinned copper lugs which firmly grip the conductor and insulation. Yellow insulated sleeves shall be provided at all the wire terminations. Thermal engraved core identification ferrules, marked to corresponding with panel wiring diagram shall be fitted at both ends of each wire. Ferrules shall fit tightly on the wires and shall not fall off when the wire is disconnected from terminal blocks. All wires directly connected to trip circuit of breaker or device, shall be distinguished by the addition of a red sleeve.

(e) Relay modules with connection by multipin connector facility shall be provided.

11.11 Terminal Blocks

a) Terminal blocks shall be of the 650 V grade, stud type. Brass studs of at least 6 mm, dia. with fine threads shall be used and securely locked within the mounting base to prevent turning. Each terminal shall comprise two threaded studs, with a link between them, washers and matching nuts and lock nuts for each stud. Insulated barriers shall be provided between adjacent terminals. Not more than two wires shall be connected on anyone stud. Where duplication of terminal blocks is necessary, suitable solid bonding links shall be incorporated in the design of the terminal block. Provision shall be made to insert terminal labels or shrouds between two successive insulating barriers. Connections to the terminals shall be at the front. Box type terminals are also acceptable.

b) Terminals also shall be numbered for identification and grouped according to function, and engraved black-on-white labels shall be provided for the terminal blocks describing the function of the circuit.

c) Terminals for circuits with voltage exceeding 125 V shall be shrouded. Terminal blocks for termination of wires/cables of different voltage grades, control, extra low voltage and instrument signals shall be segregated into groups and distinctively labeled.

d) Current transformer secondary leads shall be brought to terminal blocks, where a facility shall be provided for short circuiting and grounding the secondary. Terminals with automatic dropping links shall be provided at such places.

e) At least 20% spare terminals shall be provided.

f) All spare contacts and terminals of the panel mounted equipment and devices shall be wired to terminal blocks.

g) There shall be a minimum clearance of 250 mm between the first row of terminal blocks and the associated cable gland plate. Also the clearance between two rows of terminal blocks shall be a minimum 250 mm.

h) Panel internal wiring shall not be looped directly from instrument to instrument. The same shall be looped through the panel terminal block only.

i) If accidental short circuiting of certain wires is likely to result in malfunction of equipment, such as closing or tripping of a breaker or positive and negative wires, these wires shall not be terminated on adjacent terminal blocks.

11.12 Cable Supports

All external cables shall present a neat appearance and shall be laid in cable raceways suitably braced, placed in troughing, clipped or laced to prevent effects of vibration.

11.13 Painting of Control Panel

(a) All sheet steel work shall be phosphated in accordance with the following procedure:

i. Oil, grease and dirt shall be thoroughly removed by emulsion cleaning.

ii. Rust and scale shall be removed by trickling with clean water followed by final rinsing with dilute dichromate solution.

iii. The control panel shall be powder coated. Thickness of coating shall be minimum 60 microns. QA test certificate shall be furnished for thickness adhesion and hardening of powder coating.

(b) The exterior paint colour of the panel shall be shade 631 of IS 5 and the interior paint colour shall be glossy white.

12.0 CABINETS FOR FIELD INSTRUMENTS

(a) A Cabinet shall be provided for enclosing instruments and associated accessories which are mounted outside the control panel such as transmitter, LPU, terminal blocks etc. at-all measurement locations.

(b) It shall be fabricated from cold rolled steel sheet of standard gauge with powder coating and shall be suitable for wall mounting or pedestal mounting as required.

(c) The cabinet shall conform to IP 65 protection and shall have built-in locking facility. The cabinet shall be properly earthed. Padlocks with duplicate keys shall be provided for the cabinets. A steel plate/pipe, as per the requirement, shall be provided in the cabinet for mounting the instrument and accessories.

(d) The exterior paint colour of the cabinets shall be shade 631 of IS 5 and the interior paint colour shall be glossy white.

13.0 CABLES

(a) Contractor shall include in his scope the supply, laying of cables and associated civil/mechanical work.

(b) Cables shall be capable of satisfactorily withstanding without damage, transportation to site, installation at site, and operation under normal and short circuit conditions of the various systems to which the respective cables are connected when operating under the climatic conditions prevailing at the site as indicated in this specification.

(c) Cable joints in instrument signals and power supply cables shall not be permitted.

(d) Cables shall be capable of satisfactory performance when laid on trays, in trenches, conduits, ducts and when directly buried in the ground.

(e) Cables shall be capable of operating satisfactorily under the specified power supply system voltage and frequency variation.

13.1 Cables for Analog Signals

The cables shall comply with the following requirements:

Cables of 1100V grade, multi-pair/multi-triad cable, annealed, tinned, high conductivity, 1.0 sq. mm. stranded copper conductor, extruded PVC insulated two/three cores twisted into pair/triad, laid up collectively, individual pair/triad shielded and overall shielded with aluminium mylar tape, ATC drain wire run continuously in contact with aluminium side of the tape, inner sheathed with extruded PVC, armoured with galvanised steel wire and overall sheathed with extruded PVC conforming to IS 1554, IEC 189 & BS 5308 shall be used for analog signals.

13.2 Cables for Digital Signals

The cables shall comply with the following requirements:

Cables of 1100V grade, multi core cables, annealed, tinned, high conductivity, 1.0 sq. mm. stranded copper conductor, extruded PVC, overall shielded with aluminium mylar tape, inner sheathed with extruded PVC, armoured with galvanised steel wire, overall sheathed with extruded PVC conforming to IS 1554, IEC 189 & BS 5308 shall be used for digital signals.

13.3 Cables for Instrument/Equipment Power Supply

The cables shall comply with the following requirements:

Cables of 1100V grade, multicore cable, annealed, tinned, high conductivity, 2.5 sq. mm. stranded copper conductor, extruded PVC, inner sheathed with extruded PVC, armoured with galvanised steel wire, overall sheathed with extruded PVC conforming to IS 1554, IEC 189 & BS 5308 shall be provided for Instrument/Equipment power supply.

13.4 Cables for Master Control Station, RTU and Modem

GSM cables shall be used with relevant specification.

13.5 Laying of Cables

(a) Cables carrying AC and cables carrying DC shall be laid separately with a min. clearance of 300 mm. In outdoor areas, the cables shall be directly buried. Each cable shall be terminated to individual panel/terminal box. Identification of each cable shall be by proper tags as per cable schedule to be prepared by Contractor. Identification tags shall be securely fastened to the cables at both the ends.

(b) Cables shall be laid in accordance with layout drawings and cable schedule which shall be prepared by Contractor and submitted for Engineer's Representative approval.

(c) All cable routes shall be carefully measured and cables cut to the required lengths, leaving sufficient amount for the final connection of the cable to the terminals on either end. Various cable lengths cut from the cable reels shall be carefully selected to prevent undue wastage of cables. A loop of 1 meter shall be left near each field instrument before terminating the cable. The cable shall be bent on a large radius.

(d) Cables shall be complete uncut lengths without .any joints from one termination to the other.

(e) The cable route shall be covered by concrete tile.

(f) Cables installed above ground shall be run parallel or at right angles with beams, walls or columns in cable trays of appropriate size. Cable trays shall be rigidly supported. All cable trays shall be provided with cable tray covers.

14.0 UNINTERRUPTIBLE POWER SUPPLY (UPS) SYSTEM

General Requirement

i) The UPS shall be floor mounted, self-contained and metal clad and shall be suitable for supplying a nonlinear load.

ii) It shall be possible to open the enclosures front door when the unit is in use without exposing any live contact touch.

iii) The UPS shall be on-line type incorporating minimum six pulse rectifier and pulse width modulation inverter technology with microprocessor control. It shall incorporate a static bypass switch that shall operate in

event of UPS failure, overload or manual initiation in order to transfer the output supply to mains without disturbance to the output supply.

- iv) The UPS shall incorporate a DC under voltage trip circuit to electromechanically trip the UPS output in order to protect the batteries.
- v) The noise level of the unit shall not exceed 60 dB(A) at 1 m from the UPS cabinet.
- vi) The output of the inverter shall be a sine wave having less than 2% THD for linear loads and less than 4% for 50% non linear loads. It shall be suitable for load power factors 0.7 lag to 0.9 lead.
- vii) The unit shall have a dynamic response such that 100 % step load causes an output voltage transient of less than $\pm 4\%$ with a recovery of less than 4ms. The load crest factor shall not be less than 3:1.
- viii) Indicators shall be provided for the following
 - UPS status
 - PS alarm conditions
- ix) The UPS shall provide output for the following purpose:
 - Warning, (viz., low battery voltage)
- x) The UPS shall have an overloaded capacity of 150% for 30 seconds and shall be protected in the event of a short circuit of the output.
- xi) The batteries shall be housed, within a separate matching battery cubicle suitable for location adjacent to the UPS. The batteries shall be of the rechargeable, sealed maintenance free lead acid type. The battery supply to the UPS shall be via a fused load break switch disconnect circuit breaker. The battery recharge time to 90% of full charge shall be approximately ten times the discharge time at full load.
- xii) Terminals shall be shrouded to prevent accidental contact.

14.1 Technical Particulars

The Uninterruptible Power Supply (UPS) System with SMF Lead Acid battery shall conform to the minimum following specifications IS 1651:

A.	Input		
Input Voltage	:	230 V, $\pm 5\%$	
Frequency	:	50 Hz $\pm 5\%$	
Nominal DC input (Battery)	:	Bidder to design and submit calculations	
B.	Output		
Output Voltage	:	230 V	
Regulation mode	:	$\pm 1\%$	
Load power factor	:	0.8 to unity	

Duty : Continuous

Ripple on DC : < 2%

C. General

Principle of operation : Shall be solid state, pulse width Modulation (PWM)

Cable entry : Bottom

Cooling method : Forced air

Type of Battery : Sealed Maintenance free.

Control System Voltages

The following voltages shall be used for the control system:

Item	Voltage
Instrumentation power supplies	230 V AC / 24 V DC

The 24 V shall be derived from the UPS backed 230 V supply within the control panel by providing a regulated DC power supply unit.

15.0 Printers

Two types of printers shall be supplied for reports, alarms and events as detailed below. It shall be possible to configure any text output from the control station to either of these printers. These printers shall be provided at main central station.

It shall be possible to add additional printers if required. Additional printers shall be capable of being assigned the functions of alarm/event logging, or report printing, Alarm / Event printers, shall offer at a minimum of 100 characters per second, upper and lower case ASCII character set with true descenders, a minimum of 132 characters per line, and a self-test facility capable of printing automatically the entire character set.

The minimum size of printer buffers shall be 4 K characters.

Each printer type shall connect to the system using the standard interfaces such as RS 232/ Ethernet with both RTS/CTS control signal and XON/XOFF data transfer control methods supported.

Both printers types shall be of a low noise type.

Printer types shall be provided with all necessary softwares along with cables and connectors.

a) Alarm / Event Printer

The Alarm / Event printer shall be a dot matrix printer with a minimum of four colors available. Alarms shall be highlighted by coloured printing (i.e. plant alarms red/system alarm orange/ return to normal green) white events and alarm acceptance shall be printed in black. This printer shall be located in the main control station in a self-contained printer stand. The contractor shall supply and install all necessary cables and connectors etc.

b) Report Colour Printer

The report colour printer shall be an A4 printer capable of producing high quality text and graphical reports for plant and management proposed and full colour high quality prints of screen display mimics trends etc. In text mode the printer shall be capable of upto 7 pages per minute for text and one minute per page for graphics. The resolution shall be 600 by 600 dpi for colour and 600 by 600 dpi for black as a minimum. The contractor shall supply and install necessary cables, and connectors etc.

II. CONTROL SYSTEM & SCADA

16.0 GENERAL SCADA SOFTWARE ARCHITECTURE REQUIREMENTS

- Client / Server architecture
- Standalone single server operation
- Symmetric main-standby & capacity for triple standby server functionality
- Additional servers for user load-sharing
- Fully automated data transfer between servers to provide complete server redundancy. This transfer shall include configuration, real-time data, historic data and event lists
- Database updates shall be on an incremental basis

A scalable, fully distributable architecture providing:

- Unlimited number of server systems
- Unlimited number of display clients

Where multiple servers are deployed, the system shall be capable of being configurable from a single client. All redundancy shall be handled by the database, with the operational state of systems preserved through a server changeover. The system shall not rely on driver redundancy for data transfer when providing redundant server. The system shall present a uniform view of data including communication status after a server change-over. Configurable compression of data communications between client/server and server/server to allow optimization of communications performance over WAN networks. Change reporting on Client/Server and Server/Server links rather than polled communication to permit operation on WAN networks. Capable of operating Client/Server and Server/Server links over low to medium speed channels depending upon database size (e.g. 128K) and Support for DMZ (read-only) servers

16.1 Mimics

OSCADADA system Mimics shall support a wide range of graphical facilities. Scalable vector graphics are required in order to permit operation of the SCADA system with different resolution clients operating simultaneously. Fixed resolution bitmap graphics are not acceptable. Mimics shall be multi-layered, object oriented and permit mimics to be embedded in other mimics. Other objects that must be available for embedding in a mimic include:

Button objects, Normal, Latch, Latch with Feedback, Repeat (repeat the configured action at the defined interval), Momentary (dual action button supporting configuration of two separate actions), Hyperlinks, Disk images (e.g. JPG, PNG), Remotely updated images from a web server (e.g. for web cam images), Hyperlinks with embedded queries (for generating filtered lists directly from a mimic), Object menus, SQL Lists, Alarm Lists.

16.2 Logic

The SCADA system shall support logic sequences with full access to all SCADA system services at run time. Programming of sequences shall be to the IEC61131-3 international standard and support as a minimum the following languages:

- Ladder Diagrams
- Function Blocks
- Structured Text
- Sequential Function Charts

A functional block librarian is also required.

Sequences shall be able to be modified and started and stopped online. Sequence changes shall be a native part of the database and replicated to redundant SCADA servers.

Proprietary scripting languages to perform the control strategy will not be accepted.

16.3 Database

The SCADA database shall be of true relational database design and optimized for real-time SCADA operation. The database shall be object-oriented and organized in a hierarchical structure. It shall support user-created "Templates" that allows management of common configuration from a single point in the database. Instances of templates shall be used for repetitive, standard configuration.

Templates of standard configuration shall support multiple object types including, but not limited to:

Point objects, PLC or RTU objects, Mimics, Trends, Maps, 3D Plots, Logic objects, Schedules, Link objects, Linked tables

Templates shall support the ability for the value of object's property within an instance to be calculated by the system using an expression.

The database shall enable the user to perform automatic (scheduled) or manual database backup. The backup task shall also log an event on initiation and completion.

The completion event shall include statistics on the number of files copied and the total size of data copied.

While the backup is in progress, the database shall continue to operate; processing values, storing updates in memory and synchronising updates to the standby. When the backup is complete, all updates shall be flushed to disk.

- The backup task shall copy the following files:
- Database: Metadata, Structure, Configuration and Data
- Historic Data
- Event Journal Data
- Configuration Change Data
- Alarm Summary Data
- Registry Settings

Backup of historically stored records includes a configurable time range to allow the amount of historic backed up to be tuned to control both the backup size and execution to be kept within sensible limits on systems with large quantities of historic data.

16.4 Operator Interface

SCADA software shall provide the ability to support multiple local and remote display clients.

Display facilities shall be available via LAN, WAN and dial-up connection.

Display clients shall be supported as Rich (Control) Clients without the requirement of a database at the display node.

Rich (Control) Clients shall support database management and configuration changes.

Integrated Web Server capability shall be available, providing all display and operational facilities of the Rich (Control) Client without the need for additional software to be installed.

Web Clients shall allow users to view Mimics, Trends & Plots, Database Objects, and Reports as well as perform control functions using a standard web browser.

Web clients shall allow users to connect from any phone, tablet or laptop to view data, alarms, events, trends and query results.

Rich (Control) clients shall have an integrated database search feature.

Current generation Windows® look and feel shall be provided by the SCADA system operator interfaces, including provision for “favourites lists” comprising links to any server object. This includes, but is not limited to: Mimics, Graphs, List Queries

Display client shall support Embedded Web Pages.

SCADA Software shall provide an Android™ and iOS™ based mobile client and server system:

Communications between the SCADA Mobile Server and the Android™ and iOS™ devices shall employ SSL to ensure appropriate encryption is used on all transmitted data.

Users shall be notified of new alarm conditions relevant to their area of responsibility, and be able to action those alarms using a built-in alarm and event lists.

16.5 Open Connectivity

To provide easy access for customized reports and external data manipulation the SCADA software shall provide inherent OPC and ODBC database connectivity without the need for additional software options or modules. Integration with desktop Microsoft products is essential.

The following Open interfaces shall be provided as integrated components of the SCADA system are required:

- OPC Data Access (OPC-DA) to the SCADA server real-time and configuration database
- ODBC to the SCADA server real-time / configuration database

- OPC Historic Data Access (OPC-HDA) to historian
- OPC Alarm & Event (OPC-AE) to event sub-system
- OLE Automation interface to the SCADA server database
- NET support
- ODBC / SQL to the SCADA historical database
- ODBC / SQL to the SCADA event database

16.6 System Administration

It shall be possible to run the system services under a local Administrator account rather than as a Windows® System User. It shall be possible for the system to run under a Windows® virtual account (or other) with reduced functionality.

It shall be possible to run certain system services under a less-privileged Windows virtual account.

16.7 Startup

The SCADA system shall start-up unattended, and without compromising system security. The SCADA server process shall operate as a Windows® Service. The SCADA server shall start without the requirement for an HMI client to start. Windows® logon shall be available prior to display client start-up to provide additional security. Shutting down a display client (including on the server node) shall not affect other users or the server. SCADA administrative privilege shall be required to shut down a SCADA server

16.8 Alarm Management

The alarm system shall provide facilities where actions can be triggered by alarms. These facilities shall be provided as a built-in integrated part of the system and shall include, but not be limited to the following:

- Configuration criteria for alarm actions
- Escalate Alarm priority
- Delivery of alarm to users via SMS
- Delivery of alarm to users via E-mail
- Trigger other actions including sequences

Integrated paging facilities shall be provided without the need for additional software. The paging facilities shall include calendar operation for roster based user lists with flexible interface for reconfiguration of alarm management.

Tracking of alarms shall provide as a minimum:

- Alarm activation including point name, state, timestamp, priority
- Alarm de-activation
- Alarm acceptance including time, user responsible, optional comment
- Custom alarm fields for display of additional or operations specific information

Where a full function Rich (Control) Client is connected to multiple SCADA systems, alarms from all systems shall be combined and filtered, based on user privilege and areas of responsibility.

16.9 Trends

Graph displays shall be offered and shall be requested through a menu driven system and/or embedded within displays. These shall display data in engineering units or as percentage of full scale with the appropriate units stated on the display. Displays shall be in the form of line- graph, step(-first and -last) line, and bar graph form. These display types shall be able to be mixed on one display.

The Trending System shall include facilities to display pre-configured and ad-hoc graph displays.

The user shall be able to choose the display type for each variable separately. These variables shall include analogue values, integrated values and digital (status) values e.g. it shall be possible to produce a graph showing flow rate, total flow and flow regulator position (i.e. gate open/shut) as one display for correlation.

The colors of variable traces shall be allocated by automatically, which may then be changed by the user. The color of X and Y axes shall also be configurable.

The trending system shall support display of multiple separate Y-Axis, without imposing an artificial limitation. A facility shall be provided to change both X and Y axis scales and zero for each point graph without the need for reconfiguration. The facility to select logarithmic scales and/or inverted scales for the Y-axis shall be provided. The Y axis shall apply auto-ranging scale unless manually overridden.

16.10 Configuration

The SCADA software shall provide full, seamless on-line configuration of all database parameters including but not limited to:

- Communication channels, PLCs and RTUs, Points, Sequences, Schedules, Alarm redirection, Mimics, Trends (historical and ad hoc)/graphs, Maps, 3D Plots, Reports

The SCADA server shall provide detailed diagnostics concerning its internal operation. The diagnostics shall be available through capture to a log file as well as online locally on a server and remotely.

16.11 PLC/RTU Protocol Support

Wide area PLC/RTU protocols shall support:

- local serial port communication
- terminal server serial port communication
- Ethernet LAN communication via TCP and UDP ports
- time synchronisation
- presetting output configuration points where configured
- fully integrated incorporation of events from a PLC/RTU
- unsolicited exception reporting

The driver architecture shall support user accessible interfaces to access major driver functions. This shall include, but not be limited to:

- enable / disable PLC/RTU communications
- trigger an integrity poll
- alter communication parameters

Drivers shall maintain current state of target device information, and when used in redundant server architecture shall retain state information and be able to receive solicited and unsolicited information from the PLC/RTU immediately following a server transition. It is not acceptable for the system to indicate communication failure or not be able to receive communication from a remote device during the period of transition from one server to another.

DNP3 protocol shall be fully supported natively, including operation as a DNP3 Master and DNP3 Slave. DNP3 driver shall operate with fully redundant SCADA server architectures and natively support a variety of communication methods:

- direct serial communications
- flow control serial devices (including data radios)
- PSTN dial-up systems
- Ethernet DNP3 communications supporting both UDP and TCP communications as per the DNP User Group requirements
- Dual Networking configuration with built-in channel switching
- DNP3 direct communications with PSTN backup

DNP3 driver should support operation as Level 1, Level 2 and Level 3 Master, and additionally support:

- DNP3 file transfer, DNP3 floating point analog static and event objects, Virtual Terminal encapsulation of other protocols, DNP3 string points
- DNP3 Security Authentication V2

A Device Profile shall be provided for the driver as per the requirements of the DNP User Group.

Support for IEC61131-3 Target 5 shall be provided.

Furthermore, the following protocols shall be supported as a minimum and integrated with the product:

- Modbus Master serial protocol, Modbus Slave serial protocol
- Open Modbus/TCP Master protocol, Open Modbus/TCP Slave protocol
- IEC 60870-5-104 and IEC 60870-5-101 (KEMA certified)

- EcoStruxure Web Services client support
- Allen-Bradley DF1, RS Linx
- OPC-DA client driver (for connection to OPC Server driver)

- Trio Radio Diagnostics
- Lacroix Sofrel RTU
- SNMP driver, including support for version 2 and 3
- Integrated RealFLO EFM support for the SCADAPack Modbus driver
- Dynacard data export tool Kingfisher
- T-Box RTU
- Siemens Simatic S7 PLC
- Lufkin SAMS Pump Off Controller
- Schneider Electric Rod Pump Controller
- Schneider Electric SCADAPack50 Wireless Data Logger
- Emerson Floboss EFM, supporting 100 series RTUs
- Emerson ROCPlus EFM, supporting 800 series RTUs
- ABB TotalFlow EFM, supporting 6400, 6700 and XSeries RTUs

The OPC-DA interface shall include as a minimum, integration with SCADA database value / state / quality / timestamp data, support OPC-DA 1.0, 2.0 and 3.0 specification interfaces, polled and exception modes, tag browsing.

- Data Historian rate of collection deviation

- Low Disk Space on any data historian on the network

The System shall detect any or all of the possible failures and allow client data recovery without operator intervention.

16.12 System Security and Access

The SCADA system shall provide a high level of inherent security. To this end the SCADA software shall provide security access down to data point level, and support individual Users, User Groups and a matrix of system capability and access to any level of the SCADA database. Full-function Rich (Control) & Web client interfaces shall require explicit administrative configuration to valid connection to the SCADA server. Client interfaces shall provide the ability to restrict access to sensitive system information based on user privilege. System Administrators shall have the ability to allow/restrict client access to specific system interfaces by IP Address, IP Address Range, and/or CIDR (Classless Inter-Domain Routing) notation.

16.13 Standard Drivers

The SCADA system shall provide native support for fully integrated Wide Area SCADA PLC/RTU protocols. This shall include the capability for supporting all protocols in redundant SCADA server configurations and support redundant communication paths.

Apart from PLC and RTU communication drivers, the system shall also support as standard the following drivers:

- SMS / Paging – a full function system is required including calendar based rosters
- SNMP – monitoring of network devices such as routers, computers, UPS, etc.
- NTP – time server monitoring and alarming
- ODBC – query data from other databases
- Windows Performance Monitoring
- OPC-DA driver, OPC-XML-DA driver

16.14 Historical Data

The SCADA system shall provide a built-in data historian with the following facilities as standard features. These shall be provided without the addition of external software modules:

- Time-series relational database
- ODBC / SQL interface to historical (trend) data
- Historical data to be stored with time-stamp, point quality, alarm status

- Historic storage is to be based on configurable criteria including time between samples, alarm state change
- Compression capability

Historical files supporting fixed interval sampling only will not be accepted.

Where historic data can be retrieved through communication devices such as PLC/RTUs, the historic data sub-system shall natively provide the capability to backfill this data in to the historian.

No loss of data or gaps in data as a result of communication or server failure shall be accepted. The vendor must demonstrate its ability to ensure data integrity and history data recovery.

An API shall be included to provide interface capability with the SCADA database. This shall be either ODBC or OLE Automation.

The historic data subsystem shall provide fixed and user configurable views of the historic data tables. These views are required to provide SQL pre-processing and present historic data in aggregate format.

The SCADA server shall provide Historian functions including the capability to validate historic data prior to exposing it externally to the SCADA system, selectable archiving rates, point-by-point storage compression regimes, annotation on history samples for tracking comments on operational conditions, modification of historic data for normalisation and correction (tracks previous value and modifying user and is subject to user privilege), auditing of modified or annotated history.

The system shall support a data export mechanism to push data to Wonderware Historian and Wonderware eDNA Historian, supporting redundancy, backfill of historical data, and buffering to handle communications outages

16.15 Event Journal

The system shall provide, as a built-in feature and without the requirement for custom or external software, facilities for event logging. These facilities shall be separate from the alarm list and include the capability to insert user comments at any place in the event list.

Event lists shall be obtainable through an SQL-like query or filtered through user entry on a forms-based display.

Event data is to be stored in a time-series relational database. Each event record shall comprise a timestamp, responsible user, point name, message, and reason for event log.

16.16 Reports

An integrated reporting package shall be able to generate, print and export reports:

- Triggered by SCADA events
- On user demand
- On timed schedules

Report generation shall use latest technology in database access and be capable of combining data from multiple databases via ODBC/SQL. This shall include SCADA and non-SCADA databases.

Reports shall be able to be generated in a number of formats including:

- HTML for viewing via Web interface
- PDF format
- CSV format
- MS Office® suite format
- Crystal Reports

16.17 SCADA can be installed on computers using the following operating systems:

Server Hardware

- Windows Server 2016 (Standard and Datacenter editions, 'Server with Desktop Experience' installation option)
- Windows Server 2012 Release 2 (Standard and Datacenter editions, 'Server with a GUI' installation option)
- Windows Server 2012 (Standard and Datacenter editions, 'Server with a GUI' installation option)
- Windows Server 2008 Release 2 (Standard and Enterprise editions, 'Full' installation option) – Service Pack 1

Desktop Hardware:

Desktop class hardware is only suitable for small stand-alone client-server systems that are not intended to provide access to the database.

- Windows 10 (Professional and Enterprise editions, versions that are supported by Microsoft)
- Windows 8.1 (Professional and Enterprise editions)
- Windows 7 (Professional and Ultimate editions) – Service Pack 1

Attention: Windows 7, 8.1 or 10 should not be used for servers with more than two clients. This is because the TCP/IP security measures in these operating systems can cause significant delays.

17.0 General Process controller (PLC) Specifications for WELLS & Pump Houses

17.1 Control System

The Control System to be offered shall conform to open and distributed architectural design. It shall permit data acquisition and control (both regulatory and sequential) functions while providing capability to monitor and control the process from a central location. The system shall be sufficiently scalable and flexible that it can be configured to a wide range of process requirement without the changes in hardware.

The objective of open system besides process measurements controls & report management is to reduce the system integration by providing connectivity, conformance, multi-vendor interoperability, and information integration networking etc. The system shall have inherent capability to integrate and exchange information with other brand system devices and platforms via industry standard communications, platforms and protocols such as Modbus, Ethernet IP and Modbus TCP.

The system design must ensure openness at information level but security at control level to ensure safeguard against unauthorized entries and virus attacks. The open architecture control system should be based on open industry standards rather than proprietary to the extent applicable and necessary. The controller sub system must be microprocessor based and 32 bit. It must be capable to execute multiple loops at configurable scan times.

17.2 Standards and Certifications

❖ The PLC must conform to the main national and international standards covering electronic equipment for industrial control systems:

CE marking according EN 61131-2

CSA 22-2 N° 142 (Canadian Standards Association)

UL 508 (Underwriters Laboratories)

C-Tick ACA (Australian Communication Authority/Australia)

CSA 22-2 N° 213 Hazardous Location (CSA)

FCC Part 15 – Class A

GOST CEI

17.3 PLC Configuration

- The automated platform processors manage the entire PLC station, which is made up of a set of discrete & analog I/O modules, expert and communication modules, in both local and remote configurations
- The local IO configuration of the most powerful processor in the range shall provide 4096 discrete I/O and 1024 analog I/O (cumulative values)
- The remote IO architectures support up to 31 multiple remote drops
- The distributed IO on Ethernet supports up to 128 equipment's per scanner, up to 7 scanners shall be inserted into the CPU main rack
- The performance of the modules will be independent of their location in the system configuration
- The PLC I/O modules shall be hot swappable, i.e., card changeover, card wiring removal or communication cable change shall be possible on-line (PLC running) without causing any process interruption, bump or nuisance trip or any loss of fidelity during such action

17.4 Controller Performance Criteria

- The processors must have an internal non-volatile memory to store application and data. Processor must also have a reserved slot for a removable cartridge so that the application and data backup can also be performed also on a mobile device
- It must be possible to connect a PC (programming terminal) or a human-machine interface via a USB port integrated in the processor
- Embedded web server must provide CPU diagnostic, including detailed information on Ethernet system networking. The Embedded web server must be customizable by the user to display application variables and advanced diagnostics features

Each processor should have a savable real-time clock which manages:

- The performance capacities of the various processor models are to be expressed in terms of execution time for 1K List-equivalent instructions for the two application profiles defined below: Most powerful controller must process at least:
 - 50 Kinstructions / ms for Boolean application
 - 40 Kinstructions / ms for Numerical application
- The PLC must be able to load the program without the use of programming software, just with the use of the memory cartridge
- Processor must provide cyber-security features, such as real-time memory integrity control, access control

17.5 Operating System

- The operating system (OS) must be capable of multitasking with up to 4 periodic tasks and more than 60 event or I/O tasks

- The PLC RUN/STOP functions shall be remotely controlled by setting the parameters of an input channel
- It must be possible to maintain the outputs or set them to fall back position when the PLC switches to STOP mode via channel by channel parameter entry

17.6 MEMORY

- The memory area must consist of an executable internal memory for the application which can be saved both in an internal Flash memory embedded, and in a Flash type removable memory card
- No battery supply shall be needed for non-volatile backup
- The most powerful processor in the range must provide up to 64 MB of integrated non-volatile memory to save whole application and data, even in redundant configurations
- Removable memory cartridge must provide up to 4 GB of memory capacity
- It must be possible to secure access to application stored on the cartridge to prevent the run of application from any controller

17.7 Cyber Security

- The system must be compliant with IEC – 62443 standards
- The system MUST be Achilles level 2 certified
- The system must have passed successfully the CSPN test
- The system must be able to secure communication between PLC and engineering workstation providing authentication and integrity of data
- The internal firmware of the CPU must be digitally signed and encrypted
- The integrity of the firmware must be checked before any application download and at startup of the system
- The integrity of the engineering software must be checked on demand
- Any modification of the operating mode of the system (Run / Stop / Program modifications) must be authenticated

17.8 Distributed & Remote Configurations

- The communication functions of IP20 remote I/O modules must be independent of the input and output interface functions. It will therefore be possible to connect any module to the main field bus standards (multi-bus openness) including, amongst others:
 - Ethernet 10/100Mbps
 - Serial links
- System must support in same network a mix of synchronized and unsynchronized drops and equipment with PLC scan
- Connection to synchronized or unsynchronized drops must be provided through ring topology to insure quick recovery (<50ms) in case of one cable failure

17.9 Input/Output Modules

- All modules (except processor and power supply modules) are hot-swappable separately, i.e. each of them can be inserted and removed alone while powered up
- All modules have a display block for identifying module and channel faults: input, output, bus device, axis, etc. These diagnostics are performed without using any special tools
- The modules are fully configurable by setting parameters in the development and runtime software. The parameters are stored in the PLC application and are automatically reloaded by the CPU if a module is exchanged
- I/O modules shall have 3 levels of Isolation- a) Channel to Channel Isolation, b) Channel to power Isolation & c) Channel to Ground Isolation
- The I/O cards shall be intelligent type and shall be connected to the terminals preferably by means of prefab cables. I/O cards shall have built in galvanic / optical isolation for input and output. The Isolation shall be provided between each of the channels or groups in I/O rack

17.9.1 Digital Input

- 16/32/64 input channels per module
- Input interrogation voltage shall be 24VDC
- LED indication to indicate status of field signals, card healthiness and communication healthiness shall be provided
- Isolation level of DI with internal circuits shall be preferably 1.5KV A.C / 500V DC
- Reverse polarity protection shall be provided
- Insulation resistance should be > 10Mohms
- The inputs must be isolated in accordance with standard IEC 61131-2

17.9.2 Digital Output

- 16/32/64 output channels per module
- Output interrogation voltage shall be 24VDC
- The modules shall be individually protected against continuous over-current and short circuit
- The module shall be capable of verifying the state of each output
- Insulation resistance shall be > 10Mohms
- Fall back state of the channel shall be configurable

17.9.3 Analog Input

- 4/8 input channels per module
- Channel to channel, Channel to Bus and Channel to ground isolation shall be provided
- The catalogue must offer the following characteristics:

- High level fast isolated voltage/current inputs
- Thermocouple and RTD inputs if required
- Isolated voltage/current outputs (+/-10V, 0/4-20mA)
- HART communication if required
- Accuracy shall be 0.15% of full scale
- LED indication to indicate status of field signals, card healthiness and communication healthiness shall be provided
- Broken wire diagnostics shall be provided
- Software filtering shall be supported

17.9.4 Analog Output

- 2/4/8 output channels per module
- Suitable for 4-20mA
- Shall have 16-bit resolution
- Analog output circuits shall be able to drive load
- LED indication to indicate status of field signals, card healthiness and communication healthiness shall be provided
- Shall be able to detect broken loop on field
- Fall back state of the channel shall be configurable

17.10 Serial Links Communications

- The PLC must have serial links which support various types of communication: Modbus or open protocols. The protocol is chosen by the configuration software

17.11 Ethernet Communication

- System must integrate in its communication layers standard Ethernet. Synchronized and unsynchronized drops with PLC scan shall be managed over standard and open Ethernet communication
- Communication network must be the same everywhere in the system, from control level to field level ensuring network continuity from top to bottom
- Offer catalog must offer in-rack Ethernet modules to build the entire integrated architecture. For example, offer must provide in-rack switches, Wi-Fi access point, and fiber optic converter
- No prior declaration or configuration of the transmission or destination device is necessary for using communication function blocks
- The range must offer processors which have multiple integrated Ethernet connections with at least one Web server for diagnostic purposes, and one service port

17.12 High Available Redundant Controller for Water Supply System

- The proposed control system must at least include a processor designed to be part of a redundant architecture, obeying a principle of redundant controllers which guarantees a switchover without loss of control of the process on occurrence of a failure
- In case of a redundant processor configuration, the system is designed to have a bump less transition (no unattended spike on the IO during switchover)
- The whole redundant variable database must be exchanged during each scan time, with a minimal impact on the cycle time of the system
- It shall be possible to place the processors at a distance of up to 15 kms
- The application logic program can be modified while the system is running, and without compromising the redundancy function

18.0 General RTU/PLC Specifications for oht's/WELLS

The RTU/PLC shall be an intelligent, modular unit, capable of both data acquisition and local data processing. It shall monitor and control local equipment in a standalone mode as well as being an intelligent node in a distributed system. It shall be based on multiprocessor architecture, in which a co-processor is used for handling on-board input/output channels. To facilitate initial installation, maintenance and future expansion, all external input/output modules shall connect to the basic controller using a high-speed bus.

The SCADA controller shall be configured with a modern Windows application and programmed with open standard IEC 61131-3 programming languages. Programs shall be developed and downloaded either directly to the controller using a standard RS-232 interface cable, USB, Ethernet, or remotely through the communication network media such as phone lines, dedicated lines, mobile IP systems or wireless radios.

The controller shall be supplied with the number and type of input/output modules and communication ports as indicated elsewhere in the specifications. Expansion shall be by plugging in additional input/output modules to the I/O bus.

18.1 Central Processing Unit (CPU)

The central processing unit shall consist of a high speed 32-bit microprocessor with 32-bit internal and external bus. The design should incorporate a separate co-processor for controlling input/output channels.

The CPU shall be equipped with at least 4 MB RAM for application programs, system parameters and configuration and at least 16 MB FLASH Memory for firmware, application programs and file system.

The CPU shall include a real-time clock/calendar, accurate to within one minute per month, with lithium battery backup. The battery will maintain the memory and clock/calendar for two years of power off time. The controller shall provide an adjustable period for updating time from SCADA protocols in order to achieve accurate clock time.

The CPU shall include an internal clock with at least 10mS resolution and be capable of applying timestamps at this resolution to internal and externally obtained data.

Diagnostic LEDs shall be included for the following:

- a. Controller Status
- a. Wide area communication link activity such as transmit, receive
- b. Local peripheral communication link activity

c. I/O point indication for all DI & DO points (as a minimum)

The controller shall include a built-in power supply with wide range input, at least 10VDC - 30VDC. The power supply shall be capable of providing 24VDC output to power field transmitters.

18.2 Mixed Process Input/Output

The controller shall be available in a number of basic configurations. As a minimum, the following are required in devices with minimum footprint (i.e. no I/O modules). Further I/O shall be available through I/O module expansion.

- 16 digital inputs, 8 analog inputs, 10 relay outputs, 2 analog output options, 3 counter inputs

Digital inputs shall be provided with 11 – 24 VDC range and shall tolerate 150% over-voltage. Digital inputs shall be configurable for reporting of time-stamped events (including unsolicited reporting of state changes), and alarm time dead bands.

Digital input changes on the controller's local I/O shall be time-stamped to at least 200mS accuracy of actual input change, with an internal resolution of 10mS between detectable events. State change and timestamp shall be reported through DNP3 and IEC60870-5 SCADA protocols.

The controller shall include at least three high speed counters (up to 5 KHz) rated at 12/24 VDC. Counter input points shall include point quality such that an I/O module or other failure will indicate bad point quality if the point values cannot be updated. User logic shall also be able to derive bad point quality on a per-point basis. Point quality shall be indicated in the point database and through status flags on individual points in DNP3 and IEC60870-5 SCADA protocols.

Digital outputs shared with digital inputs shall be dry contact (closure to ground) type inputs.

Individual digital outputs shall use integrated relays with the following specifications:

- Form A with common ground for each group of five outputs
- Maximum operating voltage of at least 115 Vrms
- Minimum 1000 Vrms contact to logic isolation

Digital outputs shall be configurable for pulse output trains controlled by both protocol messages and user programming.

Digital Output points shall include point quality such that I/O module or other failure will indicate bad point quality. User logic shall also be able to derive bad point quality on a per-point basis. Point quality shall be indicated in the point database and through status flags on individual points in DNP3 and IEC60870-5 SCADA protocols.

Analog inputs shall be able to be selected as 0-5V, 1-5V, 0-20mA and 4-20mA on any channel, 14 bit resolution, $\pm 0.2\%$ accuracy over the operating temperature range, $\pm 0.1\%$ accuracy at 77 °F (25 °C). Analog Inputs shall be single ended.

Analog input changes on the controller's local I/O shall be time-stamped to at least 200mS resolution, with an internal resolution of 10mS between detectable events. Value and timestamp change shall be accessible by a user application and reported through DNP3 and IEC60870-5 SCADA protocols.

Analog Input points shall include point quality such that I/O module or other failure will indicate bad point quality. User logic shall also be able to derive bad point quality on a per-point basis. Point quality shall be indicated in the point database and through status flags on individual points in DNP3 and IEC60870-5 SCADA protocols.

Analog outputs shall support 12 bit resolution, 0-20mA and 4-20mA selection on any channel, +/- 0.25% accuracy over the operating temperature range, $\pm 0.15\%$ accuracy at 77° F (25 °C).

The controller I/O shall be controlled by an independent co-processor.

The state of digital and analog outputs shall be configurable to hold their last output value or go to the OFF condition when the application program is stopped.

18.3 Communication

The controller shall possess a minimum of five built-in communication ports with the following characteristics:

One Ethernet port 10BaseT / 100BaseT

One USB device port

Port shall be configured with different baud rate

At least two of these ports shall be software selectable for RS-232, and RS-485 2-wire operation

Serial ports shall support speeds from 300 to 115200 baud

18.4 Mechanical Design

The controller shall be DIN rail mount. Front access to all controls, indicators, communication ports and power supply connection shall be provided. RS-232 and Ethernet communication ports shall use standard RJ style connectors to allow easy access using standard cables.

All boards shall be coated with conformal coating, for protection against humidity and corrosion.

Where sockets are used, they shall be machined type and be gold plated. Bifurcated or leaf contacts will not be accepted. All system components shall be constructed of corrosion resistant zinc plated steel with removable metal covers.

18.5 Environment

The controller shall operate over an ambient temperature range of -40°C to 70°C (-40°F to 158°F) with a relative humidity 5% to 95%, non-condensing.

The controller shall operate from nominal power supplies 12-24 VDC, but shall tolerate a wider range than this. 115/240 VAC operation shall be provided through the use of an optional power supply.

18.6 Certifications and Standards

The controller shall be certified with CE Mark

All inputs and outputs (except the serial communication ports) shall survive ANSI/IEEE C37.90 surge withstand capability (SWC) tests without damage.

Controller serial ports shall be static protected to +/- 15kV as conforming to IEC 801-2 and 2.5kV surge withstand capability as per ANSI/IEEE C37.90.1-1989.

The controller shall be certified to meet or exceed the following standards:

RF emission compatibility: FCC title 13 part 15, Subpart B, Class A, CISPR22 Class A

Electrical safety classification: c(CSA)us, CAN/CSA-C22.2 No. 61010-1

Hazardous area classification: CSA Class 1, Division 2, Group A, B,C,D

Discharge Immunity: EN61000-4-2

Radiated immunity: EN61000-4-3

Fast transient immunity: EN61000-4-4

Surge immunity: EN61000-4-5

19.0 COMMUNICATION ROTOCOLS

19.1 Open Standard Protocols

The controller shall support the following industry standard protocols:

- DNP3-2010 Level 2 conformant Master and Slave* serial and DNP3 over IP,
- DNP3 Slave is required to have the ability to send DNP3 Master Read and Control requests to a peer Slave controller
- IEC60870-5-101 Slave *, IEC60870-5-104 Slave *, Modbus RTU Master, Modbus RTU Slave
- Open Modbus/TCP Client +, Open Modbus/TCP Server +

19.1.1 Protocol Capabilities

Allow up to 65500 stations to be addressed in one system.

- Ability to transfer complete configurations and IEC61131-3 application programs and data over the communication network to the controller using DNP3 and IEC60870-5 protocols. The controller shall support these facilities via RS232, RS485, TCP/IP PPP serial links, TCP/IP Ethernet, PSTN, radio, cellular IP, etc.
- Support for multiple master's capability for all Slave protocols
- Proprietary protocols shall not be used for remote communication with the device

19.1.2 Flexible Communications

19.1.2.1 Routing

The controller shall be able to intelligently route DNP3 messages across all its communication ports and interfaces. This shall include the ability to filter messages based on source port, source and destination addressing, and include connection information for the destination device such as communications port, PSTN telephone number, IP address, UDP port number, etc.

19.2 Data Concentrator Capability

Data concentration shall include as a minimum:

- DNP3 serial protocol as a master, DNP3 over IP (TCP and UDP) as a master
- Ability to put remote device communications in service and out of service on an individual device basis
- Accept Unsolicited message reports from remote devices
- Full support for integrating point quality and event timestamps from remote device in to the controller's database without loss of information
- Ability to select data concentrator to stop collecting data when event buffers are full
- Communication status for each remote device available in the controller's point database
- Communication statistics for polling and unsolicited messages available in the controller's point database
- Provision for user program or protocol commands to the controller to force an event poll, integrity poll, or remote device restart

19.3 Time Synchronization

When operating as a slave the controller shall be capable of updating its time from the following time sources:

- DNP3 protocol serial time sync method over IP communications (TCP and UDP)
- IEC60870-5-101 protocol over serial communications, IEC60870-5-104 protocol over IP communications, NTP over IP communications

19.4 Multitasking

The software shall be based on a multi-tasking executive system optimized for real-time environment. This shall include:

- Controller Hardware watchdog management
- Individual software task watchdog management

19.5 Firmware Upgrades

The operating system firmware shall be capable of being upgraded locally and remotely, utilizing compression techniques to minimize the communications transaction size for loading of firmware patches or a new firmware image. The firmware upgrade shall not commence until complete reception of the firmware image. Controller operation shall not be interrupted during the communications transfer of the firmware image.

19.6 TCP/IP Communications

The operating system shall include TCP/IP services that encompass, but are not limited, to the following:

- TCP socket interface for open protocols (e.g. IEC 60870-5-104, Open Modbus/TCP)
- Both TCP and UDP socket interfaces for DNP3 open protocol
- TCP socket interface for IEC61131-3 programming interface
- ICMP (ping) management as a client and server
- Telnet to controller diagnostics stream
- FTP file transfer to controller file system
- IP network table supporting Gateway, Host, Sub-network entries

The following IP services shall be disabled by default as a security measure:

Telnet, FTP, NTP, BOOTP

19.7 Diagnostics

Detailed diagnostics shall be available from the controller including the following features:

- Command line interface for interacting with the controller's file system and diagnostics
- Command line via serial port connection using a generic terminal application. (The serial port shall also be selectable for purposes other than dedicated command line)
- Command line from configuration application via USB, Telnet
- Command line via DNP3 Protocol Virtual Terminal

19.8 User Programming Software

The controller shall support all five IEC 61131-3 programming languages:

Sequential Function Chart (SFC), Functional Block Diagram (FBD), Ladder Diagram (LD)

Structured Text (ST), Instruction List (IL) and may include simplified Flow Chart or Quick Ladder languages.

The controller configuration and programming software shall be accessible from a single user interface. The software shall allow the user to develop and then download the application and system configuration locally via USB, serial port or Ethernet interface, and over the communication network via TCP/IP, DNP3 and IEC60870-5 protocols.

19.9 Event Capability

The controller shall natively support event facilities without the need for user programming.

Open protocol event capabilities for DNP3, IEC60870-5-101 and IEC60870-5-104 shall be fully integrated with the controller's event facilities. The number of events stored by the controller shall be configurable, with a maximum up to at least 20,000 events.

The controller shall provide the following capabilities:

- Generate events from physical or derived data objects
- Accept, process and chronologically sort events from external devices
- Merge external events using the original timestamp information provided by an external device
- Where a timestamp is not supplied externally, the controller shall add a timestamp to all event data
- Report Binary, Counter, Integer analog and Floating point analog events as a minimum
- Report events for analog points on rate of rise exceeded, rate of fall exceeded and no change after a period of time. This functionality shall be provided natively without the need for user programming
- Event configuration for each data object shall include an event priority
- Individual event configurations (e.g. each alarm limit) shall provide a selection for enabling an unsolicited communication transaction when the event is generated

19.10 Data Logging Functionality

The controller is required to have the following data logging functionality in addition to its event capabilities. The controller shall support both event and data log operation simultaneously, including both event generation and logging on the same controller data objects.

Logging shall be selectable on digital input, digital output, analog input and analog output data objects.

Analog logging shall be by 32-bit floating point engineering values.

Logging shall be configurable to include current value and summary statistics at a defined interval, including average, maximum and minimum logging trends.

Logging frequency shall be selectable by the user for each logging trend and vary from 1 second to 1 year.

All data shall be able to be retrieved and made available as a .csv file for use in Excel, Access, or HMI software. Data uploaded to a PC shall be supported using direct serial connection, leased telephone lines, radio, dial-up modem, external memory media and via the SCADA communication link.

19.11 Security

The controller shall provide communications security using recognized SCADA security open standards.

Communication link security shall be provided for the DNP3 open protocol as a minimum, supporting operation on serial and network links. This shall include DNP3 Secure Authentication v2 as a minimum with an option for data encryption. Security standards shall be aligned to FIPS-120 standards and include AES-128 encryption and HMAC SHA-256 hash algorithms as a minimum.

A secure administration application shall be provided for the Security Administrator to issue and track security keys, users and configuration computer nodes.

The administrator application shall provide the capability of specifying security configuration for groups of controllers, users (via username/password) and individual configuration computers.

A water network is used for improving system design and operation of the water utility shall be utilized to improve:

- Hydraulic performance
- Water quality
- Safety of operation

20.0 GPRS BASED TELECOMMUNICATION SYSTEM FOR SCADA NETWORKING

- I. The telecommunications system, as envisaged shall be General Packet Radio Services (GPRS) communications system on a Global system for mobile communication (GSM) as provided by the Telecommunications system service providers.
- II. To create successful communications system using GPRS network, special consideration must be taken. Since the Public Services are to be used for Private Communications the remote sites can be connected using Secured VPN Connections.
- III. Secured VPN

The remote stations should create a Secured Private Connection with Master (SCADA) location using Public GPRS Services. This must be equipped with capability to provide redundancy at various levels.

As General Philosophy, a hardware based solution is required. Master shall have a VPN Server to enable communications with all the remote locations.

Single Public IP shall be made available at Master Location to create Secured VPN Connections with these VPN Servers/ Network Managers.

- IV. Server Hardware

In view of flexibility and ease of compatibility the communication solution must be fully hardware solution.

The VPN Server at Master end must be a Single device capable of handling more than 500 Remote connections concurrently.

It must also support the Dematerialized Zone installation of the Firewall for additional Security.

V. Redundancy of VPN Servers/ Broadband Public IP Services

In view of communication with 100's of remote sites MCS shall be equipped with Two Broadband Public IP's each from different Service Provider. This will ensure the Redundancy of ISP's at MCS location.

All remote sites must create the parallel connections with both the VPN Servers in "Always Available" form to achieve the redundancy.

VI. Remote Service Provider Redundancy

Optionally GPRS Router at each remote site must be capable of carrying Two SIM Cards each from different ISP. Router must keep watch on the Service availability and should switch between the ISP's based on Availability. It should follow the Primary & Secondary philosophy to switch to or fall back on Primary Service Provider. This is must from futuristic view point and for selecting the data subscription accordingly.

All remote GPRS routers should support dynamic IP assignments from ISP's based on Public as well as Private APN Configurations.

Hardware Specifications

- GPRS Modem Should be at least quad band: GSM/GPRS/EDGE 850/900/1800 /1900 / 2100 / 2600 MHz
- GPRS modem should support 2G/3G and 4G Network
- GPRS Modem should have: 1 SMA connector for Antenna
- GPRS Modem should be of Din Rail Mount
- GPRS modem should work: on 12 to 48 VDC supply
- GPRS Modem temp range should be: -30 to + 70 Degree C
- It should support minimum 10 IPSEC parallel VPN tunnels
- GPRS modem should have Dual SIM slot to achieve network redundancy
- GPRS Modem should support VPN: GRE, L2TP, PPTP, IPsec, Open VPN, Certificates
- GPRS Modem should support Firewall: Stateless Packet Inspection, Intrusion Protection, DDoS Prevention, IP to MAC binding, DMZ, Virtual IP Mapping VRRP: Multiple Redundant Routers
- GPRS Modem should have Auto recovery feature in case the connection lost
- GPRS Solution should have Hardware based Network Manager at control center to

handle GPRS connections and should support min 500 VPN connections and should work without any software at Master/ SCSDA Location

- GPRS Router Should Have: 4 * Ethernet Port
- GPRS Router Should Have: 1 * RS232, 1* RS485 Industrial Terminal Block Connector
15kV Isolated Serial Port
- GPRS Modem should support VPN: GRE, L2TP, PPTP, IPSec, Open VPN, Certificates

- GPRS Modem should support Firewall: Stateless Packet Inspection, Intrusion Protection, DDoS Prevention, IP to MAC binding, DMZ, Virtual IP Mapping VRRP: Multiple Redundant Routers
- GPRS Modem should have Auto recovery feature in case the connection lost
- GPRS Modem should have Hardware Watch Dog
- GPRS modem should have minimum IP30 Metal enclosure
- It should be possible to reboot the device by remote SMS
- It should have inbuilt NAT Routing feature
- It should have link redundancy between WAN and GPRS
- It should have inbuilt Email alarm function
- It should have inbuilt cloud support for remote access
- It should have link redundancy between WAN and GPRS
- Approved Makes: In Hand Networks, Calamp – USA, Elpro – Australia, Sheetal wireless.
- GPRS modem should provide & support SNMP/ MIB files to integrate with third Party NMS for Network monitoring and performance monitoring
- It should support EMC level 4 or better
- GPRS Modem Should Have following: EMC & Physical Specifications
- EN61000-4-2, level 4

- EN61000-4-3, level 4
- EN61000-4-4, level 4
- EN61000-4-5, level 4
- EN61000-4-6, level 4
- EN61000-4-12, level 3
- EN61000-4-11, Voltage Dip: 70%
- Shock Test: IEC60068-2-27
- Free Fall: IEC60068-2-32
- Vibration: IEC60068-2-6
- GPRS Modem Should Certified by: CE, FCC, UL

21.0 VSAT SPECIFICATIONS

1. VSAT should work on Ex-C band with min. 1.2 meter antenna and 2 Watt BUC.
2. VSAT modem should have, –
 - a. 1 Ethernet Port
 - b. Frequency support- Tx - 6.725 - 7.025 GHz , RX- 4.5-4.8 GHz
 - c. Support for two way communications.
3. Bandwidth Allocation –

VSAT bandwidth to be shared among all stations . System should support double hop .

4. The VSAT Service Provider should have-
 - a. A valid license from DoT
 - b. minimum 25,000 installed base
 - c. Similar SCADA system for water application should have been installed.
 - d. VSAT service provider should have installed VSAT for similar type of work and system should be in operational.

- e. TL9000, ISO 20000 and ISO 27001 certified VSAT Hub and NOC services

Feature	Value
Operating Temperature	From -20 to +50
Antenna cable	Low Loss
Performance	Data Reception availability of 99% or better
Specific Features	
Communication Direction	VSAT Radio system to allow two-way communication system between Data Center and remote station
Single Hop / Double Hop	VSAT communication will be direct link, and use the internet or any surface based topology for data communication (i.e. leased lines) In case unavailability of above services double hop system should be used.
Bandwidth Sharing	VSAT bandwidth will be able to be shared among all stations but within the same customer group . It should not be shared with other users.
Alarm Conditions	VSAT remote stations shall be able to transmit based on alarm conditions at the remote site such as critical water level or exceptional precipitation events: This is a functionality of RTU / Data logger .
Accessories	All associated equipment, including Antenna all cables and mounting hardware

22.0 APPROVED VENDOR LIST FOR INSTRUMENTATION

S. No	Description	Vendor / Manufacturer / Make
1	Level Transmitters	M/s EMERSON M/s ABB, M/s Siemens M/s Endress+Hauser M/s Yokogawa
2	Flow meters/Flow Indicator/ Transmitter (Electromagnetic flow meter)	M/s ABB M/s Siemens M/s Yokogawa M/s Endress+Hauser M/s Krohne Marshall
3	Level/Float Switches	M/s EMERSON M/s ABB M/s SBEM M/s Endress+Hauser M/s Pune Techrol
4	Pressure Gauges/Pressure Switches	M/S Warree M/S ABB, M/s Wika M/s Gen Inst Co M/s Switzer M/s Danfoss

S. No	Description	Vendor / Manufacturer / Make
5	Pressure Indicator Transmitter	M/s EMERSON M/s ABB, M/s Siemens M/s Endress+Hauser M/s Wika
6	pH/Turbidity/Online Residual Chlorine Analyzer	M/s Hach Company M/s Yokogawa M/s EMERSON M/s WTW
7	DPM & Alarm Annunciator	M/s Masibus M/s Minilec M/s Peacon M/s Nishco
8	Multi-Function Energy Meter	M/s Enercon, M/s L&T M/s Masibus
9	Cables	M/s Polycab M/s Universal M/s Havells M/s Finolex M/s KEI Wires and Cables
10	Surge Protection Devices / Lightning Protection Units	M/s Hensel M/s Phoenix M/s Crompton Greaves M/s MTL Instruments M/s Pepper & Fuchs M/s Cirprotec M/s MH Instruments
11	Flow Indicator and Totalizer, Alarm Annunciators	M/s Masibus M/s Alan M/s Omron M/s NISHKO
12	Workstations, Servers	Dell, HP, ,Lenovo
13	Programmable Logic Controllers	Schneider Electric (Quantum Series), Siemens PLC(S7-400H series), Rockwell (Control Logic series), Mitsubishi, ABB
14	SCADA Programming Software	Vijeo Citect, Intellution iFix, Wonderware, Win CC, Mitsubishi
15	Control Panels / Enclosures	Rittal, Pyrotech, Hoffmann
16	Monitors / Display Screen	Samsung , LG
17	UPS	Emerson, APC, Hirel, Nelco, Aplab, DB Electronics
18	Printers	HP, Canon
19	System Console	Godrej,
20	'V'-SAT	i-Direct
21	Radio Modem	ELPRO/MTL, Prosoft Technology-USA, Calamp-USA

S. No	Description	Vendor / Manufacturer / Make
22	Wireless Gateways	ELPRO/Calamp/Teletronics

23.0 INSPECTION REQUIREMENTS

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. All testing / inspection / calibrations shall be carried out as per relevant Indian/ International/ British/ European/ ISA standard.

23.1 Instrumentation and Control

23.1.1 Factory Acceptance Test (FAT):

(a) A Factory Acceptance Test, which shall be witnessed by the Project Manager, is required for the system. No equipment shall be shipped without written confirmation by Representative of the Project Manager that the system has successfully passed its factory acceptance test.

(b) Factory Acceptance Tests shall be conducted according to test plan with detailed test procedures. The test plan and procedures shall be submitted by the Contractor for review and shall be subject to approval by the Project Manager.

(c) A complete set of system documentation, including design and maintenance documents, users manuals and the test plan and procedures shall be available during the FAT.

(d) The list of tests to be carried for both Factory Acceptance Test (FAT) along with test instruments to be used shall be furnished for review by the Project Manager. Contractor shall indicate the place of inspection and the test facilities available.

i) The testing of all the equipment and accessories shall be carried out as per latest applicable Indian/International standards recommendations.

ii) Prior to testing, all relevant documentation and sufficient briefing about the tests shall be given to Representative of the Project Manager who would witness the testing.

iii) The FAT to be performed in the factory shall include but not be limited to following:

a) Tests for guaranteed technical parameters

b) Integrated functional tests

c) Burn-in tests

d) Hydrostatic tests

e) Calibration tests

f) Power supply variation test

g) Alarm/Diagnostic check

23.1.1.1 Tests for Programmable Logic Controller (PLC)

The following tests shall be carried out for the PLC

- i. Scanning rate check for analog signals
- ii. Scanning rate check for digital signals
- iii. PLC cycle time check
- iv. Processor redundancy check
- v. Power supply redundancy check
- vi. Power supply failure alarm check
- vii. Power supply failure alarm check
- viii. Card level failure detection check
- ix. Failsafe output check on failure of output module
- x. Sensor failure detection check
- xi. Status indication check for healthiness of each input/output channel and module
- xii. Status indication check for power supply for each module
- xiii. Isolation check for input/output module
- xiv. Input filtering check for noise level
- xv. Processor – battery back-up check
- xvi. Controller functioning check on under voltage and over voltage
- xvii. Ladder logic program check by simulation of inputs and outputs
- xviii. Functional check of programming units.

23.1.1.2 Tests on local SCADA System

The following tests for various items of local SCADA system including power supply system shall be carried out as a part of FAT in addition to other tests indicated by Contractor in FAT document.

Functional

All cubicles shall be energized and the power supplies tested on the panel and internal lighting arrangements examined.

The boards shall be examined to check that there are no Status Error LEDs lit.

The peripherals like printers etc. shall be energized and proper operation of peripheral checked by self tests on equipments which have the facilities and others like VDUs, by connecting them to the system.

The system I/O shall be simulated and checked up to LOCAL SCADA system database.

By varying the different inputs at random and checking to ensure that right status reporting is done on the LOCAL SCADA system, the healthiness of all channels shall be checked with rated load connected.

Displays : The following shall be functionally checked

Mimic display: Symbols, colors, for correct/ approved format etc.

Control Operations: Simulated command operations from SCADA without any malfunctioning.

Status changes: Representation of open/close facility and mode of operation

Variables: Engineering units, updating representation

Events and alarms: Generating of alarms, events by verifying inputs at random, color code, formatting, and printing

Trend: proper selection, presentation under different time scales and printing

Reports: Reports shall be checked for correct/ approved format, logging intervals, printing intervals, data accuracy etc.

Response Time Checking:

System response time shall be tested after simulating the full I/O and Man machine interface system.

Time taken from object status change to the presentation of object status on the display.

Time taken to generate and display single alarm and multiple alarms (up to 50) from the time of alarm condition.

Time taken to display a complex picture with all variables from the time of calling the display.

The accuracy of alarms on VDU and printer.

Time stamping accuracy between LOCAL SCADA and PLC times.

Other Tests on local SCADA

Fail safe operation of local SCADA system during total (including battery) backed power failure and restoration.

Fail-safe operation during on-line connection and removal of hand held maintenance unit, if any.

Check of detecting and reporting of failure of subsystem connected to the network on VDU status display.

Check of hard copy unit functions by printing of process pictures.

Check of maintenance, backup (logic/programs, IO database, historical database, system configuration etc.) functions by connecting them to the system.

23.1.1.3 Tests on UPS system:

UPS system of local SCADA system shall be tested at manufacturer's work and also at site for its performance, functional and operation requirements.

Following are the tests to be carried out.

Voltage regulation 0-100 % of load

- Load test, current limiter operation
- Output voltage variation
- Ripple and harmonic measurement
- Efficiency and power factor
- Megger and HV test for insulation
- Heat run
- Functional tests
- Alarms and self-diagnostics tests
- Communication with local SCADA system
- DC start for UPS

23.1.1.4 Tests on Instrumentation System:

(a) Type Tests

The Contractor shall submit the test certificates for the 'Type Tests' to the Employer's Representative for approval. The type tests (as applicable) for the instruments shall be as follows:

- 'Burn In' test for electronic components
- Humidity test for electronic instruments
- Weather protection as per IS 13947
- Hysteresis test
- High voltage test
- Short circuit protection test
- Material test

(b) Routine Tests

All instruments shall be subjected to the routine tests (as applicable) mentioned below at the manufacturers works (Factory Acceptance Tests) to ensure correct functioning.

Calibration of the instruments

All the instruments shall be calibrated for accuracies as per applicable standards. The calibration shall be carried out at 0%, 25%, 50%, 75% and 100% of the range of the instrument in both increasing and decreasing directions. The instrument shall be acceptable if the accuracy and repeatability are better than those specified. The instrument used for testing shall hold a valid calibration certificate from a recognized laboratory.

(c) Over range protection test

All transmitters, digital panel meters, digital flow indicator cum integrator shall be subjected to the over range protection test.

(d) Performance test

All the instruments shall be tested by connecting to the specified power supply for the performance test.

(e) Power supply variation test

All the instruments shall work satisfactorily for the specified power supply variation. Accuracy and linearity shall not change.

(f) Hydrostatic test

All flow sensors and pressure sensors shall be tested to withstand 150% of the rated pressure. The sensitivity, accuracy and calibration of the sensors shall not deteriorate at this over-range. There shall not be physical damage.

(g) Repeatability test

All instruments shall be subjected to repeatability test over the full range at 0%, 25%, 50%, 75% and 100 % of the full range in both increasing and decreasing directions. Readings for each measurement mentioned above shall be taken for establishing the repeatability.

(h) Dimensional check

The dimensions of all the instruments shall be checked thoroughly and shall be tabulated in a good format.

i. Wherever applicable, following dimensions shall be checked/ noted

- Total length
- Insertion length
- Diameter
- Mounting head
- Process connection size etc.

ii. For panel mounted instruments and transmitters following dimensions shall be checked

- Width
- Height
- Depth

Bezel dimensions and cut-out dimensions for panel mounted instruments etc.

23.1.1.5 Quality Assurance/Quality Control (QA/QC)

QA/QC shall comply with the contract, with particular requirements specific to the equipment or service being provided.

23.1.2 Commissioning And Site Acceptance Tests (SAT)

(a) 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.

(b) Contractor shall be fully responsible for interfacing to the equipment of OTHERS as indicated in the scope of works. 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 Corporation. Problems relating to such interconnections shall be mutually resolved.

(c) After tests as above, the complete system shall be on continuous uninterrupted service with all functionalities and interconnections to Corporation's equipment for 4 weeks without any failures or manual interventions for correction, modification, rectification or replacements in the Contractor's system.

(d) Additional specific tests, if required, would be decided mutually.

(e) SAT on SCADA, UPS systems shall include the all tests covered under F AT documents except tests such heat run test and those tests which can not be conducted at site (such tests shall be approved by Corporation/Project Manager) in addition to integrated SCADA, UPS systems testing at site with all field equipment / instruments connected.

(f) SAT shall also cover the following tests for integrated SCADA, UPS systems in addition to those as indicated above.

(g) Cables

- i. Mechanical Completion: Check for physical damage and details as per approved data sheets.
- ii. Commissioning: Check connections as per the interconnection schedules/drawings.

(h) Electrical

- i. Functional checking: Commissioning checks - Check operation of all alarm circuits.
- ii. Cable testing: All cables to be meggered and checked for continuity.
- iii. Earthing: Check continuity of grid conductors, wires and measure target resistance.

(i) Integrated testing of RS-485 communication system with SCADA system.

23.2 Pre-Commissioning/Commissioning checks and tests for Instrumentation System

(a) The Contractor shall carryout the pre-commissioning/commissioning checks and tests listed below and submit the report of the same to Project Manager's Representative. The pre-ccommissioning/commissioning checks listed below are indicative and the Contractor shall prepare and submit for approval by the Project Manager's Representative the precommissioning / commissioning program proposed by him.

(b) If during the pre-commissioning/commissioning checks and tests. it is found that a instrument needs re-calibration then the instrument shall be re-calibrated by the Contractor at no extra cost to the Corporation and the test reports of the re-calibration shall be submitted to the Engineer's Representative for approval/record.

(c) Electromagnetic Flow Measuring System

- i. Check that tag plate with tag no. and description is provided.
- ii. Check that the Installation is as per manufacturer's recommendation.
- iii. Check that there is no leakage.
- iv. Check that the cable terminations are as per approved drawings.
- v. Check that cable shields are properly terminated.
- vi. Check that the earthing is as per manufacturer's recommendation.
- vii. Check that the flow meter is properly configured (installation data entry).
- viii. Check that the flow rate and totalised flow reading on the various displays match.
- ix. Check that the totaliser functions properly.
- x. Check that the data sheets and drawings are updated to reflect the as-built status.

(d) Ultrasonic Level Measuring System

- i. Check that tag plate with tag no. and description is provided.
- ii. Check that the installation is as per manufacturer's recommendation.
- iii. Check that the cable terminations are as per approved drawings.
- iv. Check that cable shields are properly terminated.
- v. Check that the earthing is as per manufacturer's recommendation.
- vi. Check that the level transmitter is properly configured (range setting) .
- vii. Check that the level reading on the various displays match.
- viii. Check that the data sheets and drawings are updated to reflect the as-built status.

(e) Conductivity Type Level Switch

- i. Check that tag plate with tag no. and description is provided.
- ii. Check that the installation is as per manufacturer's recommendation.
- iii. Check that the cable terminations are as per approved drawings.
- iv. Check that cable shields are properly terminated.
- v. Check that the earthing is as per manufacturer's recommendation.
- vi. Check that the level electrodes are connected to the correct level control units.
- vii. Check that the data sheets and drawings are updated to reflect the as-built status.

(f) Pressure Measuring System

- i. Check that tag plate with tag no. and description is provided.
 - ii. Check that the installation is as per manufacturer's recommendation.
 - iii. Check that the isolation valve with drain and test port is provided.
 - iv. Check that there is no leakage.
 - v. Check that the cable terminations are as per approved drawings.
 - vi. Check that cable shields are properly terminated.
 - vii. Check that the earthing is as per manufacturer's recommendation.
 - viii. Check that the pressure transmitter is properly configured (range setting).
 - ix. Check that the pressure reading on the various displays match.
 - x. Check that the data sheets and drawings are updated to reflect the as-built status.
- (g) Lightning Protection Unit (LPU)
- i. Check that proper LPUs are provided.
 - ii. Check that the LPUs are tagged & identified and the tagging correlates with the cable schedule and ICP drawing.
 - iii. Check that the LPUs are earthed as per manufacturer's recommendations.
 - iv. Check that LPUs are fixed rigidly.
 - v. Check that the data sheets and drawings are updated to reflect the as-built status.
- (h) Programmable Logic Controller (PLC)
- i. Check that the PLC is properly configured and installed as per the approved drawings.
 - ii. Check that the PLC wiring is as per approved drawing.
 - iii. Check that the cables terminating in the PLC are properly dressed.
 - iv. Check that the PLC is earthed as per manufacturer's recommendations.
 - v. Check that the PLC on-line battery is functioning properly.
 - vi. Check that the signals and events are getting correctly time stamped. .
 - vii. Check the PLC response when input signal is out of range.
 - viii. Check that the correct ladder program is loaded in the PLC.
 - ix. Check the PLC ladder program by simulating various IIOs under normal and abnormal conditions.
 - x. Check that the data sheets and drawings are updated to reflect the as-built status.
- (i) Instrument Control Panel (ICP)

- i. Check that the ICP is properly installed.
- ii. Check that the ICP front facia layout is as per approved drawings.
- iii. Check that the ICP and all the ICP equipment (viz. panel indicators, alarm annunciators, etc.) are connected to the proper earth.
- iv. Check that spare cutouts on the ICP are blanked.
- v. Check that the panel indicator tag plates reflect the tag no. and the correct service description.
- vi. Check that the panel meters are fixed properly in their cutouts.
- vii. Check that the instruments are identified inside the panel.
- viii. Check that the panel meter instrument ranges are as per approved data sheets.
- ix. Check that the alarm inscription details are as per approved drawings.
- x. Check that the MCBs are identified by their function.
- xi. Check the cables terminating in the ICP are properly dressed.
- xii. Check working of alarm annunciator by simulating alarm conditions.
- xiii. Check that the panel meter readings match with other displays.
- xiv. Check that the no. of decimal places and unit of measurement are same for all the displays.
- xv. Check that the data sheets and drawings are updated to reflect the as-built status.

23.3 Inspection Categories for Plant and Equipments

The following inspection and test categories shall be applied prior to delivery of the equipment, of various categories as indicated in the technical specifications for each type of the equipment:

Category A: -The drawing and QAP(Quality Assurance Plan) for testing has to be approved by the Employer's Representative before manufacture and testing. The material has to be inspected by the Employer's Representative or a third party inspecting agency approved by the Employer's Representative at the manufacturer's premise before packing and dispatching. The Expenses of two Representatives of the Employer for travel and stay will be borne by the Contractor including Air fare. The Contractor shall provide the necessary equipment and facilities for tests and the cost thereof shall be borne by the Contractor.

Category B: - The drawings of the equipment have to be submitted and approved by the Employer's Representative prior to manufacture. The material has to be tested by the manufacturer and the manufacturer's test certificates are to be submitted and approved by the Employer's Representative before dispatching of the equipment. Not withstanding the above, the Employer's Representative, after examination of the test certificates, reserves the right to instruct the Contractor for retesting, if required, in the presence of the Employer's representative. All cost for visit and travel of Employer's Representative will be borne by the Contractor.

Category C: - Samples of the materials and/or equipment shall be submitted to the Employer's Representative for pre-construction review and approval. Following approval by the Employer's Representative, the material may be manufactured as per the approved standards and delivered to the site.

The categorization of the various material, equipment and plant for purpose of inspections is as below. However this list can be altered and additions or subtractions done or categories changed in due course during the implementation of the Contract by the Employer's Representative.

23.3.1 Instrumentation Control and Automation

S. No.	Items	Category of Inspection
Instrumentation Works		
1.	Instrument Control Panel for RWPS comprising of PLC system, digital indicators, digital flow indicator and integrator, alarm annunciator, pushbuttons etc.	Category A
2.	Instrument Control Panel for CWPS comprising of PLC system, digital indicator, alarm annunciator, pushbuttons etc.	Category A
3.	Local SCADA Systems (Integrated testing with PLC system including ICP and VSat communication equipment) for RWPS, WTP and for pumping stations, wells & OHTs	Category A
4.	Digital panel meters	Category A
5.	Conductivity level switches	Category A
6.	Full Bore Electromagnetic Flow meters	Category A
7.	Ultrasonic type level measuring systems	Category B
8.	Instrumentation and Control cables	Category B
9.	Instrumentation Control Panel	Category A
10.	Pressure transmitter	Category B
11.	Alarm Annunciator	Category A
12.	Turbidity meters	Category B
13.	Residual chlorine meter	Category B
14.	PH meter	Category B
15.	Pressure Gauges	Category B
16.	Laptop Computers	Category B

23.3.2 Conditions for Supply and Inspections

For material/equipment under Category "A" and "B", the Employer's Representative will provide an authorization for packing and shipping after inspection and review of Manufacturer's Certificate for Category A and Category B.

The testing and approval for dispatching shall not absolve the Contractor from his obligations for satisfactory performance of the System.

The Employer or his duly authorized representative shall have access to the Contractor/Manufacturer's premises at suitable time to inspect and examine inspections (including testing for chemical analysis and physical properties) the material and workmanship of the material, plant and equipment during manufacture. The Contractor will be responsible for obtaining permission for such at the manufacture's premise if he is not

the manufacturer. The testing will be carried out by the Contractor/Manufacturer and certificates submitted to the Employer's Representative, who will have the right to witness or inspect the above mentioned inspection/testing at any stage desired by him. The Contractor shall forward to the Employer 3 Nos. duly certified copies of the Test Certificates and Characteristics Performance Curves for all Equipment.

If any material or any part of the works fails to pass any inspection/test, the Contractor shall either rectify or replace such materials or part of the works and shall repeat the inspection and/or test upon giving a notice. Any fault or short coming found during any inspection or test shall be rectified to the satisfaction of the Employer's Representative without any extra cost before proceeding with further inspection or wiring of that item. Any circuit previously tested, which may have been affected by the rectifications work shall be retested.

Where the Plant and Equipment is a composite unit of several individual pieces manufactured in different places, it shall be assembled and tested as one complete working unit at the Manufacturer works.

Neither the Inspection / Testing of the material or any part of the works, nor the attendance by the Employer's Representative(s), nor the issue of any Inspection Test Certificate shall relieve the Contractor from the responsibilities under the Contract.

The test Equipment, Meters, Instruments etc, used for testing shall be calibrated at recognized test laboratories at regular intervals and valid certificate shall be made available to the Employer's Representative at the time of testing. The calibration instruments used as Standard shall be traceable to National/International Standards. The calibration certificates for the test instruments shall be produced for Employer's Representative consent in advance of testing and if necessary instruments shall be recalibrated or substituted before the commencement of the test.

23.4 Spares for Instrumentation

A list of Mandatory Spares required for three years operation is given below. The quantities mentioned below are for all the three pumping stations together.

1	Instrumentation Programmable Logic Controller	Qty. required
(a)	Central processor Unit	20% of quantity or 1 No. module of each type which ever is greater.
(b)	Digital Input Module	
(c)	Digital Output Module	
(d)	Computer interface module	
(e)	Power supply module	
(f)	Analog input module	
(g)	Communication Module	
2	Alarm Annunciator	
(a)	Main microprocessor card	20% of the used quantity or 1 No. module of each type which ever is greater
(b)	Auxiliary logic card	
(c)	Fascia unit with min 12 windows	
3	Signal Multiplier	1 No.
4	Push Buttons activator. Push button contact element	20% of total used quantity or 1 No. which ever is greater
5	Selector Switches	1 No.
6	Indicating Lamps with covers	20% of total used quantity or 1 No. each which ever is greater.
7	Relays plug-in/Contactors	

Additional Technical Specification

1.1 Definitions

- a) "Battery Limits" shall mean the boundary within which the Contractor has the responsibility of providing services in accordance to the terms and conditions under this Contract;
- b) "Consumer Relation Management Centres" means the special centres, planned and established by the Contractor to provide commercial and public relations services to consumers;
- c) "Consumer or Customer" means the registered user of the water supplied through the meter at the private tap;
- d) "Contract Commencement Date" means the Date after the issue of the performance security stated in the note issued by the Employer's Representative;
- e) "Contract Completion" means the Contract Completion Date as mentioned in the Contract Completion Certificate issued by the Employer's Representative to the contractor on fulfilment of his obligations in respect of both the Design-Build and the Operation Service;
- f) "Contract Date" means the date on which the contract is signed;
- g) "Contractor" means the agency responsible for Design Build & Operation & Maintenance of the entire water system & waste water system as specified in Scope of work and in Section 6;
- h) "Contractor's Personnel" means personnel hired and deployed by the Contractor under provision of Works and Services but excluding the Agra Municipal Council (HMC) or PHED Personnel;
- i) "CPHEEO" means the Central Public Health and Environmental Engineering Organization under the Ministry of Urban Development, Government of India;
- j) "Critical Measurement Points" means the locations agreed for undertaking measurement for facilitating the monitoring of minimum Service levels stipulated in Clause of Performance Standards;
- k) "Design Build Period" means the period commencing from contract commencement date to completion of design and construction testing commissioning and trial runs of the permanent works;
- l) "Development Period" has the same meaning as Design Build Period;
- m) "Electricity Department" means the local service provider supplying electricity for facilitating Operation of the facilities;

- n) "ESR" means Elevated Service Reservoir; OHSR (Over Head Service Reservoir) has the same meaning as ESR;
- o) "Existing Assets" means infrastructure components, plant, machinery, equipment and any other units existing at the site as on the Commencement Date in the Employers Representative-ship of the Employers Representative of Assets;
- p) "Government Agencies" means all those agencies comprising of local, state and central government authorities directly or indirectly connected to provision of water and waste water collection services to the consumers in Agra
- q) "Major Maintenance" means large capital maintenance works requiring replacement of existing infrastructure / assets to be assessed and mentioned in the SIP. Only assets mentioned in the SIP are eligible for payments;
- r) "Mandatory Works" means, works which are listed in the Bill of Quantities and are required to be constructed, installed or erected and commissioned and/or rehabilitated including those during Operate and Maintenance period and in line with the provisions of this Contract unless such works require change of scope or design as agreed, as part of the works;
- s) "Minimum Service Levels" means the levels of service to be maintained in the operations, maintenance and management and service delivery to consumers, described in Clause of Performance Standards as per Section 8 of the Bid Document;
- t) "Minor Maintenance" means routine preventive or corrective maintenance works such as minor repair, reconditioning, or replacement of spare parts to ensure serviceability of existing and new infrastructure assets procured and installed by the Contractor including, pipes, electrical equipment, valves, flow meters, pressure monitoring equipment, and consumer meters, starter panel, electro-mechanical equipment etc.;
- u) "Mobilization Period" means the period in which activities defined in Section 6 would be completed. It is the period commencing from the Contract Commencement Date and extends up to limit mentioned further in this document;
- v) "New Assets" means infrastructure components, plant, machinery, equipment and any other units procured, supplied, installed, erected and commissioned by the Contractor during the Implementation period other than those existing on the site as on the Commencement Date;
- w) "NRW" means Non-Revenue Water;
- x) "Operating Payments" means the eligible payments towards operation, maintenance, repairs and service delivery after meeting the stipulated performance indicators;
- y) "Performance Standards" mean the Minimum Service Levels to be achieved and maintained by the Bulk Supplier during Contract period set forth in Section 8 of the bid document;

- z) "PHED" means the Public Health Engineering Department, GoR;
- aa) "Physical Losses" is part of the UFW and represents the volume of water leaking from the system;
- bb) "Planned Maintenance" means activities required to undertake preventive maintenance of any or all assets existing or proposed to be installed under the Contract and /or those taken over for operations under this contract;
- cc) "PMDSC" means the Consultant for Project Management Design and Supervision Consultancy as appointed by the Employer;
- dd) "Potable / Drinking Water Specification" means the water quality requirements of potable water to be supplied to the Contractor as stipulated in IS 10500, Guidelines for Physical and Chemical Parameters and Table 2.3 Bacteriological Quality of Drinking Water, in the Manual on Water Supply and Treatment, CPHEEO, Government of India, Ministry of Urban Development, New Delhi, edition May 1999;
- ee) "Preparatory Period" or "Service Improvement Plan Preparation Period" is the period commencing from the Contract Commencement Date up to the time as specified in this document during which time the Contractor will prepare the Service Improvement Plan (SIP);
- ff) "Project" means "Water Supply and Waste Water Collection System for Agra city";
- gg) "Project Report" means the Reports of AgraWater Supply System and AgraWaste Water system;
- hh) "Release Event" shall mean an event such as non-availability of water at the source, non-availability of electricity etc., or an event of force majeure;
- ii) "ASCP" means Agra smart city project or its successor agency and is synonymous with "Employer"
- jj) "Scheduled Design Build Completion Date" or "SDBCD" shall mean the date by which the construction of all the Works as per the agreed Service Improvement Plan are to be completed, commissioned and certified by the Employer's Representative;
- kk) "Schedules or Schedule" means the schedules forming part of this contract, or any one of them, as the context requires;
- ll) "Scope of Services" shall mean all those services to be provided by the Contractor in accordance to the obligations, activities, responsibilities and tasks in implementing the contract;
- mm) "Service Area" means the area where Contractor and/or AGRA or its successors is responsible for conveying water Consumers;
- nn) "Services" means all those activities, interventions, actions and tasks required as part of the implementation of design built works including all planning, design, detailed engineering,

procurement, construction, rehabilitation and operations, maintenance, and management in providing continuous pressurized water supply with improvement in level of service to the consumers in Agra; including all those activities as defined in the Scope of Services;

- oo) "SIP" mean Service Improvement Plan proposed by the Contractor and approved by Employer's Representative;
- pp) "Sub-Project means" either the Water Supply or Wastewater component of the Project;
- qq) "Water Distribution Network" is the network of pipelines downstream of the water storage capacities;
- rr) "Water Distribution Station" is the location of a ground reservoir and / or pumping station or an Overhead Service Reservoir from which when water is released, the same reaches directly to the consumers' properties through the water distribution network;
- ss) "UFW" means Unaccounted for Water and is part of the NRW. It means that quantity of water, which does not reach the desired destination from its upstream point of original measurement. UFW comprises:
 - Apparent losses such as illegal water connections and metering inaccuracies; and
 - Real losses which are leakages in the transmission networks and / or process losses.

1.2 Program Background and Objectives

Government of India has selected Agra as one of the smart city project in Uttarpradesh. Improvements to water supply for ABD area is one of the components of Agra smart city project. By implementing this project the adequate water supply with required pressure will be ensured in project area.

Water Supply improvement works

- a) Pumping station at GeoniMandi water works
- b) Transmission main from Geonimandi water works to ZPS at TajGanj
- c) Balancing CWR at Tajganj ZPS
- d) Pumping station at Tajganj ZPS
- e) Feedermain from TajGanj ZPS to zonal OHTs at Zone-1, Zone-2A,2B&2C, Zone-3, Zone-4, Zone-5 & Zone-6
- f) Distribution mains for entire ABD area
- g) House service connections for entire ABD area
- h) SCADA system for entire water supply system.

1.3 Project Objective

The objectives of the project are:

i. Water supply

- To establish continuous pressurised water supply system to consumers with quality and quantity at required pressure.
- to implement non-revenue water (NRW) management plan using district metering areas (DMA) approach
- to ensure 100 % house service connections with metering for water supply to ensure sustainability of the project by implementing a comprehensive asset management plan focussing on an integrated approach to operation & maintenance to minimize lifecycle costs.
- to adopt energy efficient water treatment processes

1.4 Employer's requirement

This part describes extent of works and Employer's requirements for works in brief. In respect of water supply, the contract includes design, construction, supply, installation, testing, trial run, operation of works and commissioning, and thereafter Operation and Maintenance services for 5 years for the entire works from commissioning date upto contract completion date and as per the stipulations of the bid document.

The contractor shall ensure the technical feasibility of the offer submitted after visiting the site. It must be clearly understood all the existing conditions and necessary improvements proposed in the project. The Contractor shall be required to design and execute every such item(s) of work(s) which are considered required or necessary for the satisfactory completion and functioning of the entire work and creating additional storage tanks, OHTs, even if such items of work are not specified in this bid document, but are essential to complete the works.

The Scope of work includes but is not limited to all necessary investigation of present system, checking the site conditions for executing all the proposals, feasibility to accommodate the proposed structures & pipelines and ensure the land availability in respect of size and ownership. Getting prior approval from Engineer-In-Charge before marking and after marking the structure on ground, adopting pipe sizes and materials strictly as per the design drawings, Ensuring necessary permissions and clearances before laying of pipelines and structures. Taking care of other utilities above and below the ground, Choosing best alignment to lay the pipelines to reduce or nullify any damage caused to existing above ground and underground utilities, Damage caused to utilities above and below ground shall be born by contractor at his own risk and cost, Contractor shall prepared his own geotechnical investigation and structural design for all CWRs & OHTs suitable to accommodate at the proposed land and get approval from competent authorities, Contractor shall follow relevant IS codes and standards for executing all works.

The Contractor shall, to the maximum extent practical and feasible, endeavour to standardize on the manufacturing and supply of Plant and equipment so as to minimize the maintenance requirements. The Contractor shall ensure that his designs are "maintenance friendly" and that all items of Plant and equipment are designed and installed in a manner which will facilitate routine and periodic maintenance operations.

All works, plants, equipment etc. shall also conform to specifications incorporated in the bid documents.

All materials and services required for procurement of the whole works shall be provided by the Contractor. Thus, the works included under this contract require design, inspection, supply, installation and commissioning within two years from contract commencement date and Operation and Maintenance for five years from commissioning date till issue of contract completion certificate.

The Employer/Employers Representative provides drawings for lump sum works as reference in the Bid. The Contractor shall review Employer/Employers Representative's data, designs and come up with its own designs for the clear water reservoir, over head tanks (OHTs) and all other associated works, based on the data and alignment suggested/allowed by the Employer/Employers Representative. The changes in the suggested works that include technical; allowed alignments etc. shall be considered only due to compelling site conditions or unforeseen technical reasons, subject to the approval of the Employer/Employers Representative or its authorised representative.

The Contractor shall be responsible for any discrepancies, errors or omissions in the specifications, drawings and other technical documents, desired output/performance of the Works, whether specifications, drawings and other documents have been approved by the Employer/Employers Representative or not, provided that such discrepancies, errors or omissions are not because of inaccurate information furnished in writing to the Contractor by or on behalf of the Employer Representative. Contractor shall not deviate from the specifications prescribed by the Employer Representative unless the proposed changes will result in better performance and cost effectiveness.

1.5 Confidentiality

The Contractor shall keep confidential and shall not, without the written consent of the Employer/Employers Representative, divulge to any Third Party any documents, data or other information arising directly or indirectly from the performance of Services under the Contract, whether such information has been furnished prior to, during or following termination of the Contract. Notwithstanding relevant Clause to the General Conditions of Contract, the Contractor may furnish to its Sub-Contractors such documents, data and other information to the extent required for the Sub-Contractors to perform their work under the Contract, in which event the Contractor shall obtain from such Sub-Contractors an undertaking of confidentiality similar to that imposed on the Contractor.

The Contractor shall not use such documents, data and other information received from the Employer/Employers Representative for any purpose other than the Services as are required for the performance of the Contract. The Contractor shall not publish, permit to be published, or disclose any particulars of the Services, Site or The Works in any trade or technical paper or advertising materials without the prior written consent of the Employer/Employers Representative.

1.6 Codes and Standards

Wherever references are made in the Contract to codes and standards, in accordance with which the Contract shall be executed, the edition or the revised version of such codes and standards 30 days prior to the Submission Deadline shall apply unless otherwise specified. During Contract execution, any changes in such codes and standards shall be applied after approval by the Employers Representative

1.7 General Principles

- The Contractor shall carry out all works, wholly, in accordance with the terms and conditions of the contract to fulfil the requirement of the project. All the materials used and the equipment installed shall be as per the specifications defined in the contract.
- The Contractor shall supply all plants, construction materials, manufactured goods, labour, machineries, equipment, etc necessary for the installation of the works in accordance with Employer's Requirement and Specifications. The said plants and materials shall include, but not limited to the following:
 - i. All pipes, fittings, valves and accessories required for the pipelines, pumping stations, clear water reservoirs and over head tanks, etc.
 - ii. All mechanical equipment, accessories and instrumentations
 - iii. All electrical equipment, accessories and instrumentations
 - iv. All SCADA and related Automation components.
 - v. All materials for concrete, grout, blockwork mortar and similar products,
 - vi. Paint, whitewash, sealing compounds, painting repair material including primer, etc.
 - vii. Steel reinforcement.
 - viii. All materials, forms and appurtenances.
 - ix. All materials required for street and roadway resurfacing, and other road restoration, restoration and/or correction to existing pipes, reconstruction of drains and sewers, etc.
 - x. All materials including water, required for testing, flushing and chlorinating of pipelines.
 - xi. All machineries, equipment and labour required for installations of the works.
 - xii. All materials used for permanent installation in the works shall be new and shall conform to the respective clauses of the specifications and if not specified they shall conform to good standards of construction practice.
- Employer reserve the right to construct any work or any part thereof on, over, under, in or through the site. Employer may use or occupy any part of the permanent work.

Generally the following activities shall be carried out for each component of this contract but shall not be limited to:

- Submission of the credential of manufacturer for supply of various materials, machinery, equipment/instruments for approval of Employers representative.
- Submission of the design/specifications, product brochures, technical data sheets, test, Quality Assurance Plan (QAP) and performance certificates etc., of all mechanical plant and works (pumps, valves, fittings etc.), instrumentation/automation SCADA system, appurtenances required for surge protection, design of the mechanical, electrical components, taking into account the interfaces to the other project components/packages and future extensions of the project.

- Construction/Installation, testing and commissioning of all civil, mechanical, electrical and instrumentation, SCADA works strictly as per scope of work, approved drawings, designs, relevant IS codes and specifications.
- Pre- commissioning checks and inspections as per requirement.
- Testing of hydraulic, mechanical, electrical and instrumentation system as per relevant IS codes and specifications and guidelines.
- Optimization of the whole system as per design parameters and commissioning of all the components including but not limited to clear sater pumping stations, laying of transmission main, construction of CWR, construction of over head tanks (OHTs), laying of distribution maind, replacement of existing house service conections and providing gap in house service connections, SCADA system for entire water supply system compatible to incorporate with IT of smart city project specifications.
- Responsibility to check the feasibility to execute and commission the components with respect to land availability and necessary clearances is solely of the Contractor, the Contractor is required to review the design of the Transfer Main pipe line, pumps, surge analysis etc. and instrumentation SCADA and Automation Control system at his own to achieve the objectives of the work.
- Getting approval of all material to be used, machinery and equipment specifications and the samples, prior to dispatch by manufacturer or supplier/installation/commissioning of work at site is the sole responsibility of the contractor. If any specific provision/references have been made in more than one specification, at different places in the tender document, the provision which is more stringent, shall be applicable.
- Providing, erecting, constructing, testing & commissioning of substation, transformer.
- The complete work of Road Crossing on National Highway, and railway crossing, shall be done by trenchless technology, and is in the scope of this contract. All other road crossings are also to be done by the contractor, by deciding a suitable method as per the instructions of the Employers Representative.
- To co-ordinate with the Operation and Maintenance staff and concerned officers of JalKal, JalNigham, PWD, Forest, BSNL, Gram Panchayat, Mining, Army/Defence, electric supply company and personnel of local water supply system or any other department/agency (for installation of new equipments etc.), with the district administrative offices and other offices for necessary approvals and certificates wherever required.
- Manufacturing, shop testing, pre-dispatch inspection, transportation to site, providing transit insurance, storage, handling at site, installation, sectional testing, pre-commissioning testing, commissioning and trial runs for all components of the system and the system as a whole, including the hydraulic, mechanical, electrical, Electro-Mechanical and instrumentation equipment.
- Analysis, design, supply and installation of Surge Control System for the operating pressure and flow for pumping mains. The contractor shall obtain surge analysis for all transmission main pipe lines (i.e. pumping main) from IISc Bangalore/IIT Delhi/IIT Chennai/IIT Kanpur/IIT Roorkee/IIT

Bombay using SAP 2 or any other recognised software as per approval of Employers Representative.

- For laying of pipe line and construction of any component of project, for Item rated works, the cost of shifting of electrical poles, transformers, telephone line, trees etc., if required shall be reimbursed to contractor under provisional sum. The permission fee for crossing of NH/SH and railway crossing shall also be reimbursed to the contractor under provisional sum on submission of the original bill of concerning department along with proof of payment done. The contractor shall be responsible for any damage occurred to telephone lines, electricity cables, OFC cables, cutting of trees, cables, distribution/pumping water mains and gas pipes, sewer lines, drains, constructed by other departments/agencies while laying water and sewer pipeline or construction of any component of the project and shall be liable to pay the amount levied by respective department(s)/agencies for the repair and/or damages so occurred.
- The submission of as-built drawings of the works is the **pre-condition for the final payment** of execution part. The final drawings shall be submitted in Six (6) copies on linen bound in an album of an approved size. The contractor shall submit all the completion drawings and approved design calculations on CD ROM/DVD in five sets with proper directory structure.
- Submission of operation and maintenance manual as per scope of works, requirements and specifications.
- Operation, routine and preventive maintenance during retention period of 1years. System shall be operated and maintained along with rectification of any defects which are observed/ pointed out by the department as defined in tender document. Payment for only operation of the system shall be admissible during retention period, and no separate payment for spares, material, equipments and labour required for rectification of defects, routine maintenance of the system shall be made.
- Operation, routine and preventive maintenance for 5 years with retention period of **(as 1st year of operation and maintenance period)** 1 year is included. Payment for all labour, spare parts, consumables, material/equipments/tools and tackles required for Operation and Maintenance shall be deemed to be included in accepted O&M charges.
- Employer will bear only **energy cost** and in case of power failure, O&M costs including diesel & lubricants cost for operation of DG set during commissioning, trial run, and Operation & Maintenance period. Cost of chemicals for treatment will be borne by the contractor/operator.
- Providing mandatory spares tools and tackles at the end of the execution of **physical works as per list required to be submitted along with the bid.**
- Existing all Civil, Pipelines, Mechanical & Electrical, Instrumentation, etc., equipments, structures, materials, etc., at the site shall be removed and transported at the location as per the instruction of the Employers representative. No extra cost will be paid for this work. Contractor shall include the cost for this work in his bid.
- Reference bench marks for Reduced Level shall be adopted as fixed by Survey of India Department.

- Arrangement of adequate security, watch and ward of the system during the execution period to safeguard the equipment and completed section of the work from any type of mishandling, theft, fire and other hazards, etc.
- Restoration of road surface after completion of backfilling of the earth shall be a part of the work.
- Premises of PHED/ULB shall be restored to planned superior premises, including greening and beautification.
- There shall be provision of daily, weekly and monthly water and power audit, water balance, to check consumption of energy per MLD for RWPH, CWPH and WTP, SPS, wastages of water and power. Separate energy meters shall be provided for lighting/auxiliary equipment.

j. Works and Components of the Facilities

Works and Components of the facilities, their design periods and design flow rates shall be as indicated the bid document herein.

A. From Commencement date to Commissioning Date:

- Managing the distribution network for distributing water efficiently, equitably and minimizing non-revenue water (NRW) and maintaining the existing system undisturbed.
- Providing continuous pressurized water supply to the connected consumers and maintaining the infrastructure.
- Meter reading, customer services and maintaining the infrastructure.
- Detecting and minimizing non-revenue connections and consumption.
- Provide consumer service connections on approval or sanction by Employer/Employer's Representative
- Provide continuous on-the-job training and institutionalise other capacity building programs and execute the programs.
- During emergency situation ensure water supply system operation so that the supply to the consumer is maintained to the best possible manner.

B. Before switchover from existing system to proposed new system

- The existing system shall be undisturbed until the new system is 100% ready to connect. The contractor shall ensure the following parameters before disconnecting existing system and switchover to new system
- The contractor shall ensure the construction of pumphouses in all respects including installation of all electrical and mechanical equipments and accessories and on completion of trial run
- The contractor shall ensure construction of CWR, OHTs in full shape after the curing period and testing and trial run of structures in full shape and ensure 100% completion of works
- Necessary permissions from respective authorities or departments to commission the project
- Necessary power supply and electrical installations before commissioning date
- Shall ensure pipeline connections, valves & equipment installations at all structures
- Ensure installation and testing of disinfecting arrangements before commissioning

- Contractor shall also ensure zonewise laying & testing and disinfecting of distribution mains after providing house service connections with water meters upto property
- After ensuring all the works in complete shape and tested as per IS standards contractor shall commission the zonewise water supply.
- During switchover period contractor shall ensure safe protected water supply to consumers and arrange necessary water supply arrangements.
- Contractor shall ensure all safety arrangements before planning for commissioning and get certified by competent authority

- Provide continuous on-the-job trainings and other capacity building programs

If the water at the Consumer location/CWRs is not found to meet Potable Water Specification then the Contractor shall report to the Employer representative and take necessary remedial steps as per directions given by Employer representative.

If the Contractor fails to achieve the services defined in performance targets, then the Contractor shall be levied with Non-Performance Adjustment as specified in Schedule 7 of section 8 of PCC. The Contractor shall not be liable for Non-Performance Adjustment to the extent such failure is attributable to a Release Event in which event the Contractor shall take necessary steps to mitigate the effects of the event and operate the potable water system in accordance with the standards of a reasonable and prudent way.

Contractor shall ensure that a minimum water level at all water retaining structures of not less than 0.30m shall be maintained at all times from reference date to the upto contract completion date.

The Contractor will supply the water through water tankers during emergencies and for special functions as per direction of Employer representative.

Replacement of equipment, assets or infrastructure which is not part of the contractor's work or agreed in the contract. Contractor will include costs for repairs of bulk flow meters, valves, panels, motor pumps and all other equipment and its spares including battery, and other equipment in his quoted price.

Useful life of equipments shall be ensured as specified in the equipment specification it will be replaced at costs of the Contractor and will not be paid.

1.8 Tests to be Carried out during O&M Period

The minimum requirement of sampling and testing is to be carried out daily at least at the points given below. This schedule shall also be maintained during the O&M period.

- Flow, turbidity, pH – online measurement for raw water; SS one hourly, daily.
- Turbidity, pH and aluminum – online measurement for clarified water; SS one hourly, daily.
- Flow, turbidity, pH, residual chlorine and aluminium – online measurement for final treated water; SS and Total Coliforms and E.Coli one hourly, daily.
- Flow, online measurement of turbidity, aluminium and SS daily in clarifier underflow and filter backwash and centrifuge supernatant.
- SS and Total Coliforms and E.Coli daily in centrifuge cake.

1.9 Phasing Of Contract

The Contract is divided into two stages (i. design and build ii. Operation and maintenance services) spread over the contract period; from the stipulated date of Contract Commencement up to the Contract Completion Date.

- I. Mobilization, preparatory and construction period as per approved designs and
- II. Operation, Maintenance, Manage, Repairs and Service Delivery Period during the contract period as per the sectional completion of work from commencement date (in case of sectional completion), till contract completion date.

1.10 Mobilization Period

During the **30 days** mobilization period the contractor is required to:

- Establish a furnished project office in Agra.
- Employ/mobilize the staff required for starting the preparatory work
- Mobilize the survey teams
- Establish Employer Representative office
- Mobilize vehicles, office (furnished), equipment, communication equipment.

1.11 Construction Program and Progress of Works

Construction Program

Contractor shall prepare Construction Program as part of contract. Construction Program shall be in the form of a Critical Path Method (CPM) or any other relevant method, Diagram showing sequences, dependencies, durations and dates for execution of all major items including sectional completion following the sub-divisions in the Bills of Quantities for the execution of the Works within the periods stated in the Contract. It shall be supported by:

- a. Construction Methodology and Data of the construction methods
- b. Equipment Utilization Schedule
- c. Manpower Utilization Schedule
- d. Subcontracting Schedule
- e. Mobilization/Demobilization Schedule

The CPM diagram incorporating the above mentioned schedules shall be prepared using Microsoft Project, or similar approved project management software, and shall be presented in hard copy and electronic form to the Employer's Representative as part of SIP.

In carrying out the Works due attention shall be paid to all measures which can reasonably be taken in order to diminish the inconvenience which the work may cause to services and access to property.

1.12 Design Considerations

Tenderer shall take following into consideration in preparation of his proposal and for subsequent Designing and Detail Engineering in the event of his selection for the execution of the proposed work.

1.13 Treated Water Quality

Facilities shall be designed so that the Treated water quality always meets drinking water requirement as defined in the Section 6 and as listed in table below:-

Table 1: Treated Water Quality Requirements

Sr. No	Characteristics	Value
1	Turbidity (NTU)	≤1
2	Colour (Units on Platinum Cobalt scale)	5 or better
3	Taste and Odour	Unobjectionable
4	PH	7.0 to 8.5
5	Total dissolved solids (mg/l)	500
6	Total hardness (as CaCO ₃)(mg/l)	200
7	Chlorides (as Cl)(mg/l)	200
8	Sulfates (as SO ₄) (mg/l)	200
9	Fluorides (as F) (mg/l)	1.0
10	Nitrates (as NO ₃) (mg/l)	45
11	Calcium (as Ca) (mg/l)	75
12	Magnesium (as Mg) (mg/l)	≤ 30
13	Iron (as Fe) (mg/l)	≤0.1
14	Manganese (as Mn) (mg/l)	0.05
15	Copper (as Cu) (mg/l)	0.05
16	Aluminum (as Al) (mg/l)	0.03
17	Alkalinity (mg/l)	200
18	Residual Chlorine (mg/l)	0.35 to .45
19	Zinc (as Zn) (mg/l)	5.0
20	Phenolic compounds (as Phenol) (mg/l)	0.001
21	Anionic detergents (mg/l)(as MBAS)	0.2
22	Mineral Oil (mg/l)	0.01
23	Arsenic (as As) (mg/l)	0.01
24	Cadmium (as Cd) (mg/l)	0.01
25	Chromium (as hexavalent Cr) (mg/l)	0.05
26	Cyanides (as CN) (mg/l)	0.05
27	Lead (as Pb) (mg/l)	0.05
28	Selenium (as Se) (mg/l)	0.01
29	Mercury (total as Hg) (mg/l)	0.001
30	Polynuclear aromatic hydrocarbons (PAH) (mg/l)	0.2
31	Pesticides (total, mg/l)	Absent
32	Gross Alpha activity (Bq/l)	0.1

Sr. No	Characteristics	Value
33	Gross Beta activity (Bq/l)	1.0

Table 2: Bacteriological Quality Requirements

Organisms	Guideline value
Clear water entering the distribution system	
E.coli or thermotolerant coliform bacteria	Must be absent
Total coliform bacteria	Must be absent

1.14 Clear water reservoir

A clear water reservoir of capacity proposed 10 LL as balancing reservoir for pumping to zonal OHTs.

1.15 Transmission mains and Feeder mains:

The transmission main from GeoniMandi WTP to TajGanj ZPS of 1200mm MS pipe with 10mm thickness protected with epoxy coating and gunneting

1.16 Water Distribution System

The scope of work includes, but is not limited to the Design, Construction, Supply, Installation, Testing, Commissioning, Trial Run, and 5 yr. O&M of all Civil, Mechanical, Electrical and Instrumentation Works related to clear water rising main, Distribution system with other ancillary structures along with all material labour and Tools and plants, operating the system and maintaining within limits of the performance indicators and training to the maintenance personnel.

The water supply scheme proposed in this project is planned considering continuous pressurized water supply for Agra. Pre-requisites for implementing continuous pressurized water supply, with adequate residual head of 12 mwcis the availability of sufficient quantity of water and an efficient pipe network for distribution of water.

Existing distribution system with AC and PVC.pipes will be completely phased out as most of the pipes are damaged and totally new distribution system with HDPE pipes envisaged. For design of the water distribution network, design criteria shall be as per CPHEEO manual.

1.17 Pumping Stations

The scope of work shall include but not to be limited to.

Surge protection system for rising main shall be provided as per design to be put forth by the contractor. However, contractor executing the works, will take in consideration the details of approved pump head calculations and pump characteristics curves, system curves, data sheets etc, in order to ensure proper design of surge protection for the pipeline system. Detailed surge analysis shall be carried out by the bidder and necessary devices like zero velocity valve, air cushion valve, air valves and/or surge vessels etc. shall be provided accordingly. No extra claim shall be entertained on this

account. Contractor shall also prepare a hindrance plan, according to which the route shall be finalised in consultation with Employers Representative. No claim, on account of any change in alignment/level shall be entertained.

- Providing suitable support structures for pipe. The saddle supports shall be provided with minimum 10 mm thick MS plate for supporting pipe line on saddles and roller support where above ground. Alternatively PTFE bearings with stainless steel plate and supported with MS saddle shoe, may be provided in order to reduce friction. At each bend a designed thrust block shall be provided and at all in-line valves and scour valves, a properly designed anchorage shall be provided. Permanent guard rails shall be provided by the side of the pipelines, if the pipelines are above ground.
- No consumer connection shall be effected from any water transmission main and feeder main
- House connections are to be transferred from existing water mains to proposed water distribution mains. The House connections shall be given from water main up to x 200 mm dia. For 200mm and above parallel water distribution main has to be proposed.

1.18 Routine Tests

- a) All routine tests shall be carried out as per the latest edition of IS 325.
- b) Acceptance Tests
Full load test to determine efficiency, power factor and slip shall be conducted on all the motors.
- c) Type Tests
The following type tests shall be carried out on one motor of each rating:
 - i. Temperature rise test
 - ii. Momentary overload test
 - iii. Vibration measurement test
 - iv. Noise level test
 - v. Over speed test
 - vi. Full load test to determine efficiency, power factor and slip
 - vii. Starting current, starting torque and pullout torque at reduced voltage

1.19 Pumping Station – Pipe work General Requirements

The Contractor shall supply, deliver and erect all pipework and fittings within the structures and externally to the limits indicated on the Contract drawings and in accordance with each section of the Specification.

Pipework and fittings shall be suitable for a safe working pressure equivalent to the maximum working pressure of the system.. The safe working pressure of the pumping mains shall be the closed valve head of the pump plus the maximum static suction head. All pipe work and fittings shall be of adequate strength to accommodate the maximum surge pressure of the system.

The minimum pressure rating of pipework and fittings shall be 10 Bar the exception being ductile iron pipework and fittings which shall have a minimum pressure rating of 16 Bar.

There shall be a sufficient number of mechanical joints to enable mechanical plant and valves to be disconnected from built – in pipework. Such joints shall be tied and shall not be allowed to sustain the weight of any pipework.

All pipework and fittings shall be sized for the required capacity at a velocity limit depending on the nature of the fluid or substance to be conveyed. Under no circumstances shall the velocity exceed 2.50 m/s.

All pipework shall be adequately supported by purpose made fixings. Support shall not be provided by plant or equipment.

The position of any thrust blocks required shall be indicated on the Contractor's detailed drawing together with the position of any sleeving required through partition walls in buildings. Puddle flanges shall be provided for building in at locations in which pipes 80mm diameter and above pass through structural concrete below ground level.

Where pipework is connected to plant and equipment readily mountable fittings in the form of unions or flanged adaptors shall be provided. The flanged adaptor on the delivery pipe of pumps shall be located upstream of the reflux valve where appropriate.

Flexible joints shall be provided in all pipework subjected to linear constraint. All jointing work including the provision of suitable full face gaskets not less than 9mm in thickness and galvanised fastenings shall be included.

Pump suction bellmouths shall be standard castings in either cast iron or ductile iron. Unless otherwise specified, tee pieces shall have a radial branch to enable a more streamlined flow from branch to body. Due allowance shall be made for reinforcement in the vicinity of the branch.

Prior to despatch each item of pipework or associated fitting shall be clearly identified in paint with the plant item number indicated on the Contractor's arrangement drawing.

Puddle flanges shall be provided on all pipes where they pass through pumping station walls. Each puddle flange shall be continuously welded to the pipe on both sides of the flange.

Pipe jointing surfaces and components shall be kept clean and free from extraneous matter until the joints have been made or assembled. Care shall be taken to ensure that there is no ingress of grout or other extraneous material into the joint annulus after the joint has been made.

The dimensions of gaskets shall comply with IS 12820. Gaskets shall be manufactured from material complying with IS 4870 for type 1 rings.

Pump suction and delivery manifolds shall be provided with a drain valve where natural drainage does not occur.

Hydraulic testing shall be carried out after all fabrication has been completed.

The Contractor shall be responsible for cleaning the internal surface of all pipes prior to erection particularly the removal of weld deposits. Initial capping of the ends for protection during transport and storage shall not be removed until erection is to take place.

1.20 Pipework and Fittings

Cast iron pipes shall conform to IS 1536.
Cast iron fitting shall conform to IS 1538.

1.21 Welder Qualification

Before welding work commences on pipework, the Contractor shall satisfy the Engineer's Representative that the welders have previously carried out similar welding work within recent months. The standard for welders shall be as required by IS:817-1966

1.22 Pipework Installation

All pipework, pipe fittings, jointing materials etc., shall be of the best quality, free from defects and obtained from a supplier approved by the Engineer. The installation of the pipework shall be carried out using skilled personnel and pipework shall be installed according to the drawings provided by or approved by the Engineer. Where valves are incorporated in pipework, the valves shall be provided with their own supports, such that no excess loading is exerted on pipework. All pipework materials shall be off-loaded, stored on site and handled thereafter in such a manner that they are adequately protected from damage or deterioration.

Unless otherwise stated all underground pipes shall be buried in trenches which have been excavated in accordance with the relevant section of the Specification.

Before being used, each pipe casting or fitting shall be properly examined and should it appear defective in any way, it shall be set apart and not used until it has been examined and passed by the Engineer. All metal pipes which shall be buried in the ground shall, prior to their installation, be slung and sounded in an approved manner. Any pipe found to be faulty by this method, shall be set aside for examination by the Engineer.

All pipework shall be cut with proper pipe cutting tools. The use of hammer and chisel for this purpose shall not be permitted. Great care shall be exercised when cutting concrete/bitumen lined spun iron and ductile iron pipes, to ensure that there is no damage to the lining. Should any damage to the lining take place which is to an extent which the Engineer deems to be undesirable, then the pipe shall be rejected. The Contractor shall then prepare another pipe for incorporation into the works. All pipes which have been cut shall have the edges dressed and deburred.

1.23 Valves

- a) Sluice Valves shall be of CI, DF opening in clockwise direction.

Sluice valves shall be of the following types:-

- i. Waterworks Purposes to IS:2906 / IS:780.

The type and size of valve to be used at each location shall be as indicated on the Drawings.

Where sluice valves above 350mm. bore are mounted with the spindle in the horizontal plane, the valve bodies shall be fitted with renewable machined gunmetal gate slides, and the gates with renewable hard bronze shoes, accurately machined to reduce sliding friction.

The mode of operation of the valves shall be as stated in item description in the Bill of Quantities.

b) Reflux Valves / Non Return Valves

Reflux valves shall comply with IS 5312 (Part I) unless otherwise specified. They shall be double flanged CI type.

All reflux valves shall be suitable for operating in the horizontal plane unless otherwise specified.

Reflux valves shall carry identification marks and/or plates in accordance with IS 5312.

1.24 Specifications for Horizontal Split Casing pumps

a) Codes and standards

The design, manufacture and performance of the pumps specified herein shall comply with the requirements of the applicable Codes and Standards, as follows, but not limited to:

No.	Standard	Title
1	IS 6595 (Part II)	Horizontal centrifugal pumps for clear, cold and fresh water.
2	IS 9137	Code for Acceptance Tests for Centrifugal, Mixed flow and Axial pumps.
3	IS 13537	Technical specification for centrifugal pumps - Class 2
4	ISO 5199	Standards of the Hydraulic Institute of USA.
5	ISO 2373	Balancing of impeller.
6	IS 5120	Performance test of pumps
7	IS 11732	Mechanical Balancing

b) Features of construction

IMPELLER

The impeller shall be an enclosed impeller, made in one piece and securely keyed on the shaft. The installation will include means to prevent loosening of the impeller during operation, including rotating in the reverse direction. The impeller shall be statically and dynamically balanced to prevent vibration, as per ISO 2373.

CASING RING

The pump shall be provided with a renewable type casing ring, to offer wearing resistance. Hardness of the casing ring shall be 50 BHN (Brinell Hardness Number Units), lower than the impeller ring.

IMPELLER RING

The pump impeller shall be provided a renewable type impeller ring on both ends. The material of construction of these rings shall be similar to that of impeller and these shall be hot push fit on impeller. The rings hardness shall be equal to impeller and 50 BHN more than the casing rings.

SHAFT

Single integral shaft, shall be designed to withstand the torque loads throughout the whole range of operating conditions, for the selected particular impeller diameter as well as all the impeller diameters covered between minimum and maximum impeller diameters when coupled to the motor shaft through flexible coupling. The shaft design should also include the possibility of running the pump with an electric motor of higher power rating meant for future expansion with increased impeller diameters.

SHAFT SLEEVES

Replaceable shaft sleeves shall be provided to protect the shaft where it passes through stuffing boxes. The end of the shaft sleeve assembly shall extend through the packing gland. Shaft sleeves shall be securely locked or keyed to the shaft to prevent loosening. Shaft and shaft sleeve assembly shall ensure concentric rotation.

STUFFING BOXES

Stuffing boxes at driving end and non-driving end shall be of such design that they can be re-packed, without removing any part, other than the gland and lantern ring. An axially split gland should be used to facilitate changing the gland packing. Sufficient space shall be available for maintenance purposes.

AIR RELEASE VALVES

Pump shall be provided with arrangement of valve to vent air, which may get accumulated in the pump.

SEALING

Self sealing water connections should be provided.

FLANGES

Flanges shall be machined flat, with flange faces vertical and at right angles to the pump mounting surface. Cast iron flange drilling and thickness shall conform to IS 1538, (part IV and VI) for ID upto 1500mm and to IS 6392 for ID greater than 1500mm.

BEARINGS

Bearings shall be either grease or oil lubricated and should absorb the radial and axial thrusts, under all operating conditions. Anti-friction bearing shall be of standard type and shall be selected to give 20,000 hours continuous operation at rated operating conditions. The rise in bearing oil/grease temperature with continuous running of the pump shall be within the allowable limits which shall not exceed 20°C for grease and 30°C for oil lubricated bearings above ambient temperature. Cooling arrangements shall be provided if required. Bush bearings will not be acceptable.

BASE PLATE

The common base plate for pump and motor shall be fabricated from mild steel sections and have sufficient rigidity to resist vibration and distortion. Suitable holes shall be provided for grouting and they shall be so located that the base will be able to be grouted in place, without disturbing the pump and motor. All pumps and motors shall be properly and accurately aligned, bolted and doweled to the base plate. Adequate space shall be provided between pump drain connections and base plate for installation of minimum 20 mm diameter drain pipe. Foundation bolts shall be complete with nuts and flat and shake proof washers.

COUPLING

A flexible pin bush type coupling shall be provided, duly bored and keyed to the pump and motor shafts. The coupling and the pump shafts have to be designed so that the breaking load of the coupling system is slightly below that of the shaft.

ACCESSORIES

All specified accessories and any other standard accessories required for correct and safe operation of the pump shall be furnished with the pumps. All incidental piping (including valves) required for sealing, lubrication and cooling of stuffing box packing and/or pump bearing shall be furnished by the Contractor.

A mild steel fabricated coupling guard shall be provided to provide a safeguard against the open rotating parts of the pump and motor.

Eye bolts (as many as required for safety), shall be provided for ease of lifting and installation.

c) Technical particulars

Features & Material of Construction

Drive	Direct
Flange Drilling	IS 1538
Prime mover	Electric Motor (Refer Electrical section)
Casing	Cast Iron IS: 210 – Gr. FG 260 with 2 % Ni
Impeller & impeller rings	SS (CF8M)
Shaft	SS (AISI 410)
Shaft Sleeve	SS (AISI 410)
Casing rings	SS (CF8M, CA15)
Glands	Bronze grade LTB2 of IS 318
Gland Packing	Graphite Asbestos
Lantern Rings	CI
Gaskets	Manufacturer's Standard durable.
Fasteners (Bolts)	Forged Steel for Pressure Parts and Carbon Steel for Non-Pressure Parts.

Drive data

1	Motor	0.415 KV motor, (TETV) Squirrel cage induction motors For details refer to Motor Specifications
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d) Accessories and services required to be supplied by the Contractor with pump.

The contractor is supposed to provide at least the following accessories

1. Base Plate
2. Foundation Bolts
3. Coupling
4. Coupling guard

DRAWINGS AND INFORMATION TO BE PROVIDED

During detailed engineering the Contractor shall submit the following:

1. General arrangement, cross-sectional and dimensional drawings/data pertaining to selected model.
2. Complete detailed drawing of the base plate
3. Complete performance curve with
 - (a) H - Q curves for complete range of impellers between minimum and maximum size of impellers and efficiency curves super imposed on them, highlighting selected impeller diameter.
 - (b) Shaft Power - Q curves for complete range of impellers.
 - (c) Efficiency -Q curve for complete range of impellers.
 - (d) NPSHr – Q Curve for the complete range of impellers.
4. Test reports, performance curves and other particulars, as required by the applicable clauses of this specification.

INSTRUCTION MANUALS:

1. Instruction manual for Erection
2. Instruction for pre-commissioning check up, operation, abnormal conditions, maintenance and repair
3. Write up on Controls and interlocks provided
4. Recommended inspection points and periods of inspection
5. Schedule of preventive maintenance
6. Ordering information for all replaceable parts
7. Recommendations for types of lubricants, lubricating points, frequency of lubrication and lubricant changing schedule.

e) Dewatering/Drainage and water circulation Pumps

The dewatering pumps shall be provided at all pumping stations (raw water and clear water) with 100% stand by units. Pumps, if provided for water circulation for cooling shall also be provided with 100% stand by units. These pumps must, comply with following features.

GENERAL

The dewatering pump shall be of suitable capacity and head. 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.

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 fixed set shall operate manually and automatically controlled by low and high level switches in the drain pit.

FEATURES OF CONSTRUCTION

1	Impeller	Bronze Grade LTB II of IS 318
2	Casing	Cast Iron Grade FG 200 of IS 210
3	Shaft	40C8 of IS 1570
4	Motor	415 V, 3Ph AC supply, submersible

DRAWINGS AND INFORMATION TO BE PROVIDED

During detailed engineering the Contractor shall submit the following:

1. Leaflets on dewatering / water circulating pump.
2. Cross sectional drawings with performance curves.

INSTRUCTION MANUALS:

1. Installation manual for erection
2. Instruction for pre-commissioning check up, operation, abnormal conditions, maintenance and repair
3. Recommended inspection points and periods of inspection
4. Schedule of preventive maintenance
5. Ordering information for all replaceable parts
6. Recommendations for types of lubricants, lubricating points, frequency of lubrication and lubricant changing schedule.

1.25 Pressure Gauges

Pressure gauges shall be of approved manufacture and suited for use in sewage. The gauges shall be fitted with diaphragm type isolating valves.

1.26 Labels

The Contractor shall arrange for the supply and fitting of engraved identification labels to all valves and items of plant. The reference numbers of all valves shall be as indicated on the schematic diagram to be supplied under the Contract.

All warning labels shall comply with relevant IS and of screw fixed rigid construction.

Designation labels shall be of 5 mm Traffolyte with black lettering on white background. Embossed materials and techniques shall not be accepted.

The Contractor shall provide 2 No. enamelled iron plates worded "Men Working on Plant". The plates shall be 200mm x 75mm with red lettering on a white background.

The Contractor shall also provide and fit warning labels for machinery that is operated under automatic control.

All identification and warning labels shall be in English.

1.27 Guards

Adequate guards shall be supplied and installed throughout the installation to cover drive mechanisms. All rotating and reciprocating parts, drive belts, etc. shall be securely shrouded to the satisfaction of the Engineer to ensure the complete safety for both maintenance and operating personnel. However, whilst all such guards shall be of adequate and substantial construction they shall also be readily removable for gaining access to the plant without the need for first removing or displacing any major item of plant. The guards shall be of the open mesh type except where retention of fluid spray is required.

1.28**Suppression of Noise**

All plant offered shall be quiet in operation. The noise level within the building shall not be more than 85 decibels (+5 per cent on this over the audible frequency spectrum measured at mid-band.) "A" scale when measured along a contour 3 metres from any single item of plant during starting, running and stopping. The noise level outside the building shall not be more than 60 decibels (+5 per cent on this over the audible frequency spectrum measured at mid-band.) "A" scale when measured along a contour 3 metres from the external wall. Noise test measurements shall be made on completion of the installation of the plant at Site to verify that it complies with this Clause. Plant which fails to comply with the noise level limits when tested will render it liable for rejection unless it is satisfactorily modified at the Contractors expense by the programmed commissioning date.

1.29 Manually Operated Travelling Crane

- a) Supplying, erecting, testing & commissioning of Hand operated Travelling Crane (HOT) (single bridge girder carrying two wheels , complete with chain pulley block, load chain of welded construction of alloy steel as per IS:2429, hand chains for hoisting & traverse mechanism, totally encased Gears, trolley, trolley track wheels. Axle & shaft, swivel type lifting hook as per IS:3815, lock to prevent hook from swiveling, brakes for lifting gear, suitable for the above parameters and as per the direction of the Engineer.

1.30 Trolley and Chain Pulley Block

- a) The chain pulley block shall be operated on the lower flange of the bridge girder.
- b) The load chain shall be made of alloy steel as per IS: 3109. It shall be heat treated to give ductility and toughness so that it will stretch before breaking. It shall be of welded construction with a factor of safety not less than 5.
- c) The hand chains for the hoisting and traverse mechanism shall hang well clear of the hook and both the chains shall be on the same side. The hand chain wheel shall be made from pressed sheet steel and shall be provided with roller type guarding to prevent snagging and fouling of the chain.
- d) All the gearing shall be totally encased. Proper lubricating arrangements shall be provided for bearings and pinions. Gears shall be cut from forged steel blanks. Pinions shall be of heat treated alloy steel. Gears shall be as per BS:436/IS:4460.
- e) The trolley track wheels shall be rim toughened, heat treated carbon steel or low alloy steel or C.I. and shall be single flanged and shall have antifricition ball bearings. The wheels shall be machined on their treads to match the flanges of the track joints.
- f) The travelling trolley frame shall be made of rolled steel conforming to IS:2062. The side plates of trolley frame shall extend beyond wheel flanges, thus providing bumper protection for the wheels. The two side plates shall be connected by means of an equalizing pin.
- g) Axles and shafts shall be made of carbon steel and shall be accurately machined and properly supported.
- h) The lifting hooks shall be forged, heat treated alloy or carbon steel of rugged construction. They shall be of single hook type provided with a standard depress type safety latch. They

shall swivel and operate on antifriction bearings with hardened races. Locks to prevent hooks from swiveling shall be provided. Hook shall be as per BS: 2903 / IS: 3815.

- i) The brake for the lifting gear shall be automatic and always in action. It shall be of screw and friction disc type self-actuating load pressure brake. Brakes shall offer no resistance during hoisting.

Data

Description	Particulars
Capacity	2 Ton
Span	On the roof ceiling 17.5 m long and 6m wide
Lift	About 14.0 m

1.31 Electrical Works

1.31.1 Scope of Work

Control panels, power distribution and control cabling, plant and area lighting, DG set, power transformer etc whatsoever required for completion of work & successful operation is included in the work.

The main Power supply will be provided by Jodhpur VidyutVitaran Nigam Ltd (JVVNL) for which the funds will be deposited through the provisional sum. The work up to DP and Metering will be carried out by JVVNL and the contractor will be required to make the remaining power supply arrangement for the STP. This will broadly include, but not limited to following:

The work after metering which includes 11 KV DP, transformer, 11 KV cable with terminations, LT PMCC Panels, starters, LT cables etc. shall be provided by the contractor if supply is on 11 KV.

Provision of main LV switchboard, Screen DB cum Control Panel and lighting panels (as per drawing), glanding, termination and connection of incoming and outgoing cables including provision of lugs etc., metering, protections and indications shall be provided on the LV switchboard and other DBs as per the design criteria given subsequently.

Provision and installation of an APFC control panel having a capacitor bank with a rating of suitable kVAR (switchable in at least 8 steps) and associated protection, indications and metering, and glanding, termination and connection of the incoming cable including provision of lugs, etc. The APFC panel shall have a micro processor based relay to improve the overall plant 'pf' up to a minimum of 0.98 lag.

Provision of earthing for all the electrical equipment such as main LV switchboard, other DBs and control panels, APFC panel, main motors, process equipment, valve actuators, drainage pump motor, exhaust fan motors, etc. by GS flats and wire of sizes given elsewhere in the specification and interconnecting with the auxiliary earthing grid inside STP/SPS, including installation on floor/wall, all including fixing, clamping, welding, bolting etc.

Provision and installation of XLPE/ PVC insulated cables, of sizes given elsewhere in the specification and drawing, in air, buried in ground and in trench and their termination and connection at the transformer, main LV switchboard, other sub-DBs, panels, motors, etc. including fixing, clamping, glanding, provision of lugs, etc.

Provision and installation of a local Start/Stop push button stations (boxes) made from GS sheet as required including its earthing by 12 SWG GI wire and termination of cable.

Provision of overall earthing, cabling and lighting systems as per the enclosed detailed specifications and drawings.

1.31.2 System Parameters

(a) Voltage	11 KV \pm 10% , 3 phase, 3 wire for HT and 415V, 3 phase, 50 cycles for LT system
(b) Short circuit level	1100 V \pm 10 % 3 phase, 4 wire 18.4 KA for 1 second for 11 KV system
(c) Frequency	50 C/S \pm 5%
(d) Ambient Temperature	50°C
(e) Earthing System	Solidly earthed
(f) Control circuit	AC, 230V, Single phase
(g) Lighting circuit	AC, 230V, single phase

1.31.3 General Criteria

The General Criteria followed for the equipment and systems are as given below.

Equipment

All the indoor electrical equipment shall be rated and sized for a 'design ambient temperature' of 45°C, while all the outdoor electrical equipment shall be rated and sized for a 'design ambient temperature' of 50°C.

The main LV switchboard and other DBs shall be with 'Form-4' enclosure as per the Indian Standards. All indoor boards/panels shall be with a degree of protection of IP 54, while all outdoor equipment shall be with a degree of protection of IP 55.

All LT power cables shall be 1100 V grade, XLPE insulated, extruded inner and outer PVC sheathed, stranded aluminium conductor and armoured, while all control cables shall be 1100 V grade, PVC insulated, extruded inner and outer PVC sheathed, stranded copper conductor and armoured.

All the electrical equipment, accessories and systems shall conform to the latest editions of the Indian Standards or other equivalent international standards.

1.31.4 Cabling, Earthing and Lighting Systems

The cabling/earthing/ and lighting system shall got approved from Employer. Main earthing conductors outside and inside the building shall be planned in such a manner that all the equipment are connected to the earthing system by two connections in a reliable manner.

1.31.5 Protections

The following protections shall be provided on the LV switchboard/Sub-DB, as applicable.

- i. Thermal overload and short circuit protection features on MCCBs and MCBs for feeders
- ii. Thermal overload, locked rotor, short circuit, negative sequence and earth fault protection for main motor feeders
- iii. Overload protection by thermal (bimetal) relays with single phasing preventor (SPP) for contactors for other motor feeders

1.31.6 Metering

The following metering shall be provided on the main LV switchboard/Sub-DBs.

- i. Incomer
 - Ammeter with selector switch
 - Voltmeter with selector switch (only for main LV switchboard)
 - Kilowatt meter (only for main LV switchboard)
 - Power factor meter (only for main LV switchboard)
 - Kilowatt-hour meter (only for main LV switchboard)
- ii. Outgoing Feeders of main LV Switchboard
 - MCCB and Ammeter with CT's & selector switch on main motor feeders
- iii. Indicating Lamps

The following indications will be provided on the LV switchboard/Sub-DB, as applicable.

- Incomer
- Supply 'ON' (Red, Yellow & Blue)
- Phase Motor Feeders
- Motor 'ON', 'OFF' & 'Trip' indications (Red, Green & Amber)

1.31.7 Transformers

General

The transformer tank shall be made from high-grade sheet steel, suitably reinforced by stiffeners made of structural steel sections. All seams, flanges, lifting lugs, braces, and other parts attached to the tank shall be welded. The interior of the tank shall be cleaned by shot blasting and painted with two coats of heat resistant, oil insoluble paint. Adequately sized manholes shall be provided for ease of inspection and maintenance. Steel

bolts and nuts exposed to atmosphere, shall be galvanised. The tank cover shall be removable and shall be suitably sloped so that it does not retain rainwater.

The thickness of transformer tank (rolling tolerance as per IS) shall be Top & (i) Bottom – 5 mm, (ii) Sides – 4 mm. Lifting lugs and eyebolts shall be so located that a safe clearance is obtained without the use of a spreader, between the sling and transformer bushings.

- a. Transformers of rating above 200 kVA shall be equipped with detachable or separately mounted radiator banks. Transformers of rating 200 kVA and below shall be three star level with fixed type radiators. Fins of the radiators shall not have sharp edges and shall be rounded in shape.
- b. When transformers are provided with separately mounted radiators, flexible joints shall be provided on the main oil pipes connecting the transformer tank to the radiator banks, to reduce vibration and facilitate erection and dismantling. The interconnecting pipes shall be provided with drain plug and air release vents.
- c. The transformer core shall be constructed from high grade, non-ageing, cold-rolled, grain oriented, silicon steel laminations. The steel laminations shall be of "core" type. Each lamination shall be coated with insulation which is unaffected by the temperature attained by the transformer during service. Core laminations shall be annealed and burrs removed after cutting. Cut edges shall be insulated. The framework and clamping arrangements of core and coil shall be securely earthed inside the tank by a copper strap connection to the tank.
- d. Windings shall be of insulated copper wire or copper strip. Windings and insulation shall be so arranged that free circulation of oil is possible between coils, between windings, and between winding and core. The windings shall be fully shrunk under vacuum before assembly. High voltage end-windings shall be suitably braced to withstand short circuit stresses and stresses caused up by surges.
- e. Off-load taps shall be provided on the HV winding.
- f. The core and coil assembly shall be dried out and impregnated under vacuum.
- g. The sequence and orientation of HV/LV side phase and neutral bushings shall be as specified in the latest edition of relevant IS.
- h. Transformer shall operate without injurious heating at the rated KVA and at any voltage up to + 10 % of the rated voltage of any tap. Transformer shall be designed for 110 % continuous over fluxing withstand capability.
- i. Noise level of the transformer shall be less than 80 dB conform to IS -2026.

1.31.8 Bushing

Solid porcelain bushings with brown glaze shall be used up to 12 kV class. Solid bushings shall have the characteristics specified in the latest edition of IS 2099.

1.31.9 Cable Terminations

LV side cable boxes shall have sufficient space for segregating the cable cores and for adequate clearance in air between bare conductors at the terminals. Cable boxes shall be complete with necessary glands, lugs and armour grips.

All auxiliary wiring from current transformers, buchholz relay, oil/winding temperature indicators, etc. shall be marshalled to a separate weatherproof and vermin proof marshalling box with an independent access cover. The degree of protection of the enclosure of the marshalling box shall be IP 55.

The marshalling box shall be complete with necessary cable glands and cable lugs. The marshalling box and components shall comply with the requirements specified for control cabinets elsewhere in this specification.

1.31.10 Applicable Standards

The transformer and its accessories shall conform to the latest editions, including all amendments and revisions, of the following standards.

- | | | |
|--|---|--|
| a. Power transformer | : | IS 1180, 2026/IEC 60076 |
| b. Fittings & Accessories | : | IS 3639 |
| c. Transformer oil | : | IS 335/IEC 60296 |
| d. Bushing > 1000 V AC | : | IS 2099/IEC 60137 |
| e. Transformer above 200 KVA rating | : | CBIP Pub. No. 295 Manual on Transformers |
| f. Transformer of rating 200 KVA & below | : | Three star level with BEE |
| g. Specifications | | |

1.31.11 Fittings and Accessories

The following fitting and accessories shall be provided on the transformer.

- Inspection manhole in the cover.
- Lifting lugs for both the transformer and the core.
- Two earthing terminals on opposite ends of the transformer tank.
- Name plate, rating plate and diagram plate.
- Radiator banks with suitably located thermometer pockets for measuring inlet and outlet oil temperature.
- Conservator, complete with filling plug, sump and drain valves and a shut-off valve on the pipe connection between transformer tank and conservator, to permit removal of the conservator. The conservator shall be designed to maintain an oil seal up to a temperature of 100 degree C.
- Oil temperature indicator with a range of minimum 30 degree Celsius up to the maximum operating temperature.
- Weather proof dehydrating breather with activated alumina or silica gel as the dehydrating agent.

- For transformer rating above 250 kVA, magnetic type oil level gauge mounted on the conservator, and with a low oil level alarm contact and a waterproof and dustproof terminal box. For transformer less than 250 kVA, oil level indicator shall be provided.
- Gas detector relays, with separate alarm and trip contacts, complete with shut-off valves.
- Separate drain valve, oil-sampling valve with plug and a top filter valve on the tank.
- Explosion vent with diaphragm. The device shall be rainproof. An equaliser pipe connecting the pressure relief device to the conservator shall be provided.
- Separately mounted, waterproof and dustproof marshalling box (IP 65) housing the oil temperature indicator with alarm and trip contacts and marshalling facilities for electrical devices mounted on the transformer. Winding temperature indicator shall be provided for transformer rating of 250 kVA and above.
- Adequate number of air vents for relieving trapped air during oil filling and during maintenance.
- Thermometer pockets and sensing element mounted on the transformer tank cover for measuring top oil temperature.
- Bidirectional wheels for movement of the transformers.
- Accessories for clamping the wheel to the foundation channel in order to withstand earthquake forces.
- Adequate amount of insulating oil required for first filling, plus 10% excess oil.

1.31.12 Tolerance on Losses

The permissible tolerances on the guaranteed values of transformer losses shall be as per IS 2026. The No load & Load losses of the transformer for rating above 200 KVA shall be as per CBIP Pub. No. 295: "Manual on Transformers". The Load losses & 50% Load losses for Transformers of rating 200 KVA and below shall be as per BEE Specification, Three star level.

1.31.13 Rejection

The Engineer or the Engineer's Representative reserves the right to reject the transformer if the same does not meet the specification requirement, subject to tolerances as per IS 2026. The rejected transformers shall be replaced by transformers complying with the requirements of this specification at the Contractor's cost.

If the commissioning of the project is likely to be delayed by the rejection of a transformer, the Engineer's Representative reserves the right to accept the rejected transformer until the replacement transformer is made available. Transporting the rejected and replacement transformers as well as installation and commissioning of both the transformers shall be at the Contractor's cost.

1.31.14 Technical Particulars

The specific technical particulars of the transformer shall be as given below:

Sl. No.	Description	Particulars
1	Rated output (kVA)	As per design
2	Transformer installation	Outdoor plinth mounted
3	No load transformation ratio	11 kV/0.433 kV
4	Number of phases	Three
5	Rated Frequency	50 Hz
6	Impedance at principal tap	As per CBIP Pub. No. 295" "Manual on Transformers" for transformers of rating more than 200 KVA. Three star level BEE specification for transformers of rating up to 200 kVA.
7	Number of windings / Material of conductor	Two / Copper for transformer of rating above 200KVA
8	Type of cooling	ONAN
9	Vector group	Dyn 11
10	LV neutral earthing	Solidly earthed
11	Design ambient temperature.	50°C
12	Winding temperature rise measured by resistance method	45°C for transformer of rating above 200 KVA and as per BEE specification for transformer of rating 200 KVA & below
13	Oil temperature rise by thermometer	40°C for transformer of rating above 200 KVA and as per BEE specification for transformer of rating 200 KVA & below.
14	Tap changer	Full capacity, off-circuit type on HV side with pad locking facility
15	Tap range	+ 5 % to -10 %
16	Tap step	2.5 %
17	Terminal connection	
a)	HV bushing	Bushings suitable for overhead ACSR "DOG" conductor
b)	LV cable box	Cable box suitable for terminating 1100 V, 3.5 core, XLP cables (Number and size of cable shall be as per the one line diagram)
c)	LV Neutral	LV neutral shall be through a 1.1 kV rated bushing, both inside the cable box for forming the 3 Ph, 4-wire system and outside the cable box for direct connections to earth pits.

1.31.15 Tests

All tests required by the specification including repeated tests and inspection that may be necessary owing to the failure to meet any tests specified, shall be carried out at the Contractor's expense.

If the transformer fails to pass the tests specified, the Engineer shall have the option to reject the unit. Additional tests shall be conducted to locate the failure and after rectification, all tests shall be repeated to prove that the rebuilt transformer meets the specification in all respects, all at the Contractor's expense.

The following tests shall be carried out on the assembled transformer during inspection at the manufacturer's works.

- a) Temperature rise test on one transformer.
- b) Measurement of resistance of windings at principal and extreme taps.
- c) Measurement of voltage Ratio at each tap, polarity and phase relationships.
- d) Measurement of impedance voltage at principal and extreme taps.
- e) Measurement of no load current and no load losses at rated frequency and at both the rated voltage and 110 % rated voltage.
- f) Measurement of efficiency at $\frac{1}{2}$, $\frac{3}{4}$ and full loads.
- g) Measurement of insulation resistance.
- h) Induced over voltage withstand test .
- i) Separate source voltage withstand test.
- j) Magnetic unbalance test.
- k) Impulse Test.

In addition to the above tests, a withstand test with lightning impulse, chopped on the tail, shall be carried out on one limb of HV winding of the transformer if impulse test has not been already carried out on transformer of similar capacity in the last two years. Type test certificate shall be submitted along with the bid, if such a test has been already carried out. If the type test has to be carried out, it shall be at the contractor's expense.

All doors shall be supported by strong hinges of the disappearing or internal type and braced in such a manner as to ensure freedom from sagging, bending and general distortion of panel or hinged parts.

All floor mounted panels/boards shall be provided with a channel base frame. Total height of all floor mounted cubicles/panels shall not be greater than 2300 mm. Where steel pedestals for mounting of boards/panels are specified, the total height including that of the pedestal shall not exceed 2500 mm. It should be extendable at both ends.

Switchboard/control cabinet/panel shall be dust and vermin proof. Degree of protection of the enclosure shall be IP 54 for indoor installations and IP 55 for outdoor installations.

1.31.16 LV Switchboard

Separate, segregated metal clad compartments shall be provided for main and auxiliary bus bars, each feeder and cable alleys. Metal clad cubicles/modules shall be provided with hinged doors in the front, with facility for padlocking door handles. More than one module may be arranged in the same vertical section. Circuits shall be of the fixed type. The switchboard enclosure shall conform to "Form-4" as per IS 8623. It shall be possible to extend the switchboard on both sides

The fixed type module shall have all the circuit components mounted in the compartment, with bolted type power and control connections. It shall be possible to remove all circuit components after removing the connections and the component fixing bolts.

Instruments, relays and control devices shall be mounted flush on hinged door of the cubicles. Switchboard shall be complete with inter-panel wiring.

Each switchboard shall also be fitted with a label indicating its title. Each cubicle shall be fitted with a label on the front and rear of the cubicle. Each relay, instrument, switch, fuse, contactor and MCCB/MCB shall be provided with a separate label.

One metal sheet shall be provided between two adjacent vertical sections running to the full height of the switchboard except for the horizontal bus bar compartment. However, each shipping sections shall have metal sheets at both ends.

After isolation of the power and control connections of a circuit, it shall be possible to carry out maintenance in a compartment safely, with the bus bars and adjacent circuits alive..

The Screen DB cum Control Panel shall have separate control section for mounting control and indicating devices and control logic wiring. The power section shall be with compartmentalized modules.

1.31.17 Bus Bars

The phase and neutral bus bars shall be rating indicated in the corresponding single line diagram. Bus bars shall be of aluminium and shall be provided with minimum clearances as specified. Bus bar shall be made of high conductivity, high strength aluminium complying with requirements of grade E91E of IS 5082. The bus bar shall be suitably braced with non-hygroscopic SMC supports to provide a through fault withstand capacity of 50 KA RMS symmetrical per second.

All bus bars and bus taps shall be insulated with close fitting sleeve of hard, smooth, dust and dirt free, heat shrunk PVC insulation of high dielectric strength, to provide a permanent non-ageing and non-tracking protection, impervious to water, tropical conditions and fungi. The insulation shall be non-inflammable and self-extinguishing type and in fast colours to indicate phases. The dielectric strength and properties shall hold good for the temperature range of 0 to 95 degree centigrade. If the insulating sleeve is not coloured, bus bars shall be colour coded with coloured PVC tape at suitable intervals.

Bus bar joints shall be of the bolted type. High tensile bolts, spring washers shall be provided to ensure good contact at the joints. Bus bars shall be thoroughly cleaned at the joints and suitable contact grease shall be applied just before making a joint.

Direct access to, or accidental contact with bus bars and primary connections shall not be possible. All apertures and slots shall be protected by baffles to prevent accidental shorting of bus bars due to insertion of maintenance tools.

Sequence of red, yellow and blue phases and neutral for four-pole equipment shall be left to right and top to bottom, for horizontal and vertical layouts respectively.

1.31.17.1.1 Power and control cables

All existing undamaged / un-jointed cables having adequate length, meeting the requirements of the new designs, will be utilized in the new installations. The existing cables with ratings same or more than the requirement would be HV tested / IR tested during the execution of the project and decided accordingly. It will be checked whether the voltage drop of such cables will be limited to 2.5 % at rated equipment current rating. The applicable standards will be IS 1554, 7098, 8130, 5831, 3975, IEC 60183, 60227, 60502, 60885. The cable shall be ISI marked.

1.31.17.1.2 Technical Data Sheet

Description	Particulars
Voltage grade of cable	1100V
Permissible voltage variation	+10% & -15%
Permissible frequency variation	+ 3%
Material of conductor	Aluminum, H4-grade, Class-2
Type of conductor	Stranded
Material of insulation	Extruded PVC, Type-A / XLPE – (Refer Single Line Diagrams for details)
Material of inner sheath	Extruded thermoplastic or unvulcanized rubber
Material of armour	Galvanized steel
Material of outer sheath	Extruded PVC, Type-ST 2
Core identification	Required

1.31.18 Earthing System

1.31.18.1 Scope

The scope includes supply of earthing conductors and earth electrode pits and their installation including associated civil work as per the specifications and drawings, to the satisfaction of the Engineer’s representative and the Electrical Inspector.

Proper earthing shall be provided to ensure adequate system neutral earthing and for equipment and personnel safety.

All work such as cutting, bending, supporting, painting/coating, drilling, welding, clamping, bolting and connection to structures, equipment frames, terminals, etc. shall be in the Contractor's scope of work. All incidental hardware and consumables such as fixing cleats/clamps, anchor fasteners, lugs, bolts, nuts, washers, bituminous compound, welding rods, anti-corrosive paint as required for the complete work shall be deemed to be included by the Contractor as part of the installation work.

1.31.18.2 Earthing System Installation

Earthing system shall conform to the latest edition including all official amendments and revisions of IS: 3043 and Indian Electricity Rules, 1956. All materials and fittings used in the earthing installation shall conform to the relevant Indian Standards or shall be as approved by the Engineer's Representative.

Installation work shall be in accordance with approved earthing layout drawings and any change in routing, size of conductors etc. shall be subject to the prior approval of the Engineer's Representative.

Installation of earth conductors in outdoor areas, buried in ground, shall include excavation of trench of size 600 mm deep and 450 mm wide, laying of conductor at 600 mm depth, welding as required of main grid conductor joints; as well as provision of risers upto 500 mm above ground at required locations and then backfilling of excavated area by material that is free from stones and other harmful mixtures. Backfill shall be placed in layers of 150 mm, uniformly spread along the trench and compacted by approved means. If the excavated soil is found unsuitable for backfilling, the Contractor shall arrange for suitable material from outside.

Metallic frames of all electrical equipment shall be earthed by two separate and distinct leads and then connected with earthing system

Neutral points of transformers shall be earthed by two separate and distinct connections to two treated electrode pits. The neutral of the transformer should be solidly earthed.

Crane rails shall be connected to the earthing system.

An earthing pad shall be provided under each operating handle of the disconnector. Operating handle of the disconnector and the supporting structure shall be bonded together by a flexible connection and connected to earth grid.

Cable sheaths and armour shall be bonded to the earthing system. Metal pipes and cable conduits shall be effectively bonded and earthed.

Neutral connection shall never be used for equipment earthing.

The scope of installation of earthing leads to the equipment and risers on steel structures/walls shall include laying the conductors, welding/cleating at specified intervals, welding to the main earth grids, risers, bolting at equipment terminals and coating welded joints by bituminous paint. Galvanised conductors shall be touched up with zinc-rich paint, when holes have to be drilled in them at site for bolting to equipment/structure.

The substation consisting of structure, transformer, fence and gate shall be properly earthed.

Wherever earthing conductor crosses underground service duct and pipes, it shall be laid 300 mm below them. If the distance is less than 300 mm, the earthing conductor shall be bonded to such service ducts/pipes.

Wherever earthing conductor passes through walls, GS sleeves shall be provided for the passage of earthing conductor. The pipe ends shall be sealed by suitable water-proof compound. Water stops shall be provided where earthing conductor enters the building from outside, below grade level.

Wherever there is hard rock and earthing resistance is not as per IS, than chemical earthing viz Pipe in Pipe or Strip in Pipe earthing may be provided.

Connections

All connections in the main earth conductors buried in earth/concrete shall be welded type. Connection between earthing conductor and earth leads shall also be of welded type. Connection between buried MS conductor and GS conductor above ground shall be done above ground.

Connection between earth leads and equipment shall be of bolted type.

1.31.18.3 Earth Electrode Pits

Electrodes shall, as far as practicable, be embedded below permanent moisture level.

Test pits with concrete covers shall be provided for periodic testing of earth resistance. Installation of pipe electrodes in test pits shall be suitable for watering. The necessary materials required for installation of test pits shall be supplied and installed by Contractor. The installation work shall also include civil works such as excavation/drilling and connection to main earth grid.

Treated earth pits shall be treated with salt and charcoal. Soil, salt and charcoal placed around the electrode shall be finely graded, free from stones and other harmful mixtures. Backfill shall be placed in layers of 250 mm thick uniformly spread and compacted. If excavated soil is found unsuitable for backfilling, the Contractor shall arrange for a suitable soil from outside.

1.31.18.4 Technical Particulars

The specific technical particulars of earthing system shall be as given below.

Sl. No.	Description	Size & Material	No. of Leads
1	11 kV equipment, transformer neutral, body and 2-pole structure	50 x 6 mm GS flat	2 each
2	Main LV Switchboard at SPS	50 x 6 mm GS flat	2
3	STP Distribution board	50 x 6 mm GS flat	2
4	Capacitor Control panel	50 x 6 mm GS flat	2
5	Cable tray support	50 x 6 mm GS flat	2
6	DBs & LPs	25 x 3 mm GS flat	2
7	Local PB station	12 SWG – GS	1
8	Motors		
a)	Small motors	8/12 SWG GS wire	2
b)	Main motors	50 X 6 mm GS flat	2
9	Earth Electrode	40 mm dia., 3 M long, heavy duty GI pipe electrode	-
10	Main grid buried in ground	50 x 6 MS flat	-

1.31.19 Cabling system

1.31.19.1 General

The cabling system covers the supply of cable trays, racks, supports and associated accessories, hardware and their installation. It shall be the responsibility of the contractor to complete the cabling system in all respects.

The following points shall be noted while planning cabling system.

- f) *Inside the building: Cable trenches with cable racks and or cable trays*
- g) *Cables shall be clamped to the cable racks at regular intervals*
- h) *All cable trays shall be hot dip galvanized while racks and supports shall be painted.*
- i) *All steel sections such as angles, channels, and brackets etc., required for supporting the cable trays shall be supplied by the contractor and fabricated at site.*
- j) *Flexible metallic conduits shall be used for termination of connection to equipment such as motors, limit switches and other apparatus.*

1.31.19.2 Installation of Cables

The Contractor shall install, test and commission the cables in accordance with the approved drawings, and instructions issued by Engineer's Representative. Cables shall be laid directly buried in earth, on cable racks, in

built up trenches and supports, on trays, in conduits and ducts or bare on walls, ceiling etc. as per approved drawings. Contractor's scope of work includes unloading, laying, fixing, jointing, bending, and termination of the cables. The Contractor shall also supply the necessary materials and equipment required for jointing and termination of the cables.

All apparatus, connections and cable work shall be designed and arranged to minimize risk of fire and any damage, which might be caused in the event of fire. Wherever cables pass through floor or wall openings or other partitions, suitable bushes of an approved type shall be supplied and put into position by the Contractor. The Contractor shall seal the cables into the bushes using fire resisting materials to prevent the spreading of fire through each partition.

Standard cable grips and reels shall be utilized for cable pulling. If unduly difficult pulling occurs, the Contractor shall check the pull required and suspend pulling until further procedure has been approved by the Engineer's Representative. The maximum pull tension shall not exceed the recommended value for the cable measured by the tension dynamometer. In general, any lubricant that does not injure the overall covering and does not set up undesirable conditions of electrostatic stress or electrostatic charge may be used to assist in the pulling of insulated cables in conduits and ducts.

After pulling the cable, the Contractor shall record cable identification with date pulled neatly with waterproof ink in linen tags / aluminium tag and shall securely attach such identification tags. Identification tags shall be attached to each end of each cable with non-corrosive wire. The said wire must be non-ferrous material on single conductor power cable. Tags may further be required at intervals on long runs of cables on cable trays and in pull boxes. Cable and joint markers and RCC warning covers shall be provided wherever required.

Sharp bends and kinks in cables shall be avoided. The bending radii for various types of cables shall not be less than 15 times the overall diameter of the cable.

Power, control and instrumentation cables shall be laid in separate cable racks/trays.

Where cables cross roads or water/sewage pipes, the cables shall be laid in reinforced spun concrete or steel pipes. For road crossings, the pipe for the cables shall be buried at not less than one meter depth.

Cables laid in ground shall be laid on a 75 mm riddled earth bed. The cables shall then be covered on top and at their sides with riddled earth of depth of about 150 mm. This should be then filled up to a depth of about 100 mm above the top of uppermost cable to provide bedding for the protective cable covers which shall be placed centrally over the cables. The protective cable covers for LV cables may be of earthenware and for HV cables of reinforced concrete. The RCC covers shall have one hole at each end, to tie them to each other with GI wires to prevent displacement. The trench should be then backfilled with the excavated soil and well rammed in successive layers of not more than 300 mm thick, with the trenches being watered to improve

consolidation wherever necessary. To allow for subsidence, a crown of earth not less than 50 mm in the center and tapering towards the sides of the trench should be provided.

Each cable shall be pulled into the particular conduit and shall be taken from the particular reel designated for the run. In hand holes, pull boxes or junction boxes having any dimension over 1000 mm, all conductors shall be cabled and/or racked in an approved manner. Care shall be taken to avoid sharp bending or kinking cables, damaging insulation or stressing cable beyond manufacture's recommendations in pulling. Cable shall be protected at all times from mechanical injury and from absorption of moisture at unprotected ends.

In each cable run, some extra length shall be kept at a suitable point to enable one or two 'straight through joints' to be made, should the cable develop a fault at a later date.

Cables on cable racks, and conduits shall be formed to avoid bearing against edges or trays, racks, conduits or their supports upon entering or leaving racks or conduits.

Cables splices shall not be used except where permitted by the Engineer's Representative. Splices shall be made by Contractor for each type of wire or cable in accordance with the instructions issued by cable manufacturers and the Engineer's Representative. Before splicing, insulated cables shall have conductor insulation stepped and bound or penciled for recommended distance back from splices to provide a long leakage path. After splicing, insulation equal to that on the spliced conductors shall be applied at each splice.

At cable terminal points, where the conductor and cable insulation will be terminated, terminations shall be made in a neat, skillful and approved manner by specially trained staff. Terminations shall be made by the Contractor for each type of wire or cable in accordance with instructions issued by cable manufacturers or the Engineer's Representative.

Control cable termination shall be made in accordance with wiring diagrams, using proper colour codes for the various control circuit, by code marked wiring diagram.

When control cables are to be fanned out and corded together with cord, the Contractor shall make connections to terminal blocks, and test the equipment for proper operation before cables are corded together. If there is any doubt about correctness of connection, the Contractor shall make a temporary connection with sufficient length of cable so that the cable can be switched to another terminal without splicing. After correct connections are established, cables shall be cut to their correct lengths, connected to terminals in the specified manner, and corded together where necessary to hold them in place in a skillful manner. Jointing of cables shall be in accordance with relevant Indian Standards Codes of Practice and manufacturer's instructions.

Materials and tools required for cable jointing work, including cold setting bituminous compound shall be supplied by the Contractor. Cables shall be firmly clamped on either side of a 'straight through joint' at a distance of not more than 300 mm away from the joints. Identification tags shall be provided at each joint at all cable terminations.

Cable seals shall be examined to ascertain if they are intact and that cable ends are not damaged. If the seals are found to be broken the cable ends shall not be jointed until after due examination and testing under supervision of the Engineer's Representative. Before jointing is commenced, insulation resistance of both sections of cables to be jointed shall be checked by megger.

After installation and alignment of motors, the Contractor shall complete the conduit installation, including a section of flexible conduit between motor terminal box and trench/tray. The Contractor shall install and connect the power, control and heater supply cables as per equipment manufacturer's drawings, if any. The Contractor shall be responsible for correct phasing of the motor power connection and shall interchange connections at the motor terminal box, if necessary, after each motor is test run.

Connections to recording instruments float switches, level electrodes, limit switches, pressure switches, thermocouples, thermostats and other miscellaneous equipment shall be done as per manufacturer's drawings and instructions.

Metal sheath and armour of the cable shall be bonded to the earthing system of the station. The size of conductor for bonding shall be appropriate with the system fault current.

All cables shall be tested for insulation resistance before jointing. After jointing is completed, all cables shall be tested again by a 1000 volt megger.

Cable core shall be tested for

- a) Continuity;
- b) Absence of cross phasing;
- c) Insulation resistance to earth; and
- d) Insulation resistance between conductors.

Contractor shall furnish testing kits and instruments required for field testing.

1.31.20 Outdoor HV Substation Equipment with Structure
1.31.20.1 General

The scope of supply consists of a two pole (or more, as required) galvanised steel (GS) structure fabricated out of ISMBs and ISMCs; PCC poles for drawing overhead line; GS structural sections for supporting and fixing various equipment; transformer, lightning arresters, disconnector, drop-out fuses, insulators and hardware, ACSR conductor, etc.; fixing accessories, and chain link fencing with padlockable gate.

The design, material, construction, manufacture, inspection and testing of all HV outdoor substation equipment and overhead line shall comply with the currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed.

The equipment shall conform to applicable standards. All standards and code of practices shall be the latest editions including all official amendments and revisions.

The details of the steel structure and support sections/members shall be subject to approval of structural design calculations to be furnished by the contractor.

1.31.21 Disconnecter Constructional Features

- viii. The disconnectors shall conform to IS 9921 and IEC 60129.
- ix. The disconnecter switch shall be complete with all parts that are necessary for complete operation. Such parts shall be deemed to be within the scope of supply, whether specifically mentioned or not. Clamps/connectors shall also be supplied.
- x. The disconnecter design shall be such that it is free from visible corona discharge in both closed and open positions, at the visible discharge test voltages as per the applicable standards.
- xi. The disconnecter shall be provided with high current carrying contacts on the hinge and jaw ends. All contact surfaces shall be silver faced copper.
- xii. The disconnecter handle shall be provided with a padlocking facility to lock it in fully open or fully closed positions. Rust proof padlocks shall be supplied with the disconnectors.
- xiii. Insulator used in the assembly of disconnecter shall be of porcelain and of brown colour. Insulator cap and base shall be of high-grade cast steel or malleable steel casting and they shall be machine faced and galvanised.
- xiv. Disconnecter base shall be of galvanized steel.

1.31.22 Operating Mechanism

- v. Operating devices for disconnecter shall be manually operable.
- vi. Operating mechanism shall provide a quick, simple and effective operation. One man shall be able to operate the disconnecter without undue effort.
- vii. The manual operating handles shall be mounted on the base of the supporting structure. Guide bearings shall be provided at a height of 750 mm above grade level. All brackets, angles, guides, guide bearings or other members necessary for attaching the operating mechanism and the operating handles to the supporting structure shall be supplied as an integral part of the disconnecter. Rustproof pins and bearings of bronze bushing, ball and roller type, shall be furnished. All bearings shall be weather protected by means of covers

and grease retainers. Bearing pressures shall be kept low to ensure long life and ease of operation.

- viii. Disconnecter and its operating mechanism shall be such that it cannot be dislodged from its open or closed positions by gravity, wind pressure, vibrations, shocks or accidental touching or breaking of the connecting rods or the operating mechanism.

The specific technical particulars of disconnectors shall be as given below.

Sl. No.	Description	Particulars
1	Installation	Outdoor
2	Rated voltage	11 kV
3	Rated Current	40 A / as per approved SLD
4	Frequency	50 Hz
5	Short circuit withstand rating for one second	26 kA (rms)
6	Design ambient temperature	50° C
7	Impulse withstand voltage across the isolating distance Across the isolating distance. Between poles and earth	75 kV rms /conform to IS 75 kV rms /conform to IS
8	One minute power frequency withstand voltage kV Across the isolating distance. Between poles and earth	28 kV rms /conform to IS 28 kV rms /conform to IS
9	Phase spacing (minimum)	914 mm/ conform to IS

1.31.23 Lightning Arrester

Lightning arrester (LA) shall be of outdoor, metal oxide (gapless) type and shall conform to IEC 60099. LA shall be of hermitically sealed type and of self-supporting construction, suitable for mounting on steel structures.

Housing of the LA shall be of porcelain, having adequate mechanical strength and rigidity for satisfactory operation under climatic conditions obtaining at site. Porcelain shall be finely glazed and shall be free from imperfections.

LA shall incorporate anti-contamination feature to prevent arrester failure, consequent to uneven voltage gradient in the event of contamination of the arrester housing.

LAs shall be complete with insulating base with a provision for bolting to flat surface of supporting structure.

LA shall be complete with line and earth terminals. The terminal clamps/connectors on the earth terminal of the arresters and the discharge counter incoming and outgoing terminals shall also be provided.

The specific technical particulars of the LA shall be as given in the table below.

Sl. No.	Description	Particulars
1	Type	Metal Oxide (Gapless)
2	Rated voltage	9.6 kV
3	Rated frequency	50 Hz
4	Nominal discharge current 8/20 Micro Sec current wave	10 kA (peak) /conform to IS
5	High current impulse 4/10 Micro Sec current wave	100 kA (peak) /conform to IS
6	Residual voltage corresponding to steep current impulse of 10 kA (peak)	108 kV (peak) /conform to IS
7	Long duration line discharge capability	Class 2
8	Lightning impulse withstand voltage of housing 1.2/50 Micro Sec current wave	75 kV (peak) /conform to IS
9	Total creepage distance of housing	900 mm /conform to IS

1.31.24 Insulators

The porcelain post insulators shall conform to IS 2544 and IEC 60273, the insulators for overhead lines shall conform to IS 731 and IEC 60305, 433 and the insulator fittings shall conform to IS 2486.

Porcelain used for the manufacture of insulators shall be homogeneous, free from flaws or imperfections that might affect the mechanical or dielectric quality. They shall be thoroughly vitrified, tough and impervious to moisture. The glazing of the porcelain shall be of uniform brown color, free from blisters, burns and other similar defects. The porcelain shall be sound, free from defects and smoothly glazed. Insulators shall have compression type glaze with a good lustre.

Insulators shall be designed to avoid excessive concentration of electrical stresses in any section or across leakage surfaces. Design features, which increase radio influence level, shall be avoided.

All metal parts shall be made of commercial grade malleable iron or open hearth or electric furnace steel, hot dip galvanised to relevant standards. Castings, if any shall be free from blow holes, cracks and such other defects.

The specific technical particulars of insulator shall be as given in the table below.

Sl. No.	Description	Particulars	
1.	Type	Strain	Post
2.	Rated voltage	11 kV	11 kV
3.	Type of insulators	Disc	Stack
4.	No. of insulators	3 per string	2 no.
5.	Impulse withstand voltage of 1.2/50 micro sec. wave	75 kV (peak)	75 kV (peak)
6.	Power frequency voltage withstand	28 kV rms / conform to IS	28 kV rms / conform to IS
7.	Dry Wet	28 kV 28 kV	28 kV 28 kV
8.	Visible discharge power frequency test	27kV / conform to IS	27kV / conform to IS
9.	Total creepage distance	900 mm/ conform to IS	900 mm/ conform to IS

1.31.25 Drop-out Fuses

Drop-out fuse assembly shall be complete with fuse carrier, post insulator, jaw and hinge, live parts, terminals, channel base, fixing bolts, nuts and washers. Fuse links shall also be supplied.

All materials used in the manufacture of drop-out fuses shall be suitable for conditions specified and shall withstand variations of temperature and atmospheric conditions without deterioration or distortion of any kind in any part. All non-metallic parts of fuse carrier shall be of tough, non-ignitable insulating materials.

Mounting of drop-out fuses shall be such that its isolation/removal/replacement is easy. It shall have positive guides for this purpose.

Bird proof constructional features shall be provided.

It shall be possible to adjust spring pressure of the top contact to ensure consistent performance

All current carrying parts shall be of copper alloy. The contacts shall be of gun metal brass or phosphor bronze.

The contact surface shall be silver plated to ensure low contact resistance.

Fuse links shall be of such construction as to prevent danger from overheating, arcing and scattering of hot metal or powder or emission of flame, when operating in service.

When the fuse link ruptures or when the fuse carrier is pulled downwards, the carrier shall swing free to an inverted position. The carrier shall be brought to a cushioning stop to eliminate shock on the carrier and lower insulator unit.

The base channel and all ferrous parts shall be hot-dip galvanised as per the applicable standards.

Drop-out fuse base channel shall bear a name plate describing the major technical particulars. Fuse base, fuse link and fuse carrier shall bear the markings as per IS.

An operating rod with provision at the top for switching and removing fuse carrier shall be provided. The rod shall be minimum 6.0 m long unless otherwise stated.

Multi-bolt (bi-metallic) terminal clamps shall be provided at the top and bottom of fuse base contacts suitable for connection to the ACSR conductor.

Fuse kit shall be supplied, consisting of fuse-link assembly, refusing tool and any other item necessary to restore the fuse units to service after an operation.

Drop-out fuse frame shall have two earthing terminals. The specific technical parameters of drop-out fuse shall be as given below.

Sl. No.	Description	Particulars
1.	Installation	Outdoor
2.	Rated Voltage	11 kV
3.	Rated Frequency	50 Hz
4.	Rated Current of contacts	40 Amp/ as per approved SLD
5.	Rated current of fuse links	10 A /as per approved SLD

1.31.26 Lighting System

1.31.26.1 Scope

This covers supply, installation and commissioning of all equipment necessary for a complete lighting and receptacle system. The type of lighting fixtures and receptacles shall be as specified. The quantity required shall be as per the approved lighting layout drawings to be submitted by the contractor. Equipment shall include lighting panels, lighting fixtures, lighting fixture supports, street lighting poles, switches, receptacles, ceiling fans, exhaust fans, conduits, wires, cables, and miscellaneous accessories as necessary for a complete system.

1.31.26.2 Lighting Fixtures

The lighting fixtures offered shall comply with the following requirements.

- o) *The fixtures shall be suitable for operation on a nominal supply of 240 V, single phase, 50 Hz, AC with a voltage variation of + 10 %.*

- p) *All lighting fixtures shall be supplied complete with lamps and all necessary accessories such as ballast, capacitor, etc. for their satisfactory operation.*
- q) *Starter of the fluorescent light fixture shall be replaceable without disturbing the reflector or lamps and without the use of any tool.*
- r) *The capacitor of the lighting fixture shall have adequate value of capacitance to correct the power factor of its fixture to 0.98 lag.*
- s) *Lamp holders for fluorescent tubes shall be of the spring loaded, low contact resistance, bi-pin rotor type, resistant to wear and suitable for operation at the specified temperature, without deterioration in insulation value, contact resistance or lamp holding quality.*
- t) *Lamp-holders for HPSV lamps shall be of GLS type, manufactured in accordance with the relevant standard and designed to give long and satisfactory service.*
- u) *Lighting fixture reflectors shall generally be manufactured from steel or aluminum sheet of not less than 20 SWG thickness.*
- v) *Polystyrene or aluminum egg-box type louvers shall be provided wherever specified.*
- w) *Each fixture shall be complete with a four way terminal block for connection and looping of incoming and outgoing cables. Each terminal shall be able to accept two 2.5 mm² copper stranded conductors.*
- x) *Each lighting fixture shall be provided with an earthing terminal suitable for connecting 16 SWG copper stranded conductor.*
- y) *All metal or metal enclosed parts of the housing shall be bonded and connected to the earth terminal to ensure satisfactory earthing continuity throughout the fixture.*
- z) *The enamel finish shall have a minimum thickness of 2 mils for outside surface and 1.5 mils for inside surfaces. The finish shall be non-porous and free from blemishes, blisters, and fading.*
- aa) *All reflectors and louvers shall be finished to the same standard as the fixture housing.*
- bb) *The lighting fixtures with lamps shall be preferably of LED type being of long life and low electricity consumption*

1.31.26.3 Receptacle Units

Decorative and industrial type receptacle units of 5 A, 15/16 A and 32 A rating with switches/MCBs shall be supplied. The units shall be suitable for mounting flush on GS sheet boxes. Receptacles in the chlorine house shall be of corrosion proof type.

The receptacle shall be suitable for 240 V, 1 Ph, (or 415 V, 3 Ph), 50 Hz AC supply. Single phase decorative receptacle shall be provided with a switch of the same current rating while Single phase industrial receptacle shall be associated with a MCB of the same current rating, housed in the same enclosure. Two phase receptacles shall be associated with a MCB of the same rating, housed in the same enclosure. The enclosure for all outdoor receptacles shall be provided with degree of protection of IP55.

1.31.26.4 Applicable Standards

All standards and codes of practice referred to below shall be the latest edition including all official amendments and revisions.

Industrial luminaire with metal reflector	:	IS 1777
Ballast for fluorescent lamp	:	IS 1534
3 pin plugs & sockets	:	IS 1293
General safety requirements for luminaires	:	IS 1913
Luminaires for street lighting	:	IS 10322
Fitting for rigid steel conduits for electrical wiring	:	IS 2667
Code of practice for interior illumination	:	IS 3646 & IS 6665
Switches for domestic & similar purposes	:	IS 3854
Electric ceiling type fans & regulators	:	IS 374
Code of practice for electrical wiring installation	:	IS 732

1.31.26.5 Tests and Test Reports

Type tests, acceptance tests and routine tests for the lighting fixtures, accessories and receptacles covered by this specification shall be carried out as per the relevant standard.

Manufacturer's type and routine test certificates shall be submitted for tests conducted as per relevant standards for the fixtures, accessories and receptacles.

The following routine tests shall be conducted as per the relevant Indian Standards.

- a. Each fixture shall be tested at 1500 Volts (rms), 50 Hz, AC for one minute and no flash over or breakdown shall occur between current carrying parts and ground.
- b. Insulation resistance of each fixture shall be tested at 500 V DC and the insulation resistance so measured shall not be less than 2 megaohms between all current carrying parts and ground.
- c. All luminaires provided with glass covers shall be subjected to thermal shock-proof test. This test shall be conducted to ensure that the cover glass will withstand sudden variation in surface temperature due to rainfall or splashing water when the lighting fixture is lit. The cover glass shall be heated in an oven to attain a steady temperature of 1000 C and then plunged into cold water. No crack should develop.
- d. Contractor shall ensure use of calibrated test equipment having valid calibration test certificates from standard laboratories traceable to National Standards.

1.31.26.6 Drawings/Documents

- a. The bidder shall furnish with the bid, relevant descriptive and illustrative literature on lighting fixtures, accessories and receptacles as well as preliminary details of lighting panels, conduits, cables, etc.
- b. The following drawings/documents shall be furnished after the award of contract for approval of Engineer's representative:
- c. Dimensional drawings of lighting fixtures
- d. Mounting details, cable entry facility and weights of lighting fixtures
- e. Light distribution diagrams (zonal and isocandela) of lighting fixtures
- f. Utilization factor tables of lighting fixtures
- g. Design calculation for lighting system, lighting and receptacle layout and circuiting diagram
- h. One line diagrams of lighting panels including rating of all equipment

1.31.26.7 Lighting System Installation

The Contractor shall supply, install, test and commission the complete system of lighting and receptacles in accordance with the approved lighting drawings and documents and in accordance with relevant Indian Standards, codes of practice, Indian Electricity rules and safety codes in the locality where the equipment/system is to be installed. Nothing in this specification shall be construed to relieve the contractor of this responsibility.

1.31.26.8 Installation of Lighting Panel, Lighting Fixtures & Receptacles

The scope of installation work shall include mounting of lighting panel, lighting fixtures and receptacles at locations as per the approved drawings. All work associated with installation such as providing and fixing of wooden blocks, ball sockets, hooks, etc., as required, drilling holes in walls, ceilings, etc., or any civil work including scaffolding, provision of ladders, etc., together with supply of hardware shall form part of the Contractor's work. All work items necessary for completing earthing connections shall be included in the scope of work.

1.31.26.9 Wiring

- a. The work shall comprise wiring in heavy gauge (minimum 16 SWG) GI conduits, fixed and supported at intervals of 500 mm on walls, ceiling etc.; installation of light control switches and receptacles housed in GS boxes; earthing with 16 SWG copper wire run along the conduit and clamped to it at every 500 mm; and termination of cables/wires at lighting panels, light control switches, receptacles, lighting fixtures etc., as required. The minimum size of conduit shall be 20 mm. Space factor (ratio of total wire area to internal conduit area) shall be 40 %.
- b. Supply of all the items of work detailed above including 650 V grade, 2.5/4 sq. mm stranded copper conductored PVC insulated cables; 5 / 10 switches; GS conduits and accessories (such as junction boxes, tees, elbows, etc); 16 SWG GS boxes complete with gasket, knockouts for conduit entries, earthing terminal with bolts, nuts and washers; 16 SWG copper earthing wire; flexible conduit etc. shall be included in the Contractor's scope. All work necessary for fixing boxes, conduits etc., together with supply of necessary accessories hardware, shall also be included in the Contractor's work.
- c. All light control switches and receptacle units (connected on the same phase) at one location (such as room entrance), shall be housed in one common GS sheet steel box.

1.31.26.10 Lighting Fixtures

Receptacle and lighting fixtures shall be fed from different circuits and wiring for the same shall be done in different conduits. The maximum load on any circuit shall not exceed 1800 Watts. In large rooms, the lighting system shall be distributed over two phases. Switches/receptacles wired on different phases shall be separated by a minimum distance of 1.8 m. Wires belonging to different phases shall not be run in the same conduit. However, more than one circuit on the same phase can be run in the same conduit. For every phase wire, a separate neutral wire shall be run. Neutral wire shall not be looped. Size of wire chosen shall be such as to limit the voltage drop to within 3 %. Minimum area of conductor shall be 2.5 sq mm stranded copper for lighting and receptacle circuits, and current density shall not exceed 2.5 A/sq mm. Generally, not more than 8 to 10 lighting points shall be wired in one circuit. For calculating connected loads of various circuits, a multiplying factor of 1.25 shall be assumed on the rated lamp wattage for sodium vapour and fluorescent lamp fixtures to take into account the losses in the ballast. A loading of 100 watts and 500 watts shall be assumed for each, single phase 5 amps and 15 amps receptacles respectively.

For street lighting, steel tubular poles complete with fixing brackets shall be used. These poles shall be coated with bituminous preservative paint on the inside as well as on the embedded outside surface. Exposed outside surface shall be painted with one coat of red oxide primer. After completion of installation, two coats of aluminium paint shall be applied. Contractor shall supply and erect the poles (including foundation work), mount the assembled fittings, and install the necessary cabling. The Contractor's scope includes supply and installation of cables required between lighting panel and 14 SWG GS junction box mounted on the street lighting pole and between junction box and metal enclosed control gear box. Contractor shall earth street light pole and junction box with 8 SWG GS wire tapped off from the 8 SWG GS wire to be laid along the street lighting cable. The Contractor shall interconnect this earthing grid to plant main earthing grid. Height and type of pole shall be subject for an engineer's approval.

- a. Before a completed installation is put into service, installation tests stipulated in the latest edition of IS: 732 and other codes of practices shall be carried out by the Contractor in the presence of the Engineer's Representative.

1.32 DG Set

Silent DG set (As per CPCB norms) complete with 1500 RPM Diesel Engine of suitable BHP & AC Brush less SPDP Alternator mounted on a common base frame & coupled through a flexible coupling or close coupled. Alternator shall be self-regulated with standard Alternator Protection (Over Voltage, Over Speed & under voltage, under speed warning & shutdown). Engine shall have residential silencer, up to 3 M Exhaust piping, electronic/Mechanical governor, Manual & electric start, Batteries, Engine instrument panel, AVM and with Weatherproof, powder coated Acoustic enclosure for DG set for sound attenuation fabricated from 1.6mmCRCA sheet steel (structure) with side wall fabricated from 1.6mm CRCA sheet & filled with 100mm thick glass wool (96kg/m3) /Foam as per IS 8183 or equivalent foam thickness and pressure, the doors are fabricated from 1.6 mm CRCA sheet packed with acoustic material, floor of MS chequered plate 5.0mm thick, canopy fixed with axial flow fan of alstom, CG, almonard make. All doors/opening are sealed with neoprene/EPDN gaskets. The enclosure has built in fuel tank, residential silencer (isolated from main DG chamber) with protection and tripping of DG set against temperature of more than 50 degree centigrade. All controls for operation of DG set are from outside the enclosure with DG control panel having Microprocessor based GenSet monitoring & control system, MCCB, Ameter, Voltmeter, PF meter, frequency meter, KWH meter, Ind lamps etc. mounted inside enclosure, visible and accessible from outside. The enclosure should be suitable for designed capacity DG set and alternator. Noise level shall be less than 75db(A) at a distance of 1 m duly certified by authorized agency complete in all respect. The DG set shall be Air cooled & naturally aspirated up to 30 KVA rating and Radiator cooled & turbo charged for rating above 30KVA.

Important Note (To be strictly adhered to by the contractor)

- (20) The work shall be carried out in the best manner, in conformity with the specification, drawings, standards, BOQ and the code of practice of IS as well as to the instruction of the Engineer-in-charge.
- (21) In addition, the work shall conform to the requirements of the following:
- (22) Indian Electricity Act and rules & regulations framed there under.
- (23) Fire insurance regulations
- (24) Rules and regulations laid down by the Chief Electrical Inspector and other statutory authorities like VVNL etc.
- (25) All materials, fittings, equipment/items, erection hardware and accessories etc to be supplied by the Contractor shall be of the best quality and shall conform to specification and drawings. These shall be manufactured & supplied in accordance with the latest revision of the IS.

- (26) The Contractor shall be a valid license holder of Agra to carry out the electrical installation work and documentary evidence to this effect shall be furnished by him before commencement of work.. Similarly the skilled workmen / Electricians / Supervisors deputed by the Contractor should also hold valid license issued or recognized by the electrical licensing board of the respective state.
- (27) The Contractor shall provide in due time, in adequate number, and in appropriate sequence all services, materials, equipment, fabrication & erection plant/ Rigs / Tools and tackles, adequate competent manpower as required for erection and any incidental work, for satisfactory execution and completion of the works covered under this specification, strictly within the agreed time schedule.
- (28) Any equipment, materials or fittings not specifically mentioned in this specification or drawings, but are genuinely necessary for the safe and efficient operation and maintenance of the works as per sound engineering practice and current statutory requirement shall also be supplied / fabricated / erected / tested / commissioned by the Contractor, and it is specifically agreed and understood that such items are also deemed to be included in the scope of work of the Contractor within the quoted price and no extra payment will be made on this account.
- (29) All safety procedures and practices shall be kept in view during execution of work in accordance with good practice. (Refer IS: 5216 – 1969 – guide for safety procedures and practices in electrical work).
- (30) The electrical Contractor shall take care of existing services and co-operate with other such contractor at site and shall coordinate his works with works of other contractors with the least amount of damage and interference to their works.
- (31) At any point of time one responsible person should be kept from the beginning to end of the job on full time basis.
- (32) All meters have to be calibrated in an approved testing laboratory before energisation and test report should be furnished to this effect.
- (33) All rates quoted shall be inclusive of all sundry materials like hardware, clamps, cleats, nuts and bolts, cement and sand, coke and salt, solders, fluxes including all consumables like electrodes, gases etc.
- (34) The Contractor shall put up temporary structure to store his materials. Materials supplied by the Owner, if any, shall also be kept in the stores. Security of the materials, insurance etc. for the stores shall be in the Contractor's scope.
- (35) On completion of the job all wooden crates, small pieces of cable/ wire etc. shall be removed by the Contractor.

- (36) All works carried out by the Contractor shall have to be guaranteed for twelve months from the date of completion.
- (37) All the approvals connected with drawings, installation etc. to be obtained from VVNL/Engineer before start of the job and in full conformity to their requirement. Proper coordination with VVNL and payment of supervision charges as applicable shall also be paid to the VVNL by the Contractor which shall be reimbursed by the Owner on reproduction of the original receipt.
- (38) After completion of all activities described in the B.O.Q. and specification to the entire satisfaction of JVVNL Engineer, the Contractor shall hand over the same after energizing, testing & commissioning of the system as a whole along with "As built" drawing.

1.33 Inspection Requirement

1.33.1 General

- a. All inspection and testing shall be carried out in accordance with the Specification and in absence of Specification relevant Indian Standard or internationally approved equivalent standard.
- b. The Contractor shall carry out at the place of manufacture tests of the Plant / Equipment at any part of the Works.
- c. The Employer shall be entitled to attend the aforesaid inspection and/or tests by his own duly authorised and designated representatives.
- d. The Employer and his duly authorised representative shall have access to the Contractor's premises at all suitable times to inspect and examine the material and workmanship of the mechanical and electrical plant and equipment during its manufacture there. If part of the plant and equipment is being manufactured on other premises, the Contractor shall obtain permission for the Employer or his duly authorised representative, to inspect as if the plant and equipment was manufactured on the Contractor's own premises. Testing (including testing for chemical analysis and physical properties) shall be carried out by the Contractor and certificates submitted to the Engineer's Representative who will have the right to witness or inspect the above mentioned inspection / testing at any stage desired by him.
- e. The procedure for the testing and inspection to be carried out during or following the manufacture of the materials to ensure the quality and workmanship of the materials and to further ensure that they conform to the Contract in whatever place they are specified shall be as described below.
- f. The Contractor shall give the Employer at least 21 clear days notice in writing of the date and the place at which any plant or equipment will be ready for inspection / testing as provided in the Contract. The Employer or his duly authorised representative shall thereupon at his discretion notify the Contractor of his intention either to release such part of the plant and equipment upon receipt of works tests certificates or of his intention to inspect. The Employer shall then give notice in writing to the Contractor, and attend at the place so named the said plant and equipment which will be ready for inspection and/or testing. As and when any plant shall have passed the tests referred to in this section, the Engineer's Representative shall issue to the Contractor a notification to that effect.
- g. The Contractor shall forward to the Employer 3 duly certified copies of the test certificates and characteristics performance curves for all equipment.
- h. If the Engineer's Representative fails to attend the inspection and/or test, or if it is agreed between the parties that the Engineer's Representative(s) shall not do so, then the Contractor may proceed with the inspection and/or test in the absence of the Engineer's Representative and provide the Employer with a certified report of the results.
- i. If any materials or any part of the works fails to pass any inspection / test, the Contractor shall either rectify or replace such materials or part of the works and shall repeat the inspection and/or test upon giving a notice. Any fault or shortcoming found during any inspection or test shall be rectified to the satisfaction of the Engineer before proceeding with further inspection of wiring of that item. Any circuit previously tested, which may have been affected by the rectification work, shall be re-tested.

- j. Where the plant and equipment is a composite unit of several individual pieces manufactured in different places, it shall be assembled and tested as one complete working unit, at the maker's works.
- k. Neither the execution of a inspection test of materials or any part of the works, nor the attendance by the Engineer's Representative(s), nor the issue of any test certificate shall relieve the Contractor from his responsibilities under the Contract.
- l. The test equipment, meters, instruments etc., used for testing shall be calibrated at recognised test laboratories at regular intervals and valid certificates shall be made available to the Engineer's representatives at the time of testing. The calibrating instrument used as standards shall be traceable to National / International standards. Calibration certificates or test instruments shall be produced from a recognized Laboratory for the Engineer's consent in advance of testing and if necessary instruments shall be recalibrated or substituted before the commencement of the test.
- m. The Contractor shall not pack for shipment any part of the Plant until he has obtained from the Employer or his authorized representative his written approval to the release of such part for shipment after any tests required by the Contract have been completed to the Employer's satisfaction.
- n. The following Testing shall be carried out for all the equipment as applicable
 - o) *Visual Inspection.*
 - p) *Material Certificates for all the specified material shall be furnished.*
 - q) *Welding Qualifications*
 - r) *Dimension Checking*
 - s) *Stage Inspections (in process inspection)*
 - t) *Dynamic balancing for all rotating parts*
 - u) *Hydrostatic / Leak testing for all pressure parts, Pneumatic Leak Test wherever applicable*
 - v) *Operation check*
 - w) *Liquid penetration tests or magnetic particle tests for all machined surfaces of pressure parts.*
 - x) *Ultrasonic test for forging materials viz.,*
 - y) *Plates of thickness 20mm and above for pressed / formed parts such as heads, etc.*
 - z) *Plates, flanges and bars of thickness / dia 40mm and above used for fabrication of pressure and load bearing members and rotating parts.*
 - aa) *Radiographic testing for all but welded parts, as per applicable codes.*

bb) *Hardness tests for all Hardened surfaces.*

- o. The Contractor shall maintain proper identification of all materials used, along with reports for all internal / stage inspection work carried out, based on the specific job requirement and or based on the data sheets / drawings / specifications.

1.33.2 Mechanical and Instrumentation Work

Sl. No.	Items	Category of Inspection
1	Ultrasonic Type Differential Level Measurement System	Category A
2	Electrically Operated Hoists	Category B
3	Sluice Valves	Category A
4	Non-Return Valves/Dual Plate Check valves	Category A
5	Valve Actuators	Category A
6	Ductile Iron Pipe Work	Category A
7	Manually Operated Overhead Travelling Crane	Category B
8	Exhaust Fans	Category C
9	Air-conditioners	Category C
10	Water Supply System	Category C
11	High Pressure Pumping System	Category B
12	Portable Fire Extinguisher	Category C
13	Ultrasonic level measuring system	Category A
14	Ultrasonic differential level measuring system	Category A
15	Float level switches	Category A
16	Pressure Gauges	Category C
17	Surge Protection Devices	Category B
18	Instrumentation & Control Cables	Category A
19	Instrument Control Panel comprising of PLC, digital indicator, alarm annunciator, mimic, pushbuttons etc.	Category A
20	Battery & Battery Charger Panel	Category A

1.33.3 Electrical Works

Sl. No.	Items	Category of Inspection
1	Transformer	Category A
2	Disconnecter	Category A
3	Diesel Generating set	Category A
4	Lightning arrestors, drop-out fuses and insulators	Category B
5	Capacitors and APFC Panel	Category A
6	LV switchboards panel and Control Cabinets	Category A
7	Induction Motors	Category A

Sl. No.	Items	Category of Inspection
8	Sub-Distribution Boards	Category B
9	Power and Control Cables	Category B
10	Earthing System	Category C
11	Lighting system equipment	Category B
12	Local Push Buttons	Category C

1.33.4 Safety Procedure and Practice

Following safety procedure and practice should be provided by electrical Contractor in switchboard room/substation as per latest edition of I.S. 5216.

- Rubber matting in front of LV switchboard and other panels in switchboard room
- One shock treatment chart in LV switchboard room
- Caution/Danger Board

Outdoor substation	:	1 no.
LV switchboard/DB	:	1 No.
- One sand bucket in switchboard room
- One fire extinguisher in switchboard room
- One set of hand gloves in switchboard room

1.33.5 Fire Safety

The requirement of hand appliance in switchboard room, electrical equipment room shall be as per the latest edition of Fire Protection Manual by Regional Tariff Committee.

- a) The Contractor shall obtain the necessary License / Authorization from the Licensing Board of the locality/State for carrying out the installation work. The persons deputed by the Contractor's firm should also hold valid permits issued/recognised by the Licensing Board of the locality/State in which the work is to be done.
- b) The electrical installation work shall be carried out by licensed electricians only and approved by appropriate authorities. It is the responsibility of Contractor to get approval of complete system from the appropriate authority.

1.33.6 Fire Extinguishers

Portable fire extinguishers are to be provided for all units as per the requirement of Tariff Advisory Committee (TAC) or meeting the requirement of local regulations whichever is stringent.

All the extinguishers shall be ISI marked.

For fighting fire, 2 kg capacity CO₂ type fire extinguishers shall be supplied and located at strategic locations as per TAC regulations. The fire extinguishers shall be with initial charge and mounted on wall bracket ready for use, complete as per IS:2878.

1.33.7 General Obligation

The Contractor shall operate and maintain the entire Plant under this contract for the period specified in this contract which shall be extendable for a further period at the Employer's option.

The Contractor will submit a detailed operation and maintenance plan for approval of Employer's representative. All operation and maintenance activities shall be carried out strictly in accordance with the approved plan.

The services shall include but not be limited to the following items.

- a) Operation and maintenance of the sewage treatment plant from the inlet chamber up to disposal, including operation of effluent reuse system through Elevated reservoir.
- b) Training for the O & M staff of designated by Employer's requirement.
- c) Generation and maintenance of periodic reports.

1.33.8 Operational Services

The Contractor shall operate the complete sewage treatment Plant and associated services on a continuous 24-hour basis.

The Contractor shall operate and utilize the control and monitoring systems provided, if found necessary, he shall make adjustments (within the operation range) of the control system and equipment, so that the Plant operation matches the treatment process requirements.

If it is determined that the facility is not capable of meeting the design parameters for any reason beyond the Contractor's control and not attributable to him, the Contractor shall determine the specific cause of failure / abnormality in the Plant functioning and report to the Employer's representative and seek his directives on the necessary corrective action to be taken/adopted.

The Contractor will be required to furnish the details of electricity consumption in the format prescribed by the Employer's representative.

All consumables and spare parts required for operating and maintaining the Plant shall be provided by the Contractor. The Plant campus shall be maintained in good conditions. The grit, screenings and other garbage generated in the plant shall be removed from the site on daily basis. No accumulation of such residues shall be permitted within the Plant campus without express application by Contractor giving adequate reasons as well

as permission of Employer's representative. The Contractor shall allow to accumulate such residues in conformity to Environmental regulations / rules in force. The Employer's Representative may, if required, decide the mode and timing of disposal of such residues in consultation with concerned Environmental and Civic Authorities. Such directions shall be followed by the Contractor promptly, both in letter and spirit, without any reservations and without any increase in O&M /other costs. The loading, unloading and transportation cost of these shall be borne by the Contractor and shall be included in the price quoted by the Contractor for O&M. The Contractor at his own expense shall provide all tools, cleaning, and housekeeping equipment, security and safety equipment

1.33.9 Laboratory Services

- a) The Contractor shall perform all tests, sampling and analysis regularly as approved by the Employer's requirement and as per the O & M standards
- b) The Contractor will submit in his offer a complete list of laboratory equipment and materials in accordance with the analysis program required, if in addition to the mandatory list of laboratory equipment.

1.33.10 Manpower

The Contractor shall provide experienced managerial, technical, supervisory, laboratory, administrative, and non-technical personnel and labour necessary to operate and maintain the treatment Plant and works properly, safely and efficiently on a continuous 24 hour basis for the full term of the O & M period. While doing so due consideration shall be given to the labour laws in force.

The qualification and capability of Contractor's personnel shall be appropriate for the tasks they are assigned to perform. The staff provided shall be fully trained in the operation of the works before being given responsibility. If, in opinion of the Employer's representative, a member of Contractor's staff is considered to be insufficiently skilled or otherwise inappropriate for the assigned task, and Employer's representative informs the Contractor in writing, the Contractor shall replace him with a person of appropriate skills and experience for the task, approved by the Employer's representative, within one month of being so informed.

The bidder shall propose in his tender a staff management structure for the operation and maintenance of works. The suggested structure (minimum) shall be as follows:

Plant Supervisor*	1 full time (at each STP)
Shift In-charge	3 (at each STP)
Electrician	1 (General shift) (at each STP)
Mechanic	1 (General shift) (at each STP)
Chemist	1 (1 Sr Chemist* and 1 Jr Chemist) at each STP
Operator / helpers	4 (at each STP)
Security staff	As required for round the clock security.
* Key staff	

The Employer may require a suitable change in the structure on the basis of design, automation and other relevant parameters it deems fit.

The Contractor shall provide all secretarial support, printing and publishing services, office furniture and office supplies as required. It shall also ensure that all labor welfare laws and regulations are followed, including weekly rests, rotation of duties

The resumes of the Contractor personnel shall be submitted to the Employer's representative for acceptance at least two months before anticipated commencement of the pre-commissioning of test. Normal time duty hours for the Contractor's O & M personnel may be modified as necessary and agreed by the Employer's representative. A rotating shift schedule shall be established by the Contractor and approved by the Employer's representative who will ensure that an adequate number of the Contractor's staff will be available for duty at Plant 24 hours each day, 7 days week, including national holidays.

In the event that it is necessary for more than one of the Contractor's O & M personnel to be absent from the Plant, for whatever reason, the Contractor shall provide a qualified replacement at his own expense and ensure that specified project duty coverage is maintained. If substitute key personnel are required for a period longer than 15 days, their CV must be approved in advance by the Employer's representative.

The O & M personnel shall be dedicated solely to the specified duties and responsibilities and shall not be diverted to perform Contractor's administrative duties, construction arrangement, office management, or other non- O & M activities. Adequate support staff shall be provided by the Contractor in order avoid any such diversion.

The Contractor shall include in his cost medical and accident insurance expenses of all the staff employed by him along with all provisions of the labour welfare acts prescribed from time to time by the State and Central Government. Adequate insurance cover shall also be maintained during O & M period for all short-term employees, as well as casual, temporary employees and visitors.

Sufficient operating staff shall also be provided at SPS, i.e. Operators, Electrical & Mechanical personnel for smooth operation as agreed with Engineer before put SPS in trial run & operation. One personnel shall also be made responsible for operation of SPS as per approval of the Engineer.

Employer is not liable for any situation arising due to any accident/mishap of whatever nature occurring in the Plant premises.

1.33.11 Safety

The Contractor shall be responsible for safety of his staff during O & M of the Plant and shall procure, provide and maintain all safety equipment necessary for satisfactory O & M such as gasmasks, gloves, boots, mats etc.,

1. The Contractor shall utilize safety awareness procedures in every element of operation and maintenance.
2. The Contractor shall emphasize site safety including adoption of

- i. Safe working procedures
- ii. Cleanliness and care of the plant as a whole
- iii. Accident and hazardous conditions prevention and reporting.
- iv. Safe practice while working near digester / gas holder areas

The Contractor shall impart safety training to all members at regular intervals, especially for new comers.

The Contractor shall provide Notice boards and display boards at appropriate locations detailing precautions to be taken by O&M personnel to work in conformity to regulations and procedures and by the visitors to the Plant.

The Contractor shall notify the Employer's representative immediately if any accident occurs whether on-site or off site in which Contractor is directly involved and results in any injury to any person, whether directly concerned with the site or a third party. Such initial notification may be verbal and shall be followed comprehensive report within 24 hours of the accident.

1.33.12 Reporting

The Contractor shall prepare consolidated daily reports, weekly and monthly reports on Plant operation and maintenance and submit to the Employer's representative. The daily reports are to be submitted within first working hour of the next day. The monthly reports shall be submitted on the first day of the next month and within two working hours.

Overall reporting formats shall be approved by Employer's representative and may have to be modified from time to time as required and approved by Employer's representative. Contractor may have to prepare and submit additional reports on particular matters and incidents as and when required by the Employer's representative for each significant occurrence.

1.34 Tests To Be Carried Out During O&M Period

The minimum requirement of sampling and testing is to be carried out daily at least at the points given below. This schedule shall also be maintained during the O&M period.

- Flow measurement
- pH, BOD, COD, Suspended Solids / MLSS, Dissolved Oxygen, Alkalinity, Total Nitrogen, Sulphate, Total Phosphate, Residual Chlorine, Fecal Coliform etc shall be carried out at laboratory.
- Instrument/equipment for on line monitoring system for effluent(BOD,COD & TSS) measuring shall be installed & shall be connected thought PLC to control room as per guide lines issued by Central Pollution Control Board vide dated 07.11.2014. However for all purposes the laboratory analyzed report shall be the based for performance purpose.

1.34.1 Building and Site Maintenance

The Contractor shall be responsible for:

- The full maintenance of building and all electrical, ventilation, plumbing and drainage installation in the building.

- Building and housekeeping maintenance.
- Full maintenance of the site water and wastewater services, cabling and earthing systems, and the site road lighting system.
- Site maintenance including the upkeep of landscaped areas/ tree Plantation etc.,
- The telephone installations in all buildings.
- The building services and housekeeping maintenance shall be undertaken on all buildings and services installations.
- Routine housekeeping maintenance shall be carried out in accordance with procedures specified in the Operation and Maintenance Manual which shall be approved by the Employer's representative.

1.34.2 Preventive Maintenance

The Contractor shall plan the day-to-day and the preventive maintenance. This planning must include, for each equipment, the estimated necessary hours in preventive maintenance and break down maintenance. It shall also include the qualification of the foreseen maintenance personnel.

The Contractor shall provide the yearly requirement of spare parts and consumable needed for the maintenance of each piece of equipment for the day-to-day maintenance, preventive maintenance, and foreseen break down maintenance/overhaul, if any.

1.35 Training

1.35.1 General

The Contractor shall be responsible for instruction and training of all his personnel in all aspects of Plant operation and maintenance till the end of the operation and maintenance period. The Contractor shall also be responsible for training personnel designed by the Employer who will operate the Plant at the expiry of the contract.

The Contractor will make available for this purpose competent staff and as well as propose schedule information that may be necessary for effective execution of the training programme.

The training shall be organized in two (2) stages as follows:

- Basic technical training education to be carried out during the final stages of the erection period of the contract through literature, manuals, handouts demonstration at site, etc.
- Intensive on-the- job training during commissioning and maintenance period.

By the end of this training period these personnel should be able to carry out their respective duties efficiently under the supervision of Employer's representatives and supervisory staff of the Employer.

The Contractor shall provide at his cost all local transportation, literature, computers, CDs and other related hardware and stationery to be used by trainers and trainees during the training period.

Towards end of O & M contract period, training shall be conducted once again to Employer’s personnel or their authorized personnel. This training shall be for the duration of 30 working days.

1.35.2 Operation and Maintenance Records

The following are a typical sample form of records (not an exhaustive and comprehensive) that are required to be maintained by the O & M Contractor. The details of complete records shall be prepared and submitted by the O & M Contractor to the Employer’s representative for approval prior to commissioning.

1.35.3 Records of Operation and Maintenance of Pumping Station

a. Operational Records

Sl. No.	Particulars	Running		Total Time	Remarks	Reading Taken by
		From Hrs	To Hrs			
1.	Pump Operation Pump 1 Pump 2 Pump 3					

b. Daily Report on Operation and Maintenance of Pump Station (Electrical)

Date:

Sl. No.	Reading Hours.	Metering panel in pump house										Details of Alarm	Details of Trips	Remarks	Reading taken by	
		Current		Voltage		Power factor		KWH		Avg KVA						

Note: Reading to be taken at every 60 mins.

Prepared By:

Date:

c. Monthly Report on Operation & Maintenance of Pump Station (Electrical)

Name of Month: Year:

Sl.	Total KWH	Average	Total Average	Details of	Details of	Details of	Remarks

No.	Consumed	power factor	KVA Demand over the month	Breakdown	Breakdown Maintenance done	spares / consumables consumed	

1.35.4 Records of Operation and Maintenance of Sewage Treatment Plant

a. Daily Report on Operation and Maintenance of Sewage Treatment Plant (Electrical)

Date:

Sl. No.	Reading Hours	Metering panel in pump house								Detail of Alarm	Detail of Trips	Remarks	Reading taken by
		Current		Voltage		Power factor		KWH					

Note: Reading to be taken at every 60 min.

Prepared By:

1.35.5 Other Records

The contractor shall maintain detailed record of material movement as appropriate and approved by Employer’s Representative.

These records shall be available to the Employer’s Representative for scrutiny and copies shall be furnished on demand.

1.35.6 Road Works

The Contractor shall construct a road for access to his office and all the work sites, which shall be separate from the existing approach road to the plant. The Contractor shall obtain all permits required for carrying out works such as excavation, if required, on public roads and shall liaise with the appropriate authorities with regard to the timing and execution of the road works.

The Contractor shall be responsible for establishing and maintain temporary road/ drain diversions required for execution of the works. The Contractor shall reinstate all the roads to the satisfaction of the Employer or his Representative after completion of works.

1.35.7 Maintenance of Existing Access Roads

The Contractor shall only use existing access for the execution of the works. In such cases the Contractor shall obtain the permission of Employer or his representative Representative’s in writing before utilizing existing access road. Once the approval has been given, the Contractor shall be solely responsible for the maintenance of the existing site access roads (if any). This responsibility shall continue until the completion of the Defects Liability Period, or until such earlier date as the Employer or his representative may advise to the Contractor in

writing. Such maintenance work shall include general upkeep and any necessary repairs to damaged road surfaces, pavement, drainage, associated slopes, etc to a standard at least equal to their original condition. While carrying out such maintenance work, the Contractor shall make arrangements to maintain through passage for vehicles and also those of other contractors over these access roads, which may comprise temporary diversions all to the approval and satisfaction of the Employer or his Representative.

The Contractor shall not run tracked or un-sprung vehicles on surfaced roads without the written approval as it may require that planking or some other protective material be used to protect the road surface.

1.35.8 Clearance of the Site

The Contractor shall clear all the three Sites to the extent required by the Employer or his representative for checking the setting-out.

Clearance of the Site shall also include demolition and removal of all articles, pumping out the accumulated water at Pumping Station Sites, excavation/filling by earth, objects and obstructions, which are expressly required to be cleared.

The Contractor shall ensure that the parts of the Site to be occupied by the proposed Permanent Works are clear, and shall maintain the remainder of the Site as may be required for access and temporary works areas required for the project.

The Contractor shall remove the material arising from such clearance and dispose of it in a manner at a location, to the approval of the Employer or his Representative.

The Contractor shall fill and make good with appropriate materials those cavities and losses of soil, which result from clearing the parts of the Site not subsequently to be occupied by the Works.

The Contractor shall not clear the Site of any existing structure without the prior written instruction of the Employer or his Representative.

1.35.9 Clearance and Reinstatement of the Site on Completion

On completion of the Works, the Contractor shall clear any temporary works and temporary access roads and reinstate the areas to their original condition and to the satisfaction of the Employer or his Representative.

1.35.10 Access for the ULB and ULB Representative

The Contractor shall permit the ULB and the ULB Representative an any person authorized by the ULB or the ULB Representative including workmen of the ULB Agra, other contractors or utility undertaking's access for the purposes of the Contract to all areas of the Site and to any additional accommodation or temporary way leave for the duration of the Contract period.

1.35.11 Water Supply and Wastewater Disposal at Site

The Contractor shall make his own arrangements for water supply during construction at site and he shall ensure the quality of the water remains usable for the purpose for which it is intended. The Contractor shall also conduct weekly/bi-weekly test for water quality and comply with the quality requirements, as directed by the ULB's representative.

1.35.12 Latrines and Washing Facilities

Throughout the period of construction of the Works the Contractor shall provide, maintain and cleanse useable and sufficient latrines and washing facilities for use by his employees. He shall ensure that his employees do not foul the Site but make proper use of the latrines. Where practicable, the latrines shall be connected to the nearest sewer, or if this is not practicable the Contractor shall provide an adequately sized septic tank and soak-pit.

After completion, the latrines and washing facilities shall be removed, all ground disinfected and the surface reinstated to the satisfaction of the Employer or his Representative.

1.35.13 Electricity for Contractor's Use on Site

The Contractor shall be responsible for provision and distribution of an electrical supply for the purpose of construction.

The installation shall comply with all the relevant regulations, Indian Standards and Codes of Practice, and Health and Safety requirements, etc. The Contractor must take every possible precaution to ensure that his installation is safe and injury to personnel or damage to plant and buildings is avoided. The Contractor shall be fully responsible for all safety. The Contractor shall test the temporary site distribution system every 3 months for compliance with the relevant standards.

1.35.14 Refuse Disposal on Site

Refuse and rubbish of every kind shall be removed from the Site and disposed off by the Contractor at his own expense, frequently and regularly so as to keep the Site in an approved wholesome, hygienic and tidy condition to the satisfaction of the employer or his Representative.

1.36 Instrumentation and Control Philosophy

The instrumentation and control schemes proposed for the STP shall comprise the following. The list given below is not exhaustive but indicative of the level of instrumentation / automation required for successful operating and maintaining the plant. The minimum level of automation shall be ensured such that the plant operations and effluent quality parameters are not deteriorated due to lack of operator attention in night shifts.

1. Pressure indicating system.

2. Level sensing, transmitting, indicating, alarm & annunciation of levels in tanks, sumps and flow channels as well as interlock and control function with associated equipment.
3. Flow measurement system.
4. Dissolved oxygen analyzing system as well as associated interlocking with blowers / delivery valves / suction throttling of aeration tank to optimize the energy consumed.
5. Torque overloads annunciation and trip interlocking with associated drives.
6. Fully automatic operation, interlock, monitoring, logging, printing, event as well as report generation etc., through PLC based PC and printer along with associated hardware and soft wares.
7. Alarm & annunciation system to annunciate the plant equipment malfunction and tripping on fault as well as any other abnormality sensing.
8. Manual override facilities shall be provided at all places where PLC controls the operations
9. The lines, levels and setting out points for works are indicated in the Drawings enclosed. The drawings are indicative only. The Contractor shall submit all drawings based on his process design, layout and hydraulics.

1.37 Construction Documents

These documents shall include:

- Unit sizing of the process and sizing of all components of the plant including mechanical& electrical equipment supported by P & I diagram, Piping diagram, GA drawing of various units and buildings etc.;
- Layout Plan and hydraulic profile;
- Architectural Drawings/Renderings;
- Detailed structural design and good-for-execution (construction) drawings pertaining to all components of the plant;
- Drawings showing the size, position and other necessary details of all mechanical and electrical equipment and fixtures;
- Wiring diagrams, power & motor control gear in power cum Motor Control Center and motor control center;
- Details of foundations, position of openings, etc., for the pumps, motors, Blowers, starter modules, Low and High tension panels, etc;
- Elementary diagram and manufacturers' shop and part drawings for each equipment, including cut section drawings;

- Drawings depicting services like internal illumination and ventilation, building water supply, sanitation and plumbing, service roads, landscaping, area lighting, storm water drainage etc;
- Any other design and drawings to comply with the Employer's requirement for completion of work & to achieve the defined parameters.

The documents and drawings shall be in sufficient detail for review of the Employer's Representative. The scale of the drawing has to be chosen accordingly in coordination with the Employer's Representative in respect of hard copies, the soft copies shall normally be made available on actual scale basis. The drawings shall be of standardized sizes and as instructed by the Employer's Representatives. The drawings shall contain the following basic information in the nameplate:

- a) Project name
- b) Name and number of the Contract
- c) Contractor's name
- d) Number and title of the drawing
- e) Date and scale
- f) Draftsman's name
- g) Name of the designer and draftsman responsible including signatures.
- h) Revision Number (R0 for drawing submitted initially and R1, R2, etc., for drawings submitted subsequently).

A blank space 90 x 50 mm shall be provided immediately above the title block for the approval stamp. If required, the detailed design and the execution drawings shall be submitted only after verification by an institute approved by the Employer.

1.38 Operation & Maintenance Manual and As-Built Drawings

The submission of the As-built drawings and the operation and maintenance manual for the system is the precondition for the final payment.

1.39 As-Built Drawings

The Contractor shall submit to the Employer's representative within one months of actual completion, "Completion" Drawings as specified below. These Drawings shall be accurate and correct in all respects and shall be shown to and by the Employer's representative.

Completion Drawings as specified below on shall be supplied by the Contractor two prints and one polyester film, along with a soft copy in CD. These drawings shall be developed in Auto CAD recent version. Drawings shall be of standards size described below.

1. Site plan showing all features existing and as constructed under this contract with all external dimensions of clear spaces among those, diameter and materials of pipeline etc. complete.

2. Architectural, civil and structural details of all components of the Plant, including plans at different levels, elevations from all sides as well as sections etc. complete with all dimensions including structural thickness, concrete grade, reinforcement details, finishing details, schedules of doors and windows, details of associated fittings and features complete.
3. All piping, plumbing and electrical details with dimensions, diameters etc. complete. At specific cases isometric views of piping may be necessary.
4. Dimensional details of all electrical, mechanical and instrumentation equipment including accessories along with arrangement inside the buildings or enclosures, connected piping and cabling, layout, etc. all complete.
5. Dimensional details of all control and measuring devices lined weirs, V-notches, probes, valves, gates, consoles, panels, switch boards, cable layout etc. for the complete Plant. Fine diagrams and circuit diagrams shall be used wherever applicable.
6. L-Section for pipelines laid externally, showing pipe profile, ground profile, soil condition, bedding location of specials, valves, and other accessories complete.
7. Dimension details of all site development works such as roads, drainage, cables, pipelines, landscaping, etc. complete with layout, cross sections, levels, etc. complete.
8. All drawings shall be prepared in appropriate scale and with adequate notes, legends, titles, etc. for clarity.

1.2 CWR & OHTs Structures Design Requirements

This section specifies the Design requirements pertaining to Civil RCC Structural works. The Civil General Technical Specifications and Standard Specifications included in the tender shall be read in conjunction with these requirements.

1.2.1 Design Submissions

The Contractor shall submit 5 (Five) copies of complete detailed design calculations of each of the components such as substructure and superstructure together with general arrangement drawings, construction drawings and explanatory sketches as required by the Employer. Separate calculations for substructures or superstructures submitted independent of each other shall be deemed to be incomplete and will not be accepted by the Employer.

The design considerations described hereunder establish the minimum basic design requirements of plain and reinforced concrete structures, architectural details, masonry structures **and structural steel works**. However, any particular structure shall be designed for the satisfactory performance fulfilling the functions for which the same is being constructed. The Contractor shall also check the stability of completed structures to be used for the project.

1.2.2 Design Standards

All designs shall be based on the latest Indian Standard (I.S.) Specifications or Codes of Practice. The design standards adopted shall follow the best, modern and sound Engineering practice in the field based on any other international standard or specialist literature subject to such standard reference or extract of such literature in the English language being supplied to and approved by the Employer's Representative.

All the designs of reinforced concrete structures shall generally conform to the recommendations made in the following publications (latest versions) of the Bureau of Indian Standards:

- i. IS : 456: Code of Practice for plain and reinforced concrete
- ii. IS: 875: Code of Practice for design loads for buildings and structures other than Earth Quake loads (Part 1 to 5).
- iii. IS: 3370: Code of Practice for concrete structures for the storage of liquids (Part I to IV)
- iv. IS: 1893: Criteria for earthquake resistant design of structures.
- v. IS: 2974: Code of Practice for design and construction of machine foundations (Part 1 to 4)
- vi. IRC: 6 Part II: Standard specification and Code of Practice for road bridges Loads and Stresses
- vii. SP: 34: Handbook on concrete reinforcement and Detailing.

All structural steel design shall generally conform to the following recommended latest publications of the Indian Standards Institution:

- i. IS:800: Code of Practice for general construction in steel
- ii. IS:806: Code of Practice for use of steel tubes in general building construction

1.2.3 Design Life

The minimum design life of all structures and buildings shall be 60 years.

1.2.4 Design Loads

All buildings and structures shall be designed to resist the worst combination of the following loads/stresses under test and working conditions; which includes dead load, live load, wind load, seismic load, stresses due to temperature changes, shrinkage and creep in materials, and dynamic loads.

1.2.5 Dead Load

This shall comprise loads arising due to all permanent construction including walls, floors, roofs, partitions, stairways, fixed service equipments and other items of machinery. In estimating the loads of process equipment all fixtures and attached piping shall be included, but excluding its contents.

The minimum Dead Loads shall be as per IS: 875 (Part 1).

1.2.6 Live Load

Live loads shall be in general as per IS: 875 (Part 2). However, the following minimum loads shall be considered in the design of structures:

- i. Live load on roofs : 1.50 kN/m²
- ii. Live load on floors supporting equipment such as pumps, Blowers, compressors, valves etc. : 10.00 kN/m²
- iii. Live load on all other floors, walkways, stairways and Platforms. : 5.00 kN/m²

In the absence of any suitable provisions for live loads in I.S. Codes or as given above for any particular type of floor or structure, assumptions made must receive the approval of the Employer's Representative prior to starting of the design work. Apart from the specified live loads or any other load due to storage of materials, any other equipment load or possible overloading during maintenance or erection/construction in part or full, most critical condition shall be considered in the design.

1.2.7 Wind Load

Wind loads shall be as per IS: 875(part 3).

1.2.8 Earthquake Load

This shall be computed as per IS: 1893. The project area falls in seismic zone 2.

1.2.9 Dynamic Load

Dynamic loads due to working of plant items such as pumps, blowers, compressors, switch gears, traveling cranes, etc. shall be considered in the design of structures.

1.2.10 Equipment Loads

Loads of all equipment like pumps (static and dynamic), valve, switchgear, electrical control and relay panels, cable load, pipe load (static and dynamic), etc. shall be considered over and above the imposed loads.

1.2.11 Crane Loads

For crane loads, an impact factor of 25% and lateral crane surge of 10% (of lifted weight + trolley weight) shall be considered in the analysis of frame according to the provisions of IS : 875. The longitudinal crane surge shall be 5% of the static wheel load.

1.2.12 Temperature Load

For temperature loading, the total temperature variation shall be considered as 2/3 of the average maximum annual variation in temperature. The structure shall be designed to withstand stresses due to 50% of the total temperature variation. Suitable expansion joints shall be provided in the longitudinal direction whenever necessary with provision of twin columns. The maximum distance of expansion joint shall be as per provision of IS: 800 and IS: 456-2000 for steel and concrete structure respectively.

1.2.13 Individual Members Load

Individual members of the frame shall be designed for the worst combination of forces such as bending moment, axial force, shear force, torsion, etc.

1.3 Mechanical Design Requirements

1.3.1 Horizontal Split Casing Centrifugal Pump for water supply

The contractor shall select suitable pumps for operation of clear water pump in the specified operating range. All the pumps shall be of similar characteristics at every pump station.

The type of pumps shall be Horizontal Split Casing type and all the pumps shall be provided with suitable motors and accessories.

The static head for the design of clear water pumps at pump Station will be the difference in centre line of inlet at CWR and highest water level in the ESR/ RL of delivery point of inlet pipe whichever applicable..

The pump shall have a stable head curve, i.e. the total head-capacity curve shall be continuously rising towards the shut off head. The shut off head shall be at least 25 to 30% more than pump design head at intersecting point of the pump curve with the upper range system head curve.

A minimum overall (combined pump & motor) efficiency as 70% for each clear water pump set and motor selection shall be made.

The required pump NPSH at duty point shall be at least ~~0.5~~ 1.0 meter less than the available NPSH. The horizontal split casing pumps shall be used with positive suction head. In case the site condition warrants suction lift, suitable vacuum pumps shall be provided for priming the pumps.

Pump must be suitable for operating in parallel over the entire operating range. The pump shall operate satisfactorily at any point between the maximum and minimum system resistance.

The pumps shall be capable of reverse rotation up to 125% rated full speed of the drive motor, due to back flow of water, without damage or loosening of threaded components.

The specifications for flanges shall be as per the relevant IS code.

Spare parts supplied with the pump shall be identical to respective pump components and shall be from original equipment manufacturer.

Pumps shall run smooth without undue noise or vibration. Noise levels and velocity of vibrations shall be within acceptable limits. Noise level shall be limited to 85 dba at a distance of 2 m. Velocity of vibrations shall be within 4.5 mm/s as per relevant Hydraulic Institutes Standards and IS.

Unless otherwise specified the drive unit power rating shall be the maximum of the following requirements:

- A) Required margin/factor as given below over the pump shaft input power required at duty point.
 - Pump shaft input power 15-75 KW - 1.20
 - Pump shaft input power >75 KW - 1.20
- B) Pump shaft input power at (-) 25 % of duty head.
- C) Pump shaft input in the operating range corresponding to minimum and maximum water level in the CWRs

1.4 Details of pump & motor to be provided in the contract will be as below:-

1.5 Brief Description and specification for Interconnecting Piping

Supplying, laying jointing and testing of interconnecting piping and valves with all accessories like support brackets pipe racks etc. are included in the contractor's scope of work. All the piping shall be carried out as per the specifications given in this tender document and following the relevant IS codes, using best quality material. Tenderers are advised to make their own assessment of the requirement of Pipes, Valves, fittings. Jointing material, gaskets, nuts bolts, and pipe supports etc. whatsoever is required for successful completion of the job as per the specifications.

Pipeline shall be design taking following into consideration

Sr. No	Pipe details	MOC
1	Pipe from Raw Water Take off point to Inlet Chamber	DI
2	All interconnecting piping between plant units	DI
3	Filter Back wash water line	D.I / C.I.
4	Scour Air Line	MS
5	Sludge and Filterback wash water lines	DI
6	Chemical dosing line	HDPE/ PP
7	Chlorine solution line	HDPE/PP
8	Clear Water pipes and fittings within pump house	DI

All gravity flow line shall be design for fluid velocity of 0.6 to 3 m/sec. All Pressure lines to be designed for Fluid velocity of 1.5 m/sec. Scour air pipeline shall be designed for 15 m/sec fluid velocity. All fitting in HDPE/ PP line shall be moulded/electrofusion/butt joints.

1.6 Civil Works Technical Requirements

This section specifies the technical requirements pertaining to Civil works. The General Civil requirements and standard specifications included in the tender shall be read in conjunction with these requirements.

Complete detailed design calculations of foundations and superstructure together with general arrangement drawings and explanatory sketches shall be submitted by the Contractor to the Engineer. Separate design calculations for foundations or superstructures submitted independent of each other shall be deemed to be incomplete and will not be accepted by the Engineer.

The various structures covered under this specification for Civil technical requirements are as mentioned below but not limited to:

- Pumping Station Building
- Clear water Reservoirs
- Valve Chambers
- Pipe Intake
- Any and all other retaining structures

All other structures not listed above but mentioned elsewhere in the bid document shall also follow the civil works technical requirements and specification of the bid document.

1.6.1 Design Standards

All the designs shall be based on the latest Bureau of Indian Standard (BIS) Specifications or Codes of Practice. The design standards adopted shall follow the best modern engineering practice in the field based on any other International Standard or specialist literature subject to such standard reference or extract of such literature in the English language being supplied to and approved by the Engineer. In case of any variation or contradiction between the provisions of the BIS Standards or Codes and the specifications given along with the tender document, the provision given in this Specification shall be followed.

1.6.2 Partly/Fully Underground Liquid Retaining Structures- Basis for Design

All underground or partly underground liquid containing structures shall be designed for the following conditions:

- i. liquid depth up to full height of wall and free board: no relief due to lateral soil pressure from outside to be considered;
- ii. Reservoir empty (i.e. no liquid or any material inside the storage area): full lateral earth pressure at rest due to surrounding saturated soil and surcharge pressure as applicable, shall be considered;
- iii. partition wall between dry sump and wet sump to be designed for full liquid depth up to full height of wall;
- iv. partition wall between two compartments to be designed as one compartment empty and other full;
- v. Structures shall be designed for uplift in empty conditions considering the depth of the highest water table recorded in the area.
- vi. walls shall be designed under operating conditions to resist earthquake forces developed due to mobilization of earth and dynamic liquid loads;
- vii. Underground or partially underground structures shall also be checked against stresses developed due to any combination of full and empty compartments with appropriate ground/uplift pressures on the base slab. A minimum factor of 1.2 shall be ensured against uplift or floatation.

1.6.3 Foundations

- i. The minimum depth of foundations for all structures, equipments, buildings and frame foundations and load bearing walls shall be as per IS: 1904.
- ii. Care shall be taken to avoid the interference of the foundations or any other component of the new building with the foundations of adjacent buildings or structure. Suitable adjustments in depth, location and sizes may have to be made depending on site conditions. The Employer's Representative shall accept no extra claims for such adjustments.

- iii. Special attention is drawn to danger of uplift being caused by the ground water table. Base raft for underground structure shall be designed for uplift forces that are likely to be developed.
- iv. Where there is level difference between the natural/ existing ground level and the foundations of structure or floor slabs, this difference shall be filled up in the following ways:
 - In case of non-liquid retaining structures the natural top soil shall be removed till a firm stratum is reached (minimum depth of soil removed shall be 500 mm.) and the level difference shall be made up by compacted backfill as per specifications. However, the thickness of each layer of the backfill shall not exceed 150 mm. The area of backfilling for floor slabs shall be confined to prevent soil from slipping out during compaction. The safe bearing capacity of this well compacted backfilled soil for design calculations shall not exceed 100 KN/m².
 - In case of liquid retaining structures, the natural top soil shall be removed as described above and the level difference shall be made up with Plain Cement Concrete (1:5:10)

1.6.4 Requirements for Reinforced and Plain Concrete Works (Structures)

The following are the design requirements for all reinforced or plain concrete structures:

- a. All blinding and leveling concrete shall be a minimum 100 mm thick with minimum concrete M10 grade.
- b. All structural reinforced concrete other than for water retaining structures shall at least be of M-25 grade with a maximum 40 mm aggregate size for footings and base slabs and with a maximum 20 mm aggregate size for all other structural member. The RCC work shall be carried out with SRC cement where the structure will remain in touch with sewage / sludge in design mix of min M-30.
- c. The minimum grade of concrete for water retaining structures shall be M-30 having minimum cement content of 350 kg/m³ with a maximum 40 mm aggregate size for footings and base slabs and with a maximum 20 mm aggregate size for all other structural member.
- d. As a design consideration to control crack, though general requirements of IS 3370 shall be followed, All liquid retaining structures shall be designed based on the serviceability crack width limit state (i.e. 0.1 mm crack width) and other limits including the ultimate limit states.
- e. The minimum clear cover to all reinforcement including stirrups and links shall be 45 mm for all water retaining structures including the bottom of roof. For other structures the minimum clear cover shall be as specified in IS: 456.
- f. Any structure or pipeline crossing below roads shall be designed for a minimum of Class A of IRC loading.
- g. The bridges and supporting structure (for clarifiers, pipeline crossing river, etc.) shall be designed to safely withstand the loadings such as loads and torque transmitted through scrapper blades, motor, water force in the river, etc. depending on the arrangement offered besides other loads.

- h. All pipes and conduits laid below the structural plinth, road works, river bed, nallah crossing, etc. except those crossing National Highway/Railway line, shall be embedded in reinforced concrete of minimum grade M25 having minimum 300 mm thick concrete cover all around.
- i. Approved quality water proofing compound (chloride free) shall be added during concreting of all liquid containing structure, in the proportion specified by manufacturer.
- j. For walls of liquid retaining structures, the following shall be considered.
 - Minimum reinforcement shall be as per IS: 3370 part -2.
 - Maximum length of panel to be concreted considering partial construction joints shall be 7.5 m. The adjacent panels shall be poured with a minimum time gap of 4 days. Height of pour shall not exceed 2 m.
- k. The following minimum thickness shall be used for different reinforced concrete members, irrespective of design thickness:

(i)	Walls for liquid retaining structures	:	200 mm
(ii)	Roof slabs for liquid retaining structures	:	150 mm
(iii)	Bottom slabs for liquid retaining structures	:	200 mm
(iv)	Floor slabs including roof slabs, walkways, canopy slabs	:	150 mm
(v)	Walls of cables / pipe trenches, underground pits etc	:	125 mm
(vi)	Column footings	:	300 mm
(vii)	Parapets, Chajja	:	100 mm
(viii)	Precast trench cover	:	75 mm

1.6.5 Requirements for Building Works

Unless otherwise specified, all the building works shall generally comply with the following

- a. All buildings shall have Reinforced Concrete framework.
- b. 75 mm thick RCC Damp Proofing Course in M15 shall be provided to all building walls.
- c. Anti-termite treatment as per IS: 6313 part-III – 1971 with injection of chloropyriousemulsifiable concrete (1%) timber care ground treatment chemically emulsion 1:3 and creating a chemical barrier under and around the column pits, wall trenches, basement excavation, top surface of plinth filling, junction of wall and floor along the external perimeter of building, expansion joints, surrounding of pipes and conduits etc.
- d. All external walls shall be in 230 mm thick brick masonry built in cement mortar in (1:4). Transoms and mullions shall be of 115 mm x 230 mm size of cement concrete in M15 with four numbers 6 mm bars and 6 mm links at 150 mm c/c shall be provided to form panels not exceeding 3500 mm x 3500 mm in size.
- e. All internal partition walls except for toilets shall be in 230 mm thick brick masonry built in cement mortar 1:4 with transoms and mullions as stated above. Toilet partition walls shall be in 115 mm thick brick masonry built in cement mortar 1:4

and shall have transoms and mullions as stated above to form panels not exceeding 1200 mm x 1200 mm size.

- f. All internal masonry surfaces shall be finished with 12 mm thick smooth faced cement plaster in cement mortar (1:4).
- g. All external masonry surfaces shall be plastered in two coats with sand faced cement plaster in cement mortar (1:4) and shall have total thickness of 20 mm. Waterproofing compound of approved make and quality shall be added to the cement mortar in proportions as specified by the manufacturer.
- h. Bathroom/ W.C. floor slab shall be sunk and filled with brickbat coba (broken bricks set in lime) and provided with waterproofing as per the specifications of an approved specialist waterproofing company. The finished floor level in Bathroom / W.C. areas shall be normally 12 mm below the finished floor level on the outer side.
 - i. Toilet facilities shall be provided at New WTP and all New Pumping stations, Master Control Centre, for men and women usage separately and shall include at least:
 - i. 1 No. Water closet with white porcelain EWC/Orissa pan minimum 580 mm long with PVC flushing cistern of 10 liters capacity.
 - ii. 1 No. Urinal of sizes 600 mm x 400 mm x 300 mm flat back type in white porcelain separated by a kota stone partition of size 680 mm x 300 mm shall be provided outside toilet.
 - iii. 1 No. Washbasin of size 510 mm x 400 mm in white Porcelain with inlet, outlet with bottle trap.
 - iv. 1 No. Mirror of size 400 mm x 600 mm PVC moulding wall mounted type fitted over washbasins.
 - v. 1 No. Plastic liquid soap bottles
 - vi. 1 No. Chromium plated brass towel rails minimum 750 mm long.
 - vii. All stopcocks, valves and pillar cocks shall be of chromium-plated brass, heavy duty.
 - viii. All fittings such as 'P' or 'S' traps, floor traps, pipes, down-take pipes etc.
 - ix. The sewage from toilet blocks shall be led to the sewerage system as directed by the Employer.
 - i. Wherever specified, staircases shall be finished with 25 mm thick Kota Stone treads and 20 mm thick Kota Stone skirting. The rise of stairs shall not exceed 170 mm and minimum width of the tread shall not be less than 275 mm. All steps shall have 20 mm nosing. R.C.C. stairways shall be provided to permit access between different levels within buildings. All roof tops and tops of overhead tanks shall be made accessible with ladder provision. Vertical ladders fitted with landing point extensions will be permitted where considered appropriate by the Employer's Representative to access areas not frequently visited.
- j. All floor cutouts and cable ducts, etc. shall be covered with pre-cast concrete covers in outdoor areas and G.I. chequered plates of adequate thickness in indoor areas. All uncovered openings around the platforms, balcony, stairs, and landing shall be protected with G.I. hand railing of 20mm diameter medium class GI placed and fixed

- in two rows. Top railing and vertical of the G.I hand railing shall be 20 mm dia. G. I. Pipe of Class-A. The lower railing shall be 25 mm dia. G.I. pipe of Class A.
- k. All staircases shall be provided with steel railing with PVC cover or wooden handrail.
 - l. The reinforced concrete roofs shall be made waterproof by application of approved cement/ lime based waterproofing treatment. The finished roof surface shall have adequate slope to drain quickly the rainwater to R.W down-take points.
 - m. For roofing drainage, PVC rainwater down-takes with khurra and door bend with grating at top shall be provided. For roof areas up to 40 m². minimum two nos. 100 mm diameter down-take pipes shall be provided. For every additional area of 40 m² or part thereof, at least one no. 100 mm dia. down take pipe shall be provided. The RW pipes shall be concealed.
 - n. Top surfaces of chajjas and canopies shall be made waterproof by providing a screed layer of adequate slope or application of an approved roof membrane and sloped to drain the rainwater.
 - o. Building plinth shall be minimum 450 mm above average finished ground level around building and shall not be less than plinth level of existing buildings.
 - p. All buildings shall have a minimum 1.0 m wide, 100 mm thick plinth protection paving in M15 grade concrete finished with stone slabs/ tiles. All plinth protection shall be supported on well-compacted stratum.
 - q. All concrete channels and ducts used for conveying liquid shall have smooth finish from inside. The width of concrete channels shall not be less than 500 mm. All open channels shall be provided with G.I. hand railings.
 - r. Kerbs to be provided below the hand railing on the catwalks/pathways should be as per relevant sections of the Factory Act.
 - s. All rooms in the treatment plant buildings and SPS shall be provided with appropriate signboards indicating the function of the rooms involved.
 - t. Wherever equipment and machinery is required to be moved for inspection, servicing, replacement etc., suitable movable gantry of required capacity shall be provided.
 - u. The design of buildings shall reflect the climatic conditions existing on site and it shall as far as possible permit the entry of natural light.
 - v. Emergency exit doorways shall be provided from all buildings in order to comply with local and international regulations. Stairways and paved areas shall be provided at the exit points.
 - w. Toilet blocks in process building shall be provided with two drinking water taps of 12mm size and sink with appropriate drainage.
 - x. All chequered Plates shall be hot dip galvanized.
 - y. All types of opening such as doors, windows and ventilators shall be minimum 25% of the floor area.
 - z. Glass shall be minimum 5 mm thick, pin headed or opaque.
 - aa. All roof tops and overhead tanks shall be made accessible with ladder provision. Vertical step ladders fitted with landing point extensions will be permitted where considered appropriate by the Engineer to access areas not frequently visited.

- bb. Steel staircases shall be constructed of standard channel stringers with M.S. grating treads 25mm thick with non skid nosing. Steel Ladders shall be minimum 600mm wide and shall not exceed 6m of straight run. The ladders shall be painted with epoxy paint.
- cc. All doors, windows and ventilators shall be made of aluminium conforming to latest version of IS: 1948. All fixtures for doors, windows and ventilators shall also be of aluminium. Aluminium grills shall be provided in all the windows. Doors shall be in two panel and both panels shall be glazed/unglazed. Minimum weight of aluminium doors and windows shall be as follows
- I. Single Glazed Window : (Weights indicated shall be aluminium)
 - a) Openable Outer Frame :Weight 0.70 kg/Rmt
 - Shutter Frame :Weight 0.97 kg/Rmt
 - Intermediate Mullion :Weight 0.97 kg/Rmt
 - Beading :Weight 0.31 kg/Rmt
 - Fixing Louvers windows/ventilators
 - Outer Frame :Weight 0.46 kg/Rmt
 - II. Double Glazed Window
 - Outer Frame :Weight 0.72 kg/Rmt
 - Shutter Frame :Weight 0.97 kg/Rmt
 - Intermediate Mullion :Weight 0.98 kg/Rmt
 - Beading :Weight 0.31 kg/Rmt
 - III. Sliding Windows
 - Bottom and Top Frame :Weight 0.70 kg/m
 - Shutter Frame :Weight 0.42 kg/m
 - InterlockingSection :Weight 0.47 kg/m
 - IV. Aluminium Door
 - Outer Frame :Weight 2.508 kg/Rmt
 - Shutter Frame :Weight 2.508 kg/Rmt
 - Bottom Stile :Weight 2.508 kg/Rmt Glazing shall be 5.5 mm thick glass.
- dd. Rain water harvesting structure to be provided as per guidelines of State government/GWD/CPWD, after approval of same under SIP

1.6.6 Concrete Reinforcement

All major structures, buildings, pump Station, water treatment plant, Electrical sub stations, river crossing structures, thrust blocks, pillars and all water retaining structures including all other

structures in the Contract will use TMT Fe 415 or Fe500 of approved make/manufacturer for concrete reinforcement.

1.6.7 Joints

Movement joints such as expansion joints, complete contraction joints, partial contraction joints and sliding joints shall be designed to suit the requirements. However, contraction joints shall be provided at specified locations spaced not more than 7.5 m in both directions right angle to each other for walls and rafts.

Suitable gap at the location of expansion joints placed at a suitable interval not more than 30m shall be provided in walls, floors and roof slabs of all structures.

Construction joints shall be provided at right angles to the general direction of the member. The locations of construction joints shall be decided as per convenience of construction. To avoid segregation of concrete in walls, horizontal construction joints are normally to be provided at every 2 m height. Approved PVC water-stops of 150 mm width shall be used for walls and 230 mm width for base slabs.

Expansion joints for non-liquid retaining structures shall be provided as per IS 3414.

1.6.8 Requirements at Existing OHTs

The Contractor shall carry out all the necessary works including foundation works for pump/motor/transformer and other equipment. modification to existing structures to cater for additional load, finishing works, lighting works etc. shall be carried out by the Contractor as detailed below. The Contractor shall suitably plan all the construction activities and take utmost care as to allow smooth functioning of the existing pump station being operated by the existing Contractor and pipelines.

The civil works envisaged at existing raw/clear water pump station shall be as follows, but not limited to:

- a) The Contractor shall carry out all civil works/modification works for installation, finishing and furnishing of the building using material as detailed in the specifications.
- b) Construction of Retaining walls if any for reclamation of land as necessary.
- c) Fencing of the Campus including electrical substation etc. if any
- d) All civil works for new substation (partly indoor) including RCC frame, roofing, trenching and laying of cables and preparation of ballast ground floor etc.
- e) Construction of foundation for new transformers and other structures of substation.
- f) Dry distemper on interior and cement based paint on exterior walls of entire pumping station structure.
- g) Providing internal roads, overall site grading and landscaping including planting of trees in campus.

1.7 Clear Water Reservoir, Sump

The scope of work includes, but is not limited to the Design, Construction, Supply, Installation, Testing, Commissioning, Trial Run, and 5 yr. O&M of the all Civil, Mechanical, Electrical and

Instrumentation Works for the Clear Water Reservoir with other ancillary structures along with all material, Labour and T&P, training to the maintenance personnel.

Clear water reservoir and clear water pump house shall be constructed within TajGanj ZPS premises Contractor shall fit the layout within available land.

1.8 Clear Water Pump Stations

The clear water pump station building is to be constructed along with Electrical outdoor switchyard. The Pump Station shall have Pump Station, Duty room, Maintenance bay, Toilet block, PLC Control Room etc. This pump station will accommodate the pumps required for pumping total TajGanj ZPSdemand requirement. And direct supply to Zone-7

1.9 Rising/feeder mains

Rising mains/feeder mains and associated works shall be designed for ultimate Capacity.Economical designs for the proposed transmission mains and feeder mains have been done from the clear water pumping stations at TajGanjZPS.The contractor shall lay along optimaum alignment to avoid interference with existing utilities. Necessary drainage arrangements shall be provided at scour valve location.

1.10 Proposed water distribution system

The existing Distribution system is very old and will be completely phased out. Entire city will be provided with new distribution system. The distribution system will be by direct pumping and also by gravity feed where OHSRs are available. The whole project is divided into 7 distribution zones. The distribution system is designed for optimum O & M by using isolated valves, scour valves, flow meters etc... The contractor shall ensure safe installation of appurtenances and ensure smooth operation

To start with, the scheme shall be introduced in one zone. After observing the results and rectifying the problems encountered, the scheme shall be introduced in all other zones.

- The zoneswill be converted to continous pressurised supply and operated for at least 12 months in a sustainable way. In case of non availability of water, the contractor shall not be responsible for commissioning the DMA at the requisite pressure.
- Volumetric charging will be introduced.
- The changes in customer attitudes and behavior (including coping strategies) will be monitored.
- The staff must be trained in modern operational techniques like leak detection and pressure management

1.11 Existing OHSR's structures are to be repaired/ refurbished to the satisfaction of Engineering In charge. Following main activities are to be executed in these works -

1. All concrete and plastering works are to be done using mix in higher proportion than the existing, to ensure proper adhesion and strength. Contractor has to ensure that the new material sticks to existing by using cement slurry and or epoxy / adhesive wherever required.

2. All existing structures are to be inspected after dewatering and desilting. All damages (spalling of plaster, spalling of concrete, damage to floor, rusting of steel etc). It has to be made good to the satisfaction of Employer's representative.
3. All concrete cracks are to be made good to the satisfaction of Employer's representative by using pressure grouting as per specifications.
4. All existing structures are to be repainted outside including steel doors and railing etc as per specifications.
5. Repainting of markings / slogans on existing structure.
6. Food grade two coated epoxy paint have to be applied on all interior walls, top dome and floor surfaces of the OHSR's (after surface preparation).
7. Providing / refurbishment of plinth protection as per specification.
8. Replacing water level indicator with specified number of level indications as per specification and direction of Engineer.
9. Providing / refurbishment of door (with lock and key arrangement) at first landing for smooth passage of persons.
10. Providing / dismantling / refurbishing of railing in existing structures.
11. Providing/ replacing of existing wire mesh at ventilator of top dome.

1.12 Mechanical Technical Requirements

1.12.1 Horizontal Split Casing Centrifugal Pump

It is proposed to provide Horizontal Split Casing Centrifugal pump set of following specifications in all Clear water and Raw water pumping station.

Contractor has to design these pumps Stations complete for Civil, Mechanical, Electrical and Instrumentation works. The pump Stations shall be designed to accommodate installation of pump sets for different sections as per scope of work and as mentioned below.

1.12.2 General Features of Pumps

The clear water pumps shall have the following features:

- a) Type of Clear Water Pump Sets,
Horizontal Split Case type pumps with squirrel cage LT Induction Motors of suitable ratings. Pump drive shall be of 0.415 kV rating.
- b) NPSH
The NPSH provided by the installation of pumps (NPSHa) shall be at least 0.5 m more than that required for the pump (NPSHr) in all conditions of operation.

1.12.3 Specifications for Horizontal Split Casing Pumps

The design, manufacture and performance of the pumps specified herein shall comply with the requirements of the applicable Codes and Standards, as follows, but not limited to:

Table1: Specification for Horizontal Split Casing Pumps

No.	Standard	Title
1	IS 6595 (Part II)	Horizontal centrifugal pumps for clear, cold and fresh water.
2	IS 9137	Code for Acceptance Tests for Centrifugal, Mixed flow and Axial pumps.
3	IS 13537	Technical specification for centrifugal pumps - Class 2
4	ISO 5199	Standards of the Hydraulic Institute of USA.
5	ISO 2373	Balancing of impeller.
6	IS 5120	Performance test of pumps
7	IS 11732	Mechanical Balancing

1.12.4 Features and Material of Construction**Features and Material of Construction Split Casing Pumps**

Casing	Horizontal split casing
Drive	Direct
Flange Drilling	IS 1538
Prime mover	Electric Motor (Refer Electrical section)
Casing	Cast Iron IS: 210 – Gr. FG 260 with 2 % Ni
Impeller and impeller rings	SS (CF8M)
Shaft	SS (AISI 410)
Shaft Sleeve	SS (AISI 410)
Casing rings	SS (CF8M, CA15)
Glands	Bronze grade LTB2 of IS 318
Gland Packing	Graphite Asbestos
Lantern Rings	CI
Gaskets	Manufacturer's Standard durable.
DRIVE DATA	
Motor	0.415 KV motor, (TEFC) Squirrel cage induction motors For details refer to Motor Specifications

1.12.5 Accessories Required To Be Supplied With Pump

The contractor is supposed to provide at least the following accessories:

- Base Plate
- Foundation Bolts
- Coupling

1.13 Electrical Technical Requirements**1.13.1 General**

The scope of work includes design, equipment selection, manufacture, inspection at Contractor's or his Sub-Contractor's works, supply, installation (including storing, unloading and transferring the material / equipment to Contractor's storage area, maintaining equipment / material in safe custody and assembling the elements of the equipment and installing at the place of work), testing and commissioning of the plant equipment/ electrical system on 'Design Build and Operate' basis and dismantling of existing electrical equipment and handed over the existing equipment to Employer's Representative at the location as directed by the Employer Representative. After successful commissioning and trial run of the plant, it should be handed over to the Employer. The Contractor shall also be responsible for Operation and Maintenance (OandM) of the plant for 10 years after it is formally taken over by the Employer. The Contractor shall submit their design calculations/ drawings

based on 'Design criteria for electrical equipment/system' for Employer's review and approval. These specification covers substations, transformers, HV/LV switchboards, energy efficient motors, soft starters, capacitors, HV and LV power cables and control cables, and other allied equipment, etc. along with the specifications for workmanship, laying cables, lighting system, earthing systems, lightning protection etc. for Agra water supply project. It shall be the responsibility of the Contractor to design the electrical system based on the selection of the mechanical equipment. Prior to commencement of work contractor shall check the availability of 33kV or 11kV power supply with state electricity authority. Bidder shall provide Best efficiency level energy efficient transformer.

The Bidder shall make his own estimate of sizes, ratings and quantities for, substation equipment, all plant items and miscellaneous systems such as earthing, lightning protection, lighting, auxiliary power distribution, etc. Design of electrical system (i.e. Substation, transformers and other electrical equipment) shall be based on Stage-II (i.e. year up to 2046) only. However, facility for upgrade/ expansion of all equipment to cater Stage-II load shall have to be considered during design-Engineering stage. Sufficient space in the switchyard and switchboard/ control room shall be provided for expansion/ up-gradation of switchyard / electrical equipment/ switchboard for Stage-II load. It should be clearly understood that the Contract will be on 'Design Build and Operate' basis and no variation will be allowed for items of works not foreseen or omitted by the Bidder at the bidding stage, except where specifically indicated in the bid documents. Details of Stage I and Stage II requirements in terms of demand and proposed year are covered in the tender.

All equipment offered shall comply with the requirements specified in the latest editions of applicable Indian/ International Standards and shall also comply with the good Engineering practices.

The drawings enclosed with the specification are for general guidance of the Bidder only. Contractor shall design the electrical system on the basis of 'Design Criteria' and to be submitted for Employer's approval. Contractor shall incorporate any changes/ suggestions in the drawings to suit site conditions and design criteria and standard Engineering practice and resubmit for approval to Employer's Representative.

The Contractor shall possess the valid electrical Contractor's license of appropriate class from the concerned statutory bodies governing the area of work place. The Contractor shall fully comply with the relevant statutory rules and regulations.

All type (as applicable), routine and acceptance tests shall be conducted in the presence of Employer/ Employer's Representative / Third Party Inspector on all the equipment as per latest applicable IS/IEC at no extra cost. Typical type test reports for other equipment shall be submitted by the Contractor for approval by Employer's Representative.

All commissioning tests shall be carried out in the presence of Employer/ Employer's Representative and approval for the same shall be obtained before commissioning and installation. All test reports shall be properly maintained by the Contractor duly approved by the statutory bodies and shall be

handed over to the Employer after completion of the job. All instrument and accessories required for testing and pre commissioning of the equipment specified herein shall be provided by the Contractor at no extra cost to the Employer.

Liaison with electric distribution company and other Government organization/ statutory bodies for obtaining Power supply/ other clearance shall be Contractor's scope. After completion of installation work, the Contractor shall arrange for inspection and obtain approval from the concerned statutory bodies. Any fees that are to be paid to such statutory bodies for testing, inspection or calibration shall be paid by the Contractor. Any modification / revision in the equipment / installation of equipment as required by the statutory bodies shall be carried out by the Contractor. All such costs / fees for revisions / modifications shall be deemed to be included in the prices of supply, installation, testing and commissioning of equipment as quoted by the Contractor.

1.13.2 Transformer Size selection Criteria

The transformer size shall be determined from the estimation of the simultaneous maximum demand based on the power rating of motors and other loads and their operating / running periods.

The design shall be based on maximum nos. of main motors working for Stage -II and the corresponding auxiliary loads including WTPs shall be considered for sizing of transformer.

Appropriate values of load factor, diversity factor, power factor and efficiency shall be considered for each type of load. Improvement in power factor due to capacitors shall not be considered. Five percent (5%) contingency shall be added to the simultaneous maximum demand thus calculated and the next standard size of transformer as per IEC shall be selected.

Two such transformers shall be provided for 100 % redundancy at main headworks only. The design calculations for transformer sizing shall be subject to the approval of the Employer's Representative.

1.14 Instrumentation, Automation And Control System Technical Requirements

1.14.1 GENERAL

This section outlines the particular requirements for the instrumentation, automation and control systems. Unless specified in this section to the contrary instrumentation Plant provided by the Contractor and workmanship shall comply with the General Instrumentation, Automation and Control Requirement Chapters of these Requirements.

1.14.2 THE SCOPE and Battery Limits

The scope of instrumentation, control and automation (ICA) works for Agra shall comprise the design, manufacture, programming and configuration, off site testing, delivery to site, installation and erection, testing, commissioning, setting to work and provision of documentation for a complete supervisory, instrumentation, control and automation system including the interfaces required to provide monitoring and control for a safe and efficient operation of plant, equipment and system.

The Contractor shall submit and obtain approval of the instruments and the system from the employer before beginning the detailed control system design.

At the time of bid submission, the contractor shall submit the completed technical schedule of the proposed instruments as per the technical schedule. All relevant manuals should be attached. Failure to adhere to the above would be treated as a non-responsive bid. The contractor should take note of the importance of this obligation

The minimum scope of work for Agra shall include but not limited to:

- **Communication Network**

Interface equipment to enable communication between water supply system field instruments, PLC's, RTU's, SCC at RWPS, WTP and CWPS, RTU's at DMA's and Master Control Center at City Campus Pumping Station.

Supply, installation, testing commissioning of RTU's along with GPRS at ESR's, OHSR's GSR's and DMAs to transmit flow, level, pressure and actuated valve position data to Master Control Centre for monitoring and control.

The monitoring and control of all the zones in the Water Supply system shall be at the Master Control Centre, for this purpose Bulk flow meters and pressure transmitters at strategic locations in the DMAs shall be provided along with RTU's, GPRS modem and shall be interfaced with the Master Control Centre. The instrumentation provided at the DMAs shall be capable to measure and record reverse flow and uncommon flow shall be alarmed at the Master Control Centre.

A minimum 60" LED screen with necessary CPU shall provide an elementary full color pictorial flow diagram display of the water supply scheme including pumping stations DMAs. The mimic shall also include displays of process values e.g. reservoir levels, process flows, water quality etc. Mounting of LED mimic panel shall be as approved by employer's representative.

The communication equipment required to achieve this interfacing complete with all required accessories shall be supplied, installed, tested and commissioned under this contract.

- **Data Acquisition and processing**

The data acquisition, processing and interfacing with the Master Control Centre of entire water supply scheme of Agra city is covered under this package. The domestic water meters data shall be collected manually and this data shall be fed into the Master Control SCADA system for records and further analytical purposes.

- **System Console**

Control room furniture(system console) include but not limited to control console for placing dual redundant workstations and two printer compartments, desk for one engineering workstation, ODMS workstation and printer compartment and chairs .The system console design shall be submitted to the Employer for prior approval.

The Contractor shall be responsible for the design of each instrumentation and plant monitoring system, including the selection and design of appropriate transducers (on approval by the Employer's representative), transmitters, signal conditioning devices, indicators, alarm system programmable devices, communications, cable system etc. The Contractor shall take account in his design of all installation and environmental conditions prevailing at the site.

1.14.3 MCC SCADA Equipment at Pumping Stations:

The MCC SCADA contractor is also responsible for supply, installation and commissioning of all the equipment related to MCC SCADA system such as RTU equipment, Communication equipment, UPS for the supply of power to related SCADA equipment and associated hardware and software and interface connection with the local PLC system (supplied and commissioned by pumping station contractor) at each pumping station and Water Treatment Plant covered under this project.

The contractors of the respective Pumping Stations shall make the following necessary provisions at each pumping station and Water Treatment Plant for the MCC SCADA system:

- Space for installation of MCC SCADA related equipment in the control room
- 230V, 50 Hz. Single phase power feeders from the local power distribution panel for the MCC SCADA equipment.
- Hardware and software provisions/configuration in the PLC system to interface and communicate with the RTU on an industry standard protocol.
- PLC Hardware and Software addition / configuration to facilitate data acquisition of selective signals of the pumping station and also control certain devices in the pumping station by the MCC SCADA system.
- Providing facility at the PLC / Control Panel (Hardware and Software) to transfer the control function from local control to remote SCADA control by the local pumping station Contractor to facilitate remote control from MCC.

The works envisaged for construction of Master Control Centre (MCC) shall be as following, but not limited to:

The proposed master control centre building of about 300 sq. m built up area (including ground+first floor) shall be built within the plot boundary of Old PHED head works. The building is proposed to be of two stories.

The ground floor will contain cabins for offices, reception area, conference room, instrumentation and electronics laboratory, store room, pantry and washroom / toilet facilities.

The first floor will have cabins for SCADA system manager, PHED Officer, the SCADA Control Room and rooms for SCADA Data Processing equipment, Communication equipment, Electrical equipment etc.

Place for additional PCs will be provided in the control room for working on offline software packages associated with water supply system. An air-lock room will be provided at the entrance to the first floor to conserve the cool air. Air washer facilities will be provided for the air-lock room to prevent entry of dust. The building is proposed for the hi-tech control centre, the interior and exterior of the building is to be constructed with good architectural finish.

The works shall comprise the following but not be limited to:

1. Control Rooms for SCADA system, Equipment rooms, offices, workshop, store, reception, washrooms and toilet facilities
2. Air-conditioning system for certain technical, working and storage areas.
3. False flooring for certain technical areas such as Control room, Equipment rooms etc.
4. Water supply distribution system
5. Trenches for pipes and cables
6. All windows, doors, with wiremesh door and auto closure, rain water pipes,
7. Drainage arrangements, storm water and foul water
8. Site works, pathways and landscaping.

1.15 Design criteria for Instrumentation, Control, Automation and SCADA Systems

1.15.1 Instrumentation System

- a) Electronic instruments shall utilize solid state electronic components, integrated circuits, microprocessors, etc., and shall be of proven design.
- b) all instruments shall be suitable for continuous operation;
- c) all digital outputs shall be volt free;
- d) all instrumentation systems for use out of doors shall be protected to IP 65 for sensors and transmitters, while enclosures under submersible conditions shall be protected to IP68;
- e) all analogue displays shall be of the digital type with no moving parts utilizing back lit liquid crystal diode technology;
- f) For transmitting instruments, output signal shall be 4-20 mA DC linear having two wire system
- g) Unless otherwise stated, overall accuracy of all measurement systems shall be $\pm 0.5\%$ of measured value, and repeatability shall be $\pm 0.5\%$.
- h) After a power failure, when power supply resumes, the instruments and associated equipment shall start working automatically.
- i) The instruments shall be designed to permit maximum interchangeability of parts and ease of access during inspection and maintenance.
- j) The instruments shall be designed to work at extremes of the ambient conditions of temperature, humidity, and chlorine contamination that may prevail. The instruments shall be given enough protection against corrosion.
- k) Lockable enclosure shall be provided for the field mounted instruments wherever required.
- l) All field instruments, and cabinets / panel-mounted instruments shall have tag plates / name plates permanently attached to them.
- m) The performance of all instruments shall be unaffected for the $\pm 10\%$ variation in power supply voltage and $\pm 5\%$ variation in frequency simultaneously.
- n) All wetted parts of sensors shall be made out of non-corrosive material capable of working with chlorine content of 5 ppm.
- o) For all instruments (transmitting analogue signals) installed in the field, surge protection devices (SPDs) shall be provided at both ends of the connecting cable for the protection against static discharges / lightning and electromagnetic interference.
- p) Pressure transmitters shall be provided with two valve manifold and a test port, so that in situ calibration can be carried out.
- q) Two wire transmitters shall be provided with on-line test terminals.

- r) The ranges of all instruments shall be suitable for the application in the process.
- s) Instruments of similar type shall be of same make for appropriate inventory of spares, ease of maintenance and training.
- t) The Indian agents of imported equipment shall have establishment to provide after sales maintenance facilities.

1.15.2 PLC System

PLC shall be provided as a Hot-Standby configuration to perform combinational and sequential logic functions, status monitoring and reporting functions with counter and timer facilities.

PLC Panel interrogation power supply should be fully redundant.

PLC shall comprise of necessary processors, input/output (I/O) modules, communication interface modules and man-machine interface (MMI) required to perform the desired functions.

Each PLC shall have memory protected built in historical archiving/data logging of system alarms & events and process variables. Data logger shall be able to log data based on time or an event PLC shall have enough memory allocated to allow 200,000 time and data stamped discrete and /or analog values to be archived. The historical archive shall allow the oldest data to roll off the system as memory is used keeping the 200,000 most current data points available. Process point time stamping frequency shall be selectable within the configuration software. It shall be possible for the archived data to be exported in CSV format allowing use with standard spreadsheet and data software applications

PLC shall have the following attributes as a Hot-Standby configuration.

- carry out sequential logic implementation for operations of plant;
- carry out computation and interfacing for data acquisition, data storage and retrieval;
- it shall accept downloaded program from a programmer;
- it shall have different functional modules to perform the desired functions;
- it shall scan the inputs in time cycles and update the status of its outputs.

1.15.3 RTU System

RTU shall be designed in accordance with this specification. The RTU shall be of proven design and suited for water supply and distribution SCADA applications.

RTU design should aim to minimize power consumption and heat generation. It should be designed to work in remote installation by being of robust physical construction with immunity to electrical noise.

The RTU shall be assembled from modular units, for example, power supply module, CPU and communications module, communication interface modules and modules for input/output purposes. I/O and serial cards shall be able to be arranged in the RTU rack in any order.

Modules shall be interconnected via a suitably robust plug and socket method. It shall not be necessary to unscrew individual wires/cables, both internal RTU wiring and I/O wiring, to replace faulty modules. The failure of one module will not affect the performance of any other module.

A marshalling terminal area shall be incorporated with each RTU to provide terminations for field cables. This area can be located in the RTU cubicle itself for an RTU replacement but for new locations there should be a separate marshalling cubicle. The RTU and marshalling cubicles shall normally be bolted together to form a 2-bay cubicle suite. A separation plate may be located between the cubicles.

The RTU and the cubicles shall be designed to accommodate the actual number of input/outputs, plus spare capacity.

1.15.4 SCADA System

The SCADA shall be a fully dual redundant server integrated microprocessor based control and data acquisition system which will monitor, control, display, record and trend all assigned plant and water supply network inputs and outputs. The main process monitoring and control shall be by means of Visual Display Unit (min. 60 inch. LED monitor) based process operator workstations that shall be located in the central control room.

SCADA/HMI system shall be **Dual Redundant server** system. SCADA/HMI system shall be designed and implemented such that the failure of a central processor or HMI console does not inhibit continuous automatic control of the plant. In the event of such a failure, historical data shall 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 shall not affect control or operation of any other outstation, unless the failed outstation provides essential data to another outstation, in which case the non-failed outstations shall revert to a fail-safe mode.

1.15.5 Functional Design Specification (FDS, Sequence of Operation)

The Contractor shall propose the details the sequence of operation for the water supply system, water treatment plant and pumping station through careful study of the water supply scheme proposed. Further, the contractor shall be solely responsible to comply with any change/additional processes during the contractors design stages.

The Contractor shall submit a complete functional design specification (FDS) for approval by the Employer within 3 months of the award of the contract.

Functional design specification (FDS) for the SCADA system shall be combined with the FDS for instrumentation, control and automation to form a complete document and shall comply with the specification of the FDS for instrumentation, control and automation. This document shall serve as the primary mechanism by which the Employer may confirm that the Contractor possesses an accurate understanding of the system and its control requirements. The Contractor is encouraged to obtain any necessary clarifications and to suggest refinements to the control descriptions contained in this Specification.

The FDS shall include a detailed block diagram of the PLC, RTU & SCADA system with a description of the communications scheme to be provided. The FDS shall include operational details of the SCADA system which have an effect on plant operations, such as power failure response, communication failure response, and automatic shut-down and start-up of the system.

The FDS shall include a description of the interface of the SCADA system with any existing or planned future DAC (Digital Access Carrier) equipment.

The Contractor shall submit a preliminary FDS and obtain approval before the system architecture design is finalized or detailed design takes place. The Contractor shall formally notify the Employer for approval of any amendments or additions to the approved FDS. The final FDS shall be submitted for approval before submission of the factory acceptance test definition documents. The Contractor should take note of the importance of this obligation.

The FDS shall comprise an overall description of the system, its functioning and control, and a detailed description of each section of the control system covering modes of operation, manual overrides, set-point and parameter selection and adjustment. The detailed description shall include a step-by-step control description which defines the function of each piece of equipment and each control action and interlock, including details of the program in each programmable item.

The FDS shall describe the 'fail-safe' features incorporated into the design for the event of failure of a plant item or system, or loss of an input signal affecting a control loop or process sequence.

The FDS shall describe control actions taken and monitoring functions which remain available during a power failure, and any automatic controls or sequencing which take place during system start-up and shut-down.

The FDS shall be presented in a clear and precise manner and shall include figures or drawings where appropriate.

1.15.6 Power Supply

The control system shall be powered from a number of uninterruptible power supplies (UPSs). These shall be sized to provide sufficient power to maintain the control system functioning for a period of not less than two hours.

The UPS for use with each Control Panel may be free standing or integral with the Control Panel and shall derive their primary power from the Control Panel.

The status of each UPS shall be monitored and alarmed via the control system for any fault condition including the UPS battery supply is about to expire.

1.15.7 Voltages

The following control voltages shall be used:

Item	Voltage
1. within starter enclosures	240 V AC
2. instrumentation power supplies	240 V AC / 24 V DC
3. PLC inputs cards	24 V DC
4. PLC outputs	24 V DC

1.16 Control System Protection

1.16.1 Short Circuit

All circuits shall be protected against short circuit by the provision of adequate numbers of fuses or miniature circuit breakers.

For ease of maintenance and system security power supplies to each instrument loop and each PLC output shall be protected with an individual fuse (terminal type).

1.16.2 Surge Protection

Surge protection devices (SPDs) shall be provided at the control panel end of all instrumentation and control cables which run for distances in excess of 50 m outside the confines of the building in which the Control panel is housed. The SPD s shall be grouped in a specific area within the Control Panel.

1.16.3 Instrumentation Power Supply Cables and Instrumentation Signal Cables

Contractor shall include in his scope the supply and laying of instrumentation signal and instrument power supply cables and associated civil / mechanical work required for completing the instrumentation, control and automation system for entire water supply system.

Cables shall be capable of satisfactorily withstanding without damage, transportation to site, installation at site, and operation under normal and short circuit conditions of the various systems to which the respective cables are connected when operating under the climatic conditions prevailing at the site as indicated in this specification.

Cable joints in instrument signal and power supply cables shall not be permitted.

Cables shall be capable of satisfactory performance when laid on trays, in trenches, conduits, ducts and when directly buried in the ground.

Cables shall be capable of operating satisfactorily under a power supply system voltage variation of $\pm 15\%$, a frequency variation of $\pm 5.0\%$.

1.17 SURVEILLANCE CCTV SYSTEM

Surveillance CCTV system is required to ensure effective surveillance of pumping stations, WTPs, OHSRs etc. as well as create a tamperproof record for post event analysis. The System shall provide an on-line display of video images on TFT monitors/Video Wall/Large plasma monitors located in Central as well as Local control rooms.

System should facilitate viewing of live and recorded images and controlling of all cameras by the authorized users present in the LAN.

System should provide inter-operability of hardware, OS, software, networking, printing, database connectivity, reporting, and communication protocols. System expansion shall be possible through off-the-shelf available hardware.

1.18 Submittals

1.18.1 Functional Design Specification (FDS)

1. The Functional Design Specification (FDS) shall be submitted to the Employer within 3 months of the award of contract and approved before manufacture and purchasing commences. The system vendor and/or Contractor shall include the following as a minimum:

- a. Project Overview, design concept, criteria and system architecture
- b. Description of the design and design criteria.
- c. Details of associated equipment.
- d. Plant Operating Screens (mimics)
- e. Instrumentation Design Specifications
- f. Quality Plan.
- g. Outline of acceptance test procedures (FAT & SAT).
- h. Implementation program for manufacture, installation and commissioning.
- i. Manufacturers literature for each item of equipment supplied.
- j. Outline of factory and site acceptance test procedures

1.18.2 Drawings and Documentation

1. All drawings of telemetry and instrumentation control and Automation (ICA) equipment shall be on A3 or A4 size sheets, with title blocks approved by the Employer.
2. Signature of the Contractor's authorized representative to indicate the drawings have been checked prior to submission.
3. The text of all drawings and documentation provided by the Contractor shall be in the English Language.

1.18.3 Contractor's Drawings

1. The Contractor shall submit 3 (three) reproducible copies plus two photocopies of general and detailed dimension arrangement drawings, schematics and wiring diagrams of all major items of Plant,

for the Employer's approval. Manufacture of an item of Plant shall not commence until the associated drawings have been approved in writing by the Employer.

2. All modifications or revisions to drawings shall be clearly indicated and the revision reference changed.

3. Drawings affecting work by other disciplines shall be provided to the Employer, within 6 weeks from the date of enterprise.

4. Drawings for instrumentation equipment shall include:

a. Manufacturer's general arrangement drawings for all items showing clearly the position of all cable glands and main components including, where appropriate, foundation plans, showing the position of all holes required for fixing bolts and cables etc.

b. Manufacturers' schematic diagrams and connection diagrams for all items showing all internal wiring and terminal connections suitably referenced. Connection diagrams shall include existing and proposed outgoing cable connections.

c. General layout of plant showing cable routing

d. Instrument schedules with complete details of each instrument

e. Block diagram showing all plant, cable runs and cable reference numbers.

f. Cable schedules giving full details of use, destinations, size and number of conductors, grade, class and length.

g. Layout of instrumentation earthing and grounding facilities.

h. Proposed arrangements for cables laid below ground showing identification references, voltage, depth of laying, route and length, crossings with other services, location of any joints and position of ducts, with cross sectional arrangements.

The Contractor shall modify existing drawings to show the modifications. If suitable existing drawings are not available the Contractor shall provide drawings showing the modifications.

1.18.4 Record Drawings

As part of the Works and before Taking Over, the Contractor shall provide and forward to the Employer, a complete set of drawings comprising two original size permanent transparency and six paper prints, of all final drawings of the Works as installed, schematic wiring diagrams, panel wiring and connection diagrams, cable route diagrams and schedules and any other special drawings which have been prepared during the course of the Contract. The Contractor shall also provide drawings on compact disk in AUTO CAD (Latest Version), for the modification and printing of drawings. Also all drawings shall be converted in to PDF files and stored in the Engineers workstation.

1.18.5 Training Plan and Manuals

1. As part of the Works and before beginning training, the Contractor shall submit to the Employer, 6 copies of complete operating and maintenance instructions for the system, referring specifically to the Plant. The documents shall also be presented on a compact disk in Microsoft Office 2003/2007 Word or latest version available for Windows software format and manual should also be prepared in local regional language i.e.in Hindi.

2. Each copy of the instructions shall be contained in a substantial binder.

3. These manuals shall include but not be limited to 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.
- Configuration of data base, reports, logs and screen displays.
- Data communication interface standards and protocols.
- All ladder logic 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. The documentation must be in electronic format, HTML based with the ability to search for topics by keyword or search for specific text.

1.19 Reference Standards

Unless otherwise approved, instrumentation shall comply with relevant quality standards test procedures and codes of practice collectively referred to as Reference Standards including those listed in General Instrumentation, Automation and Control System in accordance with the requirements detailed elsewhere in this specification.

1.20 Protection of Overhead and Underground Services

The Contractor will be held responsible for any damage to known services

(i.e. overhead services that are visible within the Site and underground services surveyed by him and indicated on the drawings during renovation) and he shall take all necessary measures to protect them. All work or protective measures shall be subject to approval of the Employer's Representative. In the event of a service being damaged he shall inform the Employer's Representative and the authority concerned, the Contractor shall not repair any such service unless instructed to do so.

Contractor will map the underground utilities. Where no underground services are shown on the drawings or scheduled but the possibility of their presence can reasonably be inferred, the Contractor shall, in collaboration with the Employer's Representative, ascertain whether any such services exist within the relevant section of the Site. The Contractor shall complete such an investigation well in advance of the start of construction work in the said section and he shall submit a report in good time to enable the Employer's Representative to make whatever arrangements are necessary for the protection, removal or diversion of the services before any construction activities commences.

As soon as any underground service not shown on the drawings is discovered, it shall be deemed to be a known service and the Contractor will be held responsible for any subsequent damage to it. If such a service is damaged during the course of its discovery, the cost of making good such damage will be met by the Contractor due to contractor not exercising reasonable diligence and that the damage was avoidable.

Where the authority concerned elects to carry out on its own account any alterations or protective measures, the Contractor shall co-operate with and allow such authority reasonable access and sufficient space and time to carry out the required work.

1.21 Signboards

Signboards shall be placed at each of the project offices, at important locations and at each DNI zone, in English, information about the project and Employer, and the names of the Employer's Representative and Contractor in a form and size to be agreed by the Employer's Representative. They shall be of durable construction capable of withstanding the effects of the climate until the end of the design build Period.

The Contractor shall keep the signboards in good repair for the duration of the contract and shall remove them on completion of the Contract.

Besides these signboards the Contractor shall not, except with the written authority of the Employer's Representative, exhibit or permit to be exhibited on the Site any other form of advertisement.

1.22 Site Drainage

The Contractor shall keep each Section of the Works well drained until the Employer's Representative certifies that it is substantially complete and shall ensure that, so far as is practicable, all work is carried out in the dry. Site areas shall be kept well drained and free from standing water except where this is impracticable having regard to methods of Temporary Works properly adopted by the Contractor.

The Contractor shall provide, operate and maintain in sufficient quantity such pumping equipment, well points, pipes and other equipment as may be necessary to minimize damage, inconvenience and interference and shall construct, operate and maintain all temporary coffer-dams, sumps, ditches, drains and other temporary works as may be necessary to remove water from the Site while construction is in progress. Such Temporary Works and construction equipment shall not be removed without the approval of the Employer's Representative.

Notwithstanding any approval by the Employer's Representative of the Contractor's arrangements for the removal of water, the Contractor shall be responsible for the sufficiency thereof and for keeping the Works safe at all times and for making good at his own expense any damage to the Works.

The Contractor shall be responsible to keep the Site clear of water at whatever pump rate is found necessary.

The Contractor's site drainage facilities shall not cause pollution in any local watercourses, he shall be responsible for any legal action resulting from pollution events.

1.23 Detours and Traffic Control

The Contractor shall program his work in such a way that, wherever the temporary closure of street sections to public thoroughfare cannot be avoided, the duration of traffic diversion can be kept as short as possible. No streets shall be closed and no detours shall be introduced and no traffic diverted until the Contractor's proposals have been approved by the Employer's Representative and the appropriate Government authorities, such as the Public Works Department.

Where work is to be carried out in public roads, the Contractor shall give notice to the Employer's Representative sufficiently in advance of the date on which he wishes to commence such work.

The Contractor shall be responsible for obtaining the permission of the Employer's Representative, Road Department and the Police for activities he intends to carry out in public roads. Two copies of the Contractor's proposals to the relevant authorities shall be submitted to the Employer's Representative. One copy of all obtained approvals shall be submitted to the Employer's Representative.

The Contractor's attention is drawn to the fact that processing of the documentation required by the local authorities prior to the cutting of existing public roads takes approximately 30 days. During the Monsoon period (June to September) no road cuttings are normally allowed.

Detours shall be selected in such a way that the inconvenience to the affected traffic as well as to the inhabitants of the affected areas is kept to a minimum.

The Contractor shall furnish, install and maintain at all times during the execution of the Works all necessary traffic signs, barricades, lights, signals and other traffic control devices, including flagging and other means of guiding traffic through the work zone. Traffic control shall be managed in accordance with prevailing rules and regulations, and with the approval and to the satisfaction of the Employer's Representative.

All devices mentioned above shall be in conformity with the requirements of the Roads Department. All traffic signs and control devices to be furnished and installed by the Contractor shall be approved by the Employer's Representative for their location, position, visibility, adequacy and manner of use under specific job conditions.

All traffic control devices necessary for the initial stage of construction shall be properly placed and operational before any construction is allowed to start. When work of a progressive nature is involved, the necessary signs shall be moved concurrently where they are needed.

If the Employer's Representative determines that proper provisions for safe traffic control are not being provided or maintained, he may restrict construction operations affected by such defective signs or devices until such provisions are established or maintained, or may altogether order suspension of the Work until a proper traffic control is achieved. In case of serious or willful disregard by the Contractor of the safety of the public or his employees, the Employer's Representative may take necessary steps to rectify the situation and deduct the cost thereof from monies due or becoming due to the Contractor. The Contractor shall be responsible for all resulting delays.

The Contractor shall designate or otherwise employ personnel to furnish continuous surveillance of the traffic control operations. The designated personnel shall be available day and night to respond to calls involving damage due to traffic accidents.

At sections where traffic is in operation and when ordered by the Employer's Representative, the movements of the Contractor's equipment from one place of work to another shall be subject to traffic control. During rush hours movement of larger vehicles, such as trucks, cranes, dumpers, etc. through main thoroughfare are not permitted by the police. Spillage resulting from hauling operations along or across the road way shall be removed immediately at the Contractor's expense.

The cost of road construction for detours will be paid separately but costs of traffic control is deemed to be included in the rates for works.

1.24 Provision of Temporary Services

When the execution of the Works requires the temporary disconnection of existing public utilities, the Contractor shall provide the affected users with temporary services in at least the same standard as the original services.

For water supply he may install temporary lines or arrange for regular supply by tankers. The amount of water to be provided for the interruption period for a specific area shall be assessed by the Contractor. The Contractor shall submit to the Employer's Representative, for its approval, the recommended volume of water to be provided.

When forced to disconnect existing sewers/drainage facility, the Contractor shall install temporary pipes of adequate size to carry off sewage/driange shall be allowed to flow upon the ground surface or into the trench excavation.

No valve or other controls in public service facilities shall be operated by the Contractor without approval of the Employer's Representative and the relevant authorities. All users affected by such operation shall be notified by the Contractor at least one hour before the operation and advised of the probable time when service will be restored.

1.25 Protection of Adjoining Property and Reinstatement upon Completion

The Contractor shall be responsible and take all measures in order to protect adjoining property including buildings, electrical and telephone poles, bridges and culverts, retaining walls, compound walls and fences, and other structures. Prior to the commencement of the activities, the Contractor shall assess the probability and extent of unavoidable damages, if any, to the building and properties and submit his assessment to the Employer's Representative. The Employer's Representative may make his own opinion and if required may order arrangements for protection or repair of such likely unavoidable damage in which event the Contractor shall complete the activities.

Temporary facilities shall be provided by the Contractor, only for as long as required after which he shall dismantle and remove the same from their place of use as speedily as possible. Re-usable components shall be safely stored by the Contractor in his yard. The place of use shall be cleared andreinstated immediately to at least the condition existing before the temporary facilities were provided, andto the satisfaction of the Employer's Representative.

1.26 Coordination with Other Authorities

1.26.1 Statutory Services

As far as possible the Contractor shall acquaint himself with the actual location of all existing public utilities such as sewers, water mains, drains, cables for electricity, telephone lines, lighting poles, masts, etc., before commencing any activities likely to affect the existing utilities. The Contractor shall with the assistance of the Employer obtain such information directly from the responsible authorities as early as possible.

1.26.2 Notices, Permits

Well in advance of the programmed start of any work which may affect traffic or any existing utilities the Contractor shall give advance information to the Employer/Employer's Representative indicating

the type, the exact location, the programmed starting time and the expected duration of the activities and shall provide whatever particulars may be required by the authorities to issue any required permits and make all necessary arrangements. The Employer will provide necessary permissions.

1.27 Submissions by the Contractor

1.27.1 Updating, Monitoring and Reporting Progress

The Contractor shall monitor the progress of the Works including information provided by his Sub-contractors and suppliers, as necessary, for purpose of network planning, scheduling and updating and shall confirm the actual progress on each current activity shown on applicable CPM networks. The CPM networks shall form part of the Monthly Progress Report and shall indicate changes of schedule, if any in network activity duration and start/finish imposed dates. It shall also be provided in electronic form.

The Contractor shall prepare written explanatory notes on the particular activities which are overrunning or going to overrun against the schedule. If any such overrunning work is on the critical path, the Contractor shall state what corrective actions will be taken by him to bring it back on the schedule.

1.27.2 Detailed Fortnightly Program

The contractor shall submit at the end of each working week a detailed bar chart program for the next fortnight. The program shall identify where further drawings or instructions are to be issued by the Employer's Representative to avoid disruption to the progress of the Works.

1.27.3 Progress Reports

The Contractor shall furnish the Employer's Representative with Six(6) copies of Progress Reports at regular monthly intervals in a form determined by the Employer's Representative, containing the following information:

- physical progress for the report month and estimated progress for the next month;
- CPM networks and explanatory notices;
- updated S-curves for physical progress at different sections of the Works
- any report which may be specifically requested by the Employer and/or the Employer's Representative.

These monthly progress reports shall be submitted not later than 7 days after the end of the report month.

1.28 Quality Control

1.28.1 Quality Control Plan and Procedures

The Contractor shall be responsible for establishing and maintaining procedures for quality control that will ensure that all aspects of the Works comply with the requirements of the Contract. All the materials shall be got tested from the reputed institutions/Organization as approved by the Employers representative and from the NABL accredited laboratories prior to procurement. The costs for all such tests shall be borne by the contractor and shall be deemed to be included in the rates quoted.

As soon as reasonably practicable prior to the commencement of Works the Contractor shall submit for approval a Quality Control Plan giving detailed proposals for control of quality of all aspects of work on the Site and at suppliers' workshops.

The Quality Control Plan shall include the following: a) a list of the Contractor's staff engaged in quality control b) a list of any outside testing agencies employed by the Contractor for work in connection with quality control c) where a testing laboratory is to be established on Site under the Contract, a list of major items of equipment and a layout of the laboratory, together details of the tests which will be carried out there d) a list of manufactured items and materials, obtained by the Contractor for the Works, which require inspection at the suppliers' premises, and the proposed procedures for ensuring quality control e) a list of materials and operations to be inspected by the Contractor at the various stages of construction work on Site, together with inspection procedures, test types and frequencies f) sample of proposed quality control records, testing and reporting forms.

Unless the Employer's Representative permits otherwise, the approved Quality Control Plan shall be followed throughout the construction of the Works. Any approval by the Employer's Representative of the Contractor's plan and procedures shall not relieve the Contractor of his obligation to ensure that the Works comply with the requirements of the Contract.

The Contractor shall appoint a suitably qualified member of his staff to be responsible for all aspects of quality control and to maintain effective liaison with the Employer's Representative.

1.28.2 Sampling and Testing

The Contractor shall provide for the approval of the Employer's Representative, samples of all construction materials and manufactured items required for the Permanent Works. All samples rejected by the Employer's Representative shall be removed from Site. All approved samples shall be stored by the Contractor in a sample room, at a location approved by the Employer's Representative, for the duration of the Contract, and any materials or manufactured items subsequently delivered to Site for incorporation in the Permanent Works shall be of a quality at least equal to the approved sample. The approved samples may only be disposed of with the Employer's Representatives approval.

Samples shall be submitted and tests carried out sufficiently early to enable further samples to be submitted and tested if required by the Employer's Representative. Samples for testing will generally be selected by the Employer's Representative from materials to be utilized in the project and all tests will be under the supervision of, and as directed by, and at such points as may be convenient to the Employer's Representative.

Material requiring testing shall be furnished in sufficient time before intended use so as to allow for testing. No materials represented by tests may be used prior to receipt of written approval of said materials.

The Contractor shall give the Employer's Representative 15 days notice in writing of the date on which any of the materials will be ready for testing or inspection at the suppliers' premises or at a laboratory approved by the Employer's Representative and unless the Employer's Representative shall attend at the appointed place and time the test may proceed in his absence. The Contractor shall in any case submit to the Employer's Representative within 3 days after every test such number of certified copies of the test readings as the Employer's Representative may require.

Approval by the Employer's Representative as to the placing of orders for materials or as to samples or tests shall not prejudice any of the Employer's Representative's powers under the Contract.

The provisions of this clause shall also apply to materials supplied under any nominated subcontract.

After all construction at each Section is completed and before applying for taking-over, the Contractor shall perform field tests as called for in the Specifications. The Contractor shall demonstrate to the Employer's Representative the proper operation of the facilities and the satisfactory performance of the individual components including all units and equipments, etc.. Any improper operation of the system or any improper or faulty construction shall be repaired or corrected to the satisfaction of the Employer's Representative. The Contractor shall make such changes, adjustments or replacement of equipment as may be required to make the same comply with the Specifications, or replace any defective parts or materials. In case any of the section of works or equipment as noted by the Employers representative, does not function and fulfil the requirement for which it is intended to ev, n after the same is repaired or corrected, that section of any work or equipment shall be constructed/replaced. Costs towards such construction/replacement will be borne by the contractor and no payment will be made to the contractor on this behalf. Some of the faulty equipment may require total replacement without going in to repair; the descision regarding the replacement of faulty unrepairable equipment will be made by Employers representative.

In addition to any special provision made herein as to sampling and testing materials by particular methods, samples of materials and workmanship proposed to be employed in the execution of the Works may be called for at any time by the Employer's Representative and these shall be furnished without delay by the Contractor at his own cost. Approved samples will be retained. The Employer's Representative will be at liberty to reject all materials and workmanship that are not equal or better in quality and character than such approved samples.

1.28.3 The tests required for quality control shall include but not be limited to:

- a) tests conducted at the premises of the Contractor, Subcontractor, manufacturer or supplier which are normally or customarily carried out at such premises for the items or materials being supplied for the Works
- b) tests which are normally or customarily conducted on the items or materials being supplied for the Works by the Contractor, Subcontractor, supplier or manufacturer but which have to be conducted at an approved laboratory because the necessary testing facilities are not available on the premises of the Contractor, Sub-Contractor, supplier and manufacturer
- c) tests on locally obtained materials or items either on the Site or at an approved laboratory for the purpose of obtaining the approval of the Employer's Representative to the classification, use and compliance with the Specifications of such items or materials
- d) routine quality control tests conducted by the Contractor to ensure compliance with the Specifications
- e) regular testing of concrete and other materials as specified in the relevant section of the Technical Specifications
- f) Standard shop and Site acceptance tests, including trial assemblies, of Plant.

1.28.4 Inspection and Acceptance

The Employer's Representative will not inspect any item of fabricated or finished work until such time as the Contractor shall have forwarded to the Employer's Representative the approved Working Drawings covering the items to be inspected, together with copies of the respective orders.

Manufactured items and materials delivered to the Site shall be inspected by the Contractor on arrival. Any defects shall be notified to the Employer's Representative.

Minor defects to surface finishes and the like in manufactured items shall be made good in an approved manner to the satisfaction of the Employer's Representative. Items with more serious defects shall be returned to the suppliers for correction or replacement as appropriate. Detailed requirements pertaining to Inspection, Testing and Commissioning for Civil, Electrical, Mechanical, Instrumentation works is provided under Section 6 Volume 2 General technical Specifications. All the costs arising due to all the Inspection Testing & commissioning will be borne by the contractor.

1.29 Site Records

Daily records of on-site testing and inspection shall be kept on forms of approved format. Test results shall be certified by the responsible member of the Contractor's staff. All test certificates and inspection records (including any from suppliers or other outside testing agencies) shall be clearly identified with the appropriate part of the Works to which they refer, and they shall be submitted to the Employer's Representative together with the respective Passing Certificate.

Once each month, or at such other intervals as the Employer's Representative may require, the Contractor shall submit in an approved form a summary of all quality control inspections and tests performed at Site and elsewhere in the intervening period.

Test results shall be summarized in tabular form or graphically or both in a way that best illustrates the trends, specific results and specification requirements. Where the tests show that the specified requirements were not achieved, the report shall describe the action that was taken.

Each report shall also contain a forecast of quality control work likely to be carried out during the period to be covered by the succeeding report.

The Contractor shall keep detailed and up-to-date inventories in an approved form of goods and materials already approved by the Employer's Representative for which Passing Certificates have been issued as well as of all other goods and materials subject to quality control which are on order, delivered, found faulty, lost during the work or found to be surplus to requirements. The Employer's Representative shall have access to these records at all times.

1.30 Daily Log Book

The Contractor shall keep a Daily Log Book at each location where major construction activities are taking place. This Daily Log Book shall be in a form approved by the Employer's Representative and shall contain, but not be limited to, the following major items of information:

- a) Name of Contractor and Package No.
- b) date
- c) weather conditions (max./min., temperature, hours and intensity of rainfall)
- d) work carried out during the day per Section (description, quantities)
- e) major equipment used per section (on contractual work, on extra work ordered, approximate operating time on either)
- f) strength of labour force per Section (on contractual work, on extra work ordered, hours worked on either)
- g) Delays (cause, effects such as idle time etc.)

- h) Unusual events (earthquakes, floods, fires, storms, accidents, strikes, rallies, etc.)
- i) Visitors at Site.

Each daily log shall be signed by the responsible Site Manager of the Contractor and "noted" by the Employer's Representative.

1.31 Separation of Water and Sewer lines

The issue of relative placement of the water line and sewer in relation to possibilities of pollution should also be paid attention. The provisions of the Manual of Water Supply be followed in the matter. Accordingly broadly the following may be followed:

Horizontal Separation:

- Desirable 3 m separation
- In case of local compulsions, it may be laid in a separate trench on a shelf closer to the sewer but 0.5 m above the top of the sewer

Vertical Separation:

- In case of crossings, the water main should be 0.5 m above the sewer top or drain for 3 m on either sides and should have joints as far as possible.
- Any water pipeline shall not in any case be allowed to pass through the sewer manhole/chamber.