

SITC of Electrical Cables, Electrification work of pump house & panel room, Plant lighting, CCTV with associated work and other electrical, mechanical and civil work at mahisagar based water sources of VMC (2nd attempt).



VADODARA MUNICIPAL CORPORATION

**Office of Executive Engineer
Water supply Department**

Technical Bid

June - 2026



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INVITATION FOR BID
(IFB)



NATIONAL COMPETITIVE BIDDING

1. The Executive Engineer, Water Works (Elec./mech.) Department, Vadodara Municipal Corporation invites bids for the works detailed in the table.

The bidders may submit bids for the following work.

TABLE

Pack. No.	Name of work	Approximate value of works (Rs.)	Bid security (Rs.)	Tender Fee (Rs.)	Period of completion	Class of Registration
1	2	3	4	5	6	7
1.0	SITC of Electrical Cables, Electrification work of pump house & panel room, Plant lighting, CCTV with associated work and other electrical, mechanical and civil work at mahisagar based water sources of VMC (% Rate basis) (2nd attempt).	12,47,89,762/- (Without GST)	24,95,800/-	20,000/-	09 Months (Excl. 1 Monsoon)	Appropriate

2. Prospective / Interested bidder may download the Bid Documents from website <https://tender.nprocure.com> free of cost till the Time and Date as mentioned in online NIT at website <https://tender.nprocure.com>.
3. However, Bidder who is submitting the Bid Online will have to pay the Bid Document Fee / Tender Fee through Demand Draft only of any Schedule Bank payable at Vadodara and in favor of Municipal Commissioner, Municipal Corporation, Vadodara. Once the Bid is received online, Bid Document / Tender Fee will not be refundable.

The Demand Draft for Bid Document / Tender fee and Demand Draft/ Bank Guarantee against Bid Security / EMD shall be submitted in electronic format through online (by scanning) while uploading the bid, this submission shall mean that bid document / tender fee and Bid Security / EMD has been received. Accordingly, the offer of only those shall be opened whose Bid Document / Tender Fee and Bid Security / EMD have been received electronically. However, for the purpose of realization of Demand Draft / Bank Guarantee bidder shall send the same in original through R.P.A.D. so as to reach to Executive Engineer, 2nd floor, room no.-210, Vadodara Municipal Corporation, Khanderao Market Building, Rajmahal Road, Vadodara-390001 on or before date & time as provided in NIT.

Penaltative action for not submitting original Demand Draft / Bank Guarantee along with hard copy to Executive Engineer / Tender Inviting Authority by bidder shall be initiated.



Bidder will be abeyance from filling tender as per the VMC's circular.

4. Bids received online, will be opened on the time, date and place as specified in the online NIT at website <https://tender.nprocure.com> in the presence of the bidders or their authorized representatives, who wish to remain present.

If the office happens to be closed on the day of opening of the bids as specified, the bids will be opened on the next working day at the same time and venue.

5. A pre bid meeting will be held as per detail provided in NIT at office of The Executive Engineer, 2nd floor, room no.-210, Vadodara Municipal Corporation, Khanderao Market Building, Rajmahal Road, Vadodara-390001 to clarify the issues and to answer questions on any matter that may be raised at that stage as stated in clause 9.2 of 'instructions to Bidders' of the bidding documents.

6. Other Information is as under:

- A. Agencies can prepare and edit their offers a number of times before the end of the tender submission date and time. After the tender submission date and time, the bidder cannot modify / edit / withdraw their submitted offer in any case. No written or online request in this regard shall be granted.
- B. Price-bid Offers in physical form will not be accepted in any case.
- C. Demand Draft purchased by the other than bidder and issued after the last date of submission of Bids, will not be considered or accepted.
- D. The cost incurred by the contractor for this offer for clarification or attending discussion, conferences or site visits will not be reimbursed by the Employer or Engineer-in-Charge.
- E. Conditional tender shall not be accepted.
- F. Any changes, addition, alternation made in the prescribed form attached with tender are liable to be rejected.
- G. Any change in format or conditional Bank Guarantee will not be accepted and the bidder will be considered non-responsive.
- H. All the bidders are instructed to fill in information strictly in accordance with the format given in the checklist /qualification document / tender document.
- I. It is mandatory for the bidders to supply each and every information as asked strictly in electronic format at appropriate places only.
- J. Blank / insufficient information shall be treated as nil information and shall result in disqualification.



- K. Even if the bidder has been qualified in a similar or larger size of project in the past, it shall not be deemed to be a ground / reason for not giving required information for this work / bid.
- L. Information supplied for earlier projects shall not be considered while evaluation of this bid. The Government will not ask for any other information, unless it is found absolutely necessary by the competent authority.
- M. If found necessary, the contractor will be intimated for negotiation,

Works following documents shall be submitted in electronic format through online by scanning and Hard copy of the same should be sent in original to the Tender opening authority through RPAD or Speed post, so as to reach the Executive Engineer on or before date & time as provided in NIT. Price bid shall be submitted in electronic format only through online.

- 1) Attach Original DD/Bank Guarantee for Earnest Money Deposit.
- 2) Attach Original DD for Tender fees.
- 3) True copies attested by self-attested of the original documents defining the legal status to the bidder/firm. Its structure and organization place of registration and principal place of the business shall be furnished.
- 4) The bidder/firm in the same name, must be well established, experienced contractors, having registered as an approved **“Class A or Equivalent”** contractor with VMC Local Govt. bodies/Govt./MES/State Govt./Semi Govt. or such Govt. organizations.

Note: The Qualified bidder must have VMC registration certificate of appropriate class within 30 Days after issue of Work Order. In case it is not done, the payment will not be processed.

- 5) Details of Technical & Supervisory personnel already employed by the firm work. The list of engineers shall be attached with their Designation, Qualification, Experience, Mobile Number & E-mail details.
- 6) Copy of certificates under labour act and P.F. Registration certificate.
- 7) Copy of GST Certificate with GST number.
- 8) Copy of Valid Electrical Contractor License issued by govt. authority
- 9) Bank Solvency or Financial resources including bank credits & other facilities available shall be 25 % of the tender amount.
- 10) Detail communication facilities like Office/Residence phone number and address, mobile number, fax number, E-mail address should be available with the bidder.



- 11) List of Ongoing work or partly completed work along with work order and other supporting documents.
- 12) Bidder has to submit list of work under arbitration/court case or any dispute. The bidder shall submit final/latest decision/status of arbitration/court case for all disputes and if it is found that the decision of dispute is against the bidder then such bidder is liable to disqualify even if other qualification criteria are met with.
- 13) Work completion certificate (Form 3A), work order and other supporting documents for PQ Criteria as per tender requirements.
- 14) CA certificate for Annual Avg. Turnover as per tender requirement.
- 15) List of Key plants, tools and machineries as per tender requirements.
- 16) Audited balance sheet and ITR as per tender requirements.
- 17) Bid capacity as per tender requirement along with work orders.
- 18) Site visit certificate.
- 19) Various affidavits and undertaking as per tender requirements.



SECTION - 1
INSTRUCTIONS TO BIDDERS (ITB)



Section 1: Instructions to Bidder

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A. General			
1.	Scope of Bid	19.	Sealing & Marking of Bids
2.	Source of Funds	20.	Deadline for Submission of Bids
3.	Eligible Bidders	21.	Late Bids
4.	Qualification of the Bidder	22.	Modification and Withdrawal of Bids
5.	One Bid per Bidder		
6.	Cost of Bidding	E. Bid Opening and Evaluation	
7.	Site Visit	23.	Bid Opening
		24.	Process to be Confidential
B. Bidding Documents		25.	Clarification of Financial Bids
8.	Content of Bidding Documents	26.	Examination of Bids and Determination of Responsiveness
9.	Clarification of Bidding Documents	27.	Correction of Errors
10.	Amendment of Bidding Documents	28.	Deleted
		29.	Evaluation and Comparison of Financial Bids
C. Preparation of Bids		30.	Deleted
11.	Language of Bid		
12.	Documents Comprising the Bid	F. Award of Contract	
13.	Bid Prices	31.	Award Criteria
14.	Currencies of Bid and Payment	32.	Employer's Right to Accept any Bid and to Reject any or all Bids
15.	Bid Validity	33.	Notification of Award and Signing of Agreement
16.	Bid Security	34.	Performance Security
17.	Alternative Proposals By Bidders	35.	Advance Payment and Security
18.	Format and Signing of Bid	36.	Dispute Review Expert
		37.	Correct or Fraudulent Practices



A. GENERAL

1. Scope of Bid

- 1.1 The Employer (The Executive Engineer) invites bids for the works (as defined in these documents and referred to as ‘the works’) detailed in the table given in IFB. The bidders may submit bids for any or all of the works detailed in the table given in IFB.
- 1.2 The successful bidder will be expected to complete the works by the intended completion date specified in the Contract data.
- 1.3 Throughout these bidding documents, the terms ‘bid’ and ‘tender’ and their derivatives (bidder/ tenderer, bid / tender, bidding/ tendering, etc.) are synonymous.

2. Source of Funds

- 2.1 The expenditure on this project will be met from the grant.

3. Eligible Bidders

- 3.1 This Invitation for Bids is open to all eligible bidders.
- 3.2 All bidders shall provide in Section 2, Forms of Bid and Qualification Information, a statement that the Bidder is neither associated, nor has been associated, directly or indirectly, with the consultant or any other entity that has prepared the design, specifications, and other documents for the Project or being proposed as Project Manager for the Contract. A firm that has been engaged by the Employer to provide consulting services for the preparation or supervision of the works, and any of its affiliates, shall not be eligible to bid.

4. Qualification of the Bidder

- 4.1 All bidders shall provide in Section 2, Forms of Bid and Qualification Information, a preliminary description of the proposed work method and schedule, including drawings and charts, as necessary. The proposed methodology should include a program of construction backed with equipment planning and deployment duly supported with broad calculations and quality assurance procedures proposed to be adopted justifying their capability of execution and completion of work as per technical specifications, within stipulated period of completion.
- 4.2 Deleted
- 4.3 Deleted
- 4.4 Deleted



4.5 QUALIFICATION CRITERIA:

Experience of having successfully completed similar works during last 7(Seven) years ending last day of month previous to the one in which applications are invited i.e. from 2018-2019 to 2025-2026 should be either of the following: -

- Three similar completed works costing not less than the amount equal to 40% of the estimated cost **(Rs. 4,99,15,905/-)**
Or
- Two similar completed works costing not less than the amount equal to 50% of the estimated cost **(Rs. 6,23,94,881/-)**
Or
- One similar completed work costing not less than the amount equal to 80% of the estimated cost **(Rs. 9,98,31,810/-)**

Similar work means “SITC of HT/LT Cables **and/or** Electro-mechanical work related to Pumping Station and/or Treatment Plant” in Municipal Corporation / MES / Central / State / Semi Government organization and other such government organization.”

Physical Criteria: The Bidder must have experience of “SITC of any high tension (HT) System/Equipment (e.g. HT Panel/RMU/HT Cable/Step-down Transformer/HT 2 pole structure/HT DGSet/HT Motor-pumpset etc.)” in any completed work in last 7 (seven) year ending last day of month previous to the one in which applications are invited i.e. from 2018-2019 to 2025-2026 in Municipal Corporation / MES / Central / State / Semi Government organization and other such government organization.

Copy of work order and completion certificate/Form 3A (Issued by competent authority) to be enclosed with the tender for experience else work experience will not be considered. Bidder to enclose supporting document (Issued by competent authority) which clearly indicate cost & Quantity of executed/Completed work/Item for above.

Experience of any work executed as a joint venture, as a subcontractor or by MOU will not be considered.

The Completed work/works costing will be considered exclusive of GST for the same.

- 4.5.1** Qualification will be based on Applicant’s meeting all the following minimum pass/fail criteria regarding the Applicant’s general and particular experience, personnel and equipment capabilities and financial positions, as demonstrated by the applicant’s responses in the forms attached to the letter of application (specified requirement for joint ventures are given under para 4.6 below) Subcontractors experience and resources shall not be taken in to account in determining the applicants compliance with the qualifying criteria

To qualify for more than one contract, the applicant must demonstrate having experience and resources sufficient to meet the aggregate of the qualification

criteria for each contract given in paragraphs 4.5.4, 4.5.5 and 4.5.9 below

4.52 Base year and Escalation

The base year shall be taken as Current financial year

Following enhancement factors will be used for the costs of works executed and the financial figure to a common base value for works completed in India.

Year	Financial Year	Multiplying factor
Base year of inviting tender	2025-2026	1.00
-1	2024-2025	1.10
-2	2023-2024	1.21
-3	2022-2023	1.33
-4	2021-2022	1.46
-5	2020-2021	1.61
-6	2019-2020	1.77
-7	2018-2019	1.94

Applicant should indicate actual figures of costs and amount for the works executed by them without accounting for the above-mentioned factors.

In case the financial figures and value of completed works are in foreign currency the above enhanced multiplying factors will not be applied. Instead, the current market exchange rate (State Bank of India BC Selling rate as on the last date of submission of the bid) will be applied for the purpose of conversion of the amount in foreign currency into India rupees.

4.5.3. General Experience.

The Applicant shall meet with the following minimum criteria:

- (a) Average Annual Financial Turnover during the last 3 years, should be at least 30% of the estimated cost **(Rs. 3,74,36,929/-)**.
- ~~(b) Experience in successfully completing or substantially completing at least one contract of highway (road and / or bridge works) airport runway of at least 40 percent of the value of proposed contract within the last five years.~~

~~The works may have been executed by the applicant as prime contractor only or as a member of a joint venture or as a nominated sub-contractor. As subcontractor, he should have acquired the experience of execution of all major items of works under the proposed contract. In case a project has been executed by a joint venture, weight towards experience of the project would be given to each joint venture in proportion to their financial participation in the joint venture.~~

~~Substantially completed works means those works which are at least 90 % completed (only for Network Project) as on the date of submission (i.e. gross value of work done up to the last date of submission is 90 % or more of the original contract price) and continuing satisfactorily.~~

~~For these, a certificate from the employers shall be submitted along with the application incorporating clearly the name of the work, contract value, billing amount, date of commencement of works, satisfactory performance of the contractor and any other relevant information.~~

4.5.4. Personnel Capabilities.

Availability for his work of personnel with adequate experience as required; as per Appendix.

4.5.5. Equipment Capabilities

Based on the studies carried out by the Engineer, the minimum suggested major equipment to attain the completion of works in accordance with the prescribed construction schedule are shown in the Appendix.

The bidders should, however, undertake their own studies and furnish with their bid, a detailed construction planning and methodology supported with layout and necessary drawings and calculations to allow the employer to review their proposals. The numbers, types and capacities of each plant/equipment shall be shown in the proposals along with the cycle time for each operation for the given production capacity to match the requirements.

4.5.6. Financial Position

The Applicant should give undertaking that he has access to, or has available, liquid assets (aggregate of working capital, cash in hand and uncommitted bank guarantees) and / or credit facilities up to 25 percent of the value of the contract / contracts applied.

4.5.7. The audited balance sheets for the last five years should be submitted, which must demonstrate the soundness of the applicant's financial position, showing long – term profitability including an estimated financial projection for the next two years, If necessary, the employer will make inquiries with the applicant's bankers.

4.5.8. Litigation History

The Applicant should provide accurate information on any litigation or arbitration resulting from contracts completed or under execution by him over the last five years. A consistent history of awards against the Applicant or any partner of a joint venture may result in failure of the applicant.

4.5.9. Disqualification



Even though the applicants meet the above criteria, they are subject to be disqualified if they have:

Made misleading or false representation in the forms, statements submitted, and / or Record of poor performance such as abandoning the work, rescinding of contract for which the reasons are attributable to the non – performance of the contractor; consistent history of litigation awarded against the applicant or financial failure due to bankruptcy. The rescinding of contract of a joint venture on account of reasons other than non – performance, such as Most Experienced partner of joint venture pulling out, court directions leading to breaking up of a joint venture before the start of work, which are not attributable to the poor performance of the contractor will, however, not affect the qualification of the individual partners.

#4.6 JOINT VENTURE: (Maximum 3 Members i.e. 1 Lead & 2 Others) (Applicable only for estimated project cost of 50 Crore and above)

4.6.1. Joint ventures must comply with the following requirement:

(a) Following are the minimum qualification requirements:

- I. The lead partner shall meet not less than 50 percent of all criteria given in para & 4.5.3 & 4.5.6 above. The joint venture must collectively satisfy the criteria of para 4.5.3 & 4.5.6 above. The experience of the other joint venture partners shall be considered if it is not less than 30 percent of the qualifying criteria in para 4.5.3 & 4.5.6 above.
- II. Individually each member must satisfy the requirements of para 4.5.7 & 4.5.8 above.

(b) Bid shall be signed so as to legally bind all partners, jointly and severally, and shall be submitted with a copy of the joint venture agreement providing the joint and several liabilities with respect to the contract.

4.6.2. Qualification of a joint venture does not necessarily qualify any of its partners individually or as a partner in any other joint venture. In case dissolution of a joint venture, each one of the constituent firms may qualify if they meet all the qualification requirements, subject to the written approval of the Employer.

4.7. Bid Capacity.

Applicants who meet the minimum qualification criteria will be qualified only if their available bid capacity at the expected time of bidding is more than the total estimated cost of the works. The available bid capacity will be calculated as under:

Assessed Available Bid Capacity = (A*N*2-B), where

A = Maximum value of work executed in any one year during the last five years (updated to the price level of the year indicated in appendix) taking into



account the completed as well as works in Progress.

B = Value at current price level of the existing commitments and ongoing works to be completed during the next (period of completion of work for which bids are invited); and

N = Number of years prescribed for completion of the works for which the bids are invited.

Note:- ~~In Case of joint venture, the available bid capacity will be applied for each partner to the extent of his proposed participation in the execution of the work.~~

4.8 Even though the bidders meet the above qualifying criteria, they are subject to be disqualified if they have:

- Made misleading or false representation in the forms, statements and Attachments the submitted in proof the qualification requirements; and / or Record of poor performance such as abandoning the works, not properly completing the contract, inordinate delay in completion, litigation history, or financial failures etc.; and/ or
- Participated in the previous bidding for the same work and had quoted unreasonably high bid prices and could not furnish rational justification to the employer.

5. One bid per bidder

- 5.1. Each bidder shall submit only one bid for one package. A bidder who submits or participates in more than one bid ~~(other than as a subcontractor or in cases of alternatives that have been permitted or requested)~~ will cause all 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 and liable for those costs.

7. Site Visit

- 7.1. The Bidder, at the Bidder's own responsibility and risk is encouraged to visit and examine the Site of work and its surrounding 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.

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:

Sr No	Section	Description
1	Invitation for Bid (IFB)	
2	Section -1	Instructions to Bidders
3	Section -2	Qualification Information
4	Section -3	Conditions of Contract
5	Section -4	Contract Data
6	Section -5	Technical specifications
7	Section -6	Form of Bid
8	Section -7	Bill of Quantities
9	Section -8	Securities and Other Forms
10	Section -9	Drawings

- 8.2 Technical bid is available online and all documents to be furnished by the bidder in compliance to the same will be prepared by him and furnished in two parts (refer clause 12).
- 8.3 The bidder is expected to examine carefully all instructions, conditions of contract, contract data, forms, terms, and technical specifications, bill of quantities, forms, Annexes 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 26 hereof**, bids which are not substantially responsive to the requirements of the Bid Documents shall be rejected.

9. Clarification Bidding Documents

- 9.1 A prospective bidder requiring any clarification of the bidding documents may notify the Employer in writing or through E-mail at the Employer's address indicated in the invitation to bid. The Employer will respond to any request for clarification which he received earlier than 15 days prior to the deadline for submission of bids. Employer's response will be published on website including a description of the enquiry but without identifying its source.



9.2 Pre-bid meeting

- 9.2.1. The bidder or his official representative is invited to attend a pre-bid meeting which will take place at the address, venue, time and date as indicated in the appendix. Or send queries via email on or before Prebid
- 9.2.2. The purpose of the meeting will be to clarify issues and to answer questions on any matter that may be raised at that stage.
- 9.2.3. The bidder shall be required to submit any questions in writing or e-mail to reach the Employer not later than 03 days before the meeting.
- 9.2.4. Minutes of the meeting, including the question raised (Without identifying the source of enquiry) and the responses given will be published without delay on the tender website i.e. www.nprocure.com. Any modification of the bidding documents listed in sub-Clause 8.1 which may become necessary as a result of the pre-bid meeting shall be made by the Employer exclusively through the issue of an Addendum pursuant to Clause 10 and not through the minutes of the pre-bid meeting.
- 9.2.5. 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.
- 10.2. Any addendum thus issued shall be part of the bidding documents. The Employer will assume no responsibility for the same.
- 10.3. To give prospective bidders reasonable time in which to take an addendum into account in preparing their bids, the Employer may, at his discretion, extend as necessary the deadline for submission of bids, in accordance with Sub-Clause 20.2 below.



C. PREPARATION OF BIDS

11. Language of the Bid

11.1 All documents relating to the bid shall be in the English language.

12. Documents Comprising the Bid

12.1. The bid be submitted by the bidder (refer Clause 8.1) shall be in two separate parts:

Part I shall be named “Technical Bid” and shall comprise

- (i) Bid Security in the form specified in Section 8
- (ii) Qualification Information and supporting documents as specified in Section 2
- (iii) Certificates, undertakings, affidavits as specified in Section 2
- (iv) Any other information pursuant to Clause 4.5 of these instructions
- (v) Undertaking that the bid shall remain valid for the period specified in Clause 15.1

Part II shall be named “Financial Bid” and shall comprise

- (i) Form of Bid as specified in Section 6
- (ii) Priced Bill of Quantities for items specified in Section 7

12.2. The Bidder shall submit the details / information pertaining to each part i.e. technical as well as financial and must be submitted online only.

12.3. Following documents will be deemed to be part of the bid.

Sr No	Section	Description
1	Invitation for Bid (IFB)	
2	Section -1	Instructions to Bidders
3	Section -2	Qualification Information
4	Section -3	Conditions of Contract
5	Section -4	Contract Data
6	Section -5	Technical specifications
7	Section -6	Form of Bid

8	Section -7	Bill of Quantities
9	Section -8	Securities and Other Forms
10	Section -9	Drawings

13. Bid Prices

13.1 The Contract shall be for the whole works as described in Sub-Clause 1.1, based on the priced Bill of Quantities submitted by the Bidder.

13.2 The bidder shall fill in rates and prices and line-item total (both in figures and words) for all items of the Works described in the Bill of Quantities along with total bid price.

(Both in figures and words). Items for which no rate or price is entered by the bidder will not be paid for by the Bill of Quantities.

13.3 All duties, taxes, and other levies **except GST** 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. **(GST will be paid extra as per the prevailing GST rates at the time of billing)**

13.4 Deleted

13.5 The rates and prices quoted by the bidder are subject to adjustment during the performance of the Contract in accordance with the provisions of Clause 47 of the Condition of Contract **(Irrespective of the time limit and Bid Amount)**

14. Currencies of Bid and Payment

14.1 The unit rates and the prices quoted by the bidder shall be entirely in Indian Rupees. All payments shall be made in Indian Rupees.

15. Bid Validity

15.1 Bids shall remain valid for a period of not less than 120 days after the deadline date for bid submission specified in Clause 20.

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 period. A bidder may refuse the request without forfeiting his bid security. 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 security for a period of the extension, and in compliance with Clause 16 in all respects.

#16. Bid Security



- 16.1. The Bidder shall furnish, as part of his Bid, a Bid security in the amount as shown in column 4 of the table of IFB for this particular work. This Bid security shall be in favor of Employer as named in Appendix and may be in one of the following forms;
- a. Bank Guarantee from any scheduled Indian bank, in the format given in Volume III. **(Bank Guarantee is applicable only for Bid Estimated Amount of 01 Crore and above)** and Bank Guarantee of Schedule and Private Banks shall be considered as per GoG Finance Department's Circular No. FD/MSM/e -file / 4/2024/2859/D. M. O. Date 01/05/2025 or as per their latest amendment.
- 16.2. Bank guarantees (and other instruments having fixed validity) issued as surety for the bid shall be valid for 45 days beyond the validity of the bid validity period specified in sub clause 15.1 employer shall not pay any interest and bid security of L2 will be given after work order /LOI to Lowest bidder. i.e. total validity of $120+45 = 165$ Days
- 16.3. Any bid not accompanied by an acceptable Bid Security and not secured as indicated in Sub-Clauses 16.1 and 16.2 above shall be rejected by the Employer as non-responsive.
- 16.4. The Bid Security of unsuccessful bidders will be returned within 28 days of the end of the bid validity period specified in Sub-Clause 15.1 except L2 Agency.
- 16.5. The Bid Security of the successful bidder will be discharged when the bidder has signed the Agreement and furnished the required Performance Security.
- 16.6. The bid Security may be forfeited
- (a) If the Bidder withdraws the bid after Bid opening during the period of Bid validity.
- (b) If the Bidder does not accept the correction of the Bid Price, if any or
- (c) In the case of a successful Bidders, if the Bidder fails the specified time limit to
- (i) Sign the Agreement; or
- (ii) Furnish the requirement Performance Security.
- (d) #If found necessary, the bidder will be intimated for negotiation, He will be intimated maximum three times within the validity period for negotiation, If contractor does not respond in time, his Bid Security (EMD) will be forfeited and his tender will be rejected. Punitive action will be taken on such contractors. (As per GoG R&B Dept's Gr. No. S/22/2017/6369/D, Dt.08/06/2018).



17. Alternative Proposals by Bidders.

- 17.1. Bidders shall submit offers that fully comply with the requirements of the bidding documents, including the conditions of contract (including mobilization advance or time for completion), basic technical design as indicated in the drawing and specifications. Conditional offers or alternative offers will not be considered further in the process of tender evaluation.

18. Format and Signing of Bid

- 18.1. The Bidder shall prepare documents comprising the bid as described in Clause 12 of these Instructions to bidder as the “Technical Bid “and “Financial Bid” in separate parts to be uploaded.

D. SUBMISSION OF BID

19. Deleted

20. Deadline for Submission of the Bids

- 20.1. Complete Bids must be received online by the Employer at the tender website specified above not later than the date indicated in appendix.
- 20.2. The Employer may extend the deadline for submission of bids by issuing an amendment in accordance with Clause 10, in which case all right and obligation of the Employer and the bidders previously subject to the original deadline will then be subject to the new deadline.

21. Deleted

22. Modification and Withdrawal of Bids

- 22.1. Bidders may modify or withdraw their bids online before the deadline prescribed in Clause 20 or pursuant to Clause 23.
- 22.2. No bid shall be modified or withdrawn after the deadline for submission of Bid.
- 22.3. Withdrawal or modification of a bid between the deadline for submission of bids and the expiration of the original period of bid validity specified in Clause 15.1 above or as extended pursuant to Clause 15.2 may result in the forfeiture of the Bid security pursuant to Clause 16.

23 Bid submission

- 23.1. Bidder to submit all PQ Documents online as well as Offline with sign & stamp. Do not submit price bid offline else Bid will be rejected.



E. BID OPENING AND EVALUATION

23. Bid Opening

- 23.1. The Employer will open all the Bids received including modifications made pursuant to Clause 22, in the presence of the Bidders or their representatives who choose to attend at time, date and the place specified in Appendix in the manner specified in Clauses 20 and 23.3, In the event of the specified date of Bid opening being declared a holiday for the Employer, the Bids will be opened at the appointed time and location on the next working day.
- 23.2. Deleted.
- 23.3. The “Technical Bid” shall be opened. The amount, form and validity of the bid security furnished with each bid will be announced. If the bid security furnished does not conform to the amount and validity period as specified in the invitation for bid (ref. Column 4 and paragraph 3), and has not been furnished in the form specified in Clause 16, the technical bid will not be opened.
- 23.4.
- (i) Subject to confirmation of the bid security by the issuing Bank, the bids accompanied with valid bid security will be taken up for evaluation with respect to the Qualification information and other information furnished in part I of the bid pursuant to Clause 12.1.
 - (ii) If required, the bidder will be asked in writing to clarify his Qualification Documents with respect to any required clarification.
 - (iii) The bidders will respond in not more than 7 days of issue of the clarification letter.
 - (iv) Immediately (usually within 3 or 4 days), on receipt of this clarification the Evaluation Committee will finalize the list of responsive bidders whose financial bids are eligible for consideration.
- 23.5. Deleted
- 23.6 At the time of opening of “Financial Bid”, the names of the bidders were found responsive in accordance with Clause 23.4(iv) will be announced. The bids of only these bidders will be opened. The responsive Bidders’ names, the Bid prices, the total amount of each bid, any discount and such other details as the Employer may consider appropriate, will be announced by the Employer at the opening.
- 23.7 the time of opening of “Financial Bid”, the names of the bidders were found responsive in accordance with Clause 23.4(iv) will be announced. The bids of only these bidders will be opened. The responsive Bidders’ names, the Bid prices, the total amount of each bid, any discount, and such other details as the Employer may



consider appropriate, will be announced by the Employer at the opening.

23.8 In case bids are invited for more than one package, the order for opening of the “Financial Bid” shall be in order of Estimated amount of Bids from highest to lowest.

23.9 The Employer shall prepare minutes of the Bid opening, including the information disclosed to those present in accordance with Sub-Clause 23.6.

24 Process to be Confidential

24.1 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 effort by Bidder to influence the Employer’s processing of Bids or award decisions may result in the rejection of his Bid.

25. Clarification of Financial Bids

25.1. To assist in the examination, evaluation, and comparison of Bids, the Employer may, at his discretion, ask any Bidder for clarification of his Bid, including breakdowns of unit rates. The request for clarification and the response shall be in writing or by e-mail, but no change in the price or substances of the Bid shall be sought, offered, or permitted except as required to confirm the correction of arithmetic errors discovered by the Employer in the evaluation of the Bids.

25.2. Subject to sub-clause 25.1, no Bidder shall contact the Employer on any matter relating to his Bid opening to the contract is awarded. If the Bidder wishes to bring additional information to the notice of the Employer, it should do so in writing.

25.3. Any effort by the Bidder to influence the Employer in the Employer's bid evaluation, bid comparison or contract award decision may result in the rejection of the Bidders’ bid.

26. Examinations of Bids and Determination of Responsiveness

26.1 During the detail evaluation of "Technical Bid", the Employer will determine whether each Bid (a) meets the eligibility criteria defined in Clause 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 document. During the detailed evaluation of the “Financial Bid”, 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.

26.2 A substantially responsive “Financial Bid” is one which confirms all the terms, conditions and specifications of 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.

263. 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 non-conforming deviation or reservation.

27. Deleted

28. Deleted

29. Evaluation and Comparison of Financial Bids

- 29.1. The Employer will evaluate and compare only the Bids determined to be substantially responsive in accordance with Sub-Clause 26.2.

29.2. Deleted.

- 29.3. The Employer reserves the right to accept or reject any variation or deviation. Variation and deviations and other factors, which are in excess of the requirements of the Bidding documents or otherwise result in unsolicited benefits for the Employer, shall not be taken in to account in Bid evaluation.

- 29.4. The estimated effect of the price adjustment conditions under Clause 47 of the Conditions of Contract, during the period of implementation of the Contract, will not be taken in to account in Bid evaluation.

- 29.5. 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 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 34 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.

- 29.6. A bid which contains several items in the bill of Quantities which are unrealistically priced low and which cannot be substantiated satisfactorily by the bidder may be rejected as non-responsive.

30. Deleted



F. AWARD OF CONTRACT

31. Award Criteria

31.1. Subject to Clause 32, 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; and
- (ii) to be within the available bid capacity adjusted to account for his bid price which is the lowest evaluation in any of the packages opened earlier than the one consideration.

In no case, the contract shall be awarded to any bidder whose available bid capacity is less than the evaluated bid price, even if the said bid is the lowest evaluated bid. The contract will in such cases be awarded to the next lowest bidder at his evaluation bid price.

32. Employer's Right to Accept any Bid and to Reject any or all Bids

32.1. Notwithstanding Clause 31, 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 Bidder or any obligation to inform the affected Bidder or Bidders of the grounds for the Employer's action.

33. Notification of Award and Signing of Agreement

33.1. 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 condition of contract called the "Letter of Acceptance") will state the sum that the Employer will pay the Contractor in consideration of the execution, completion, and maintenance of the Works by the Contractor as prescribed by the Contract (hereinafter and in the Contract called the "Contract Price").

33.2. 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.

33.3. The Agreement will incorporate all agreements between the Employer and the successful Bidder. It will be signed by the Employer and to the successful Bidder, within 28 days following the notification of award along with the Letter of Acceptance. Within 21 days of receipt, the successful Bidder will sign the Agreement and deliver it to the Employer.

33.4. 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.

34. Performance Security

- 34.1. (A) Within 10 (Ten) days of receipt of Letter of Acceptance, the successful Bidder shall furnish to the Employer an irrevocable and unconditional guarantee from a Bank in the form set forth in Section 8 (the "Performance Security") for an amount equal to 5% (five percent) of its Contract Price (Capital Cost +GST). In case contractor fails to provide it within provided time period, deduction will be done at a rate of 6% p.a. In case of bids mentioned below, the successful Bidder, along with the Performance Security, Shall also furnish to the Authority an irrevocable and unconditional guarantee from a Bank in the same form given at Section 8 towards an Additional Performance Security (The "Additional Performance Security") for an amount calculated as under:
- (a) If the Contract Price offered by the Selected Bidder is lower than 10% but upto 20% of the Estimated Project Cost, then the Additional Performance Security shall be calculated @ 20% of the difference in the (i) Estimated Project Cost (as mentioned in Bid Document) - Minus 10% of the Estimated Project Cost and (ii) Contract Price offered by the selected Bidder.
 - (b) If the Contract Price offered by the Selected Bidder is lower than 20% of the Estimated Project Cost, then the Additional Performance Security shall be calculated @ 30% of the difference in the (i) Estimated Project Cost (as mentioned in Bid Document) - Minus 10% of the Estimated Project Cost and (ii) Contract Price offered by the selected Bidder.
 - (c) This Additional Performance Security shall be treated as part of the Performance Security.
- (B) The Performance Security shall be valid beyond 60(sixty) days of the Defects Liability Period and the Additional Performance Security shall be valid beyond 28 (twenty-eight) days of Project Completion Date.
- 34.2. If the performance security is provided by the successful Bidder in the form of a Bank Guarantee, it shall be issued either (a) at the Bidder's option, by a Nationalized/Scheduled Indian bank or (b) by a foreign bank located in India and acceptable to the Employer. As per GoG Finance Department's Circular No. FD/MSM/e-file/4/2023/0057/D.M.O. Date 21/04/2023 or as per their latest amendment.
- 34.3. Failure of the successful Bidder to comply with the requirement of Sub-Clause 34.1 shall constitute sufficient grounds for cancellation of the award and forfeiture of the Bid Security.



35 Advance Payment and Security

- 35.1 The Employer will provide an Advance payment on the Contract Price as stipulated in the Conditions of Contract, subject to maximum amount, as stated in the Contract Data.

36. Deleted

37. Corrupt or Fraudulent Practices

- 37.1 The Employer will reject a proposal if it determines that the Bidder recommended for award has engaged in corrupt or fraudulent practices in completing for the contract in question and will declare the firm ineligible, either indefinitely or for a stated period of time, to be awarded a contract with National Highways Authority of India/ State PWD and any other agencies, if it at any time determines that the firm has engaged in corrupt or fraudulent practices in completing for the contractor, or in execution.
- 37.2 Furthermore, Bidders shall be aware of the provision stated in Sub- Clause 59.2 of the Conditions of Contract.



APPENDIX TO ITB

Clause Reference With respect to Section –I

1.	The Name of the Employer is	[Cl.1.1]
2.	The last Seven years.	
	Base Year 2025-2026	
	2024-2025	
	2023-2024	
	2022-2023	
	2021-2022	
	2020-2021	
	2019-2020	
	2018-2019	
3.	This Annual Financial Turnover Amount is Rs.....	[Cl.4.5.3 (a)]
4.	Value of Work is Rs. 12,47,89,762/- (without GST)	
5.	Deleted	
6.	The cost of electrical, Mechanical work is Rs.	
7.	The cost of water supply / sanitary works is Rs.	
8.	Liquid assets and / or availability of credit facilities is 25% of Estimated Cost	[Cl.4.5.6]
9.	Price level of the financial year 2025-26	[Cl. 4.5.2]
10.	The pre-bid meeting will take place at The Executive Engineer on date & time as per NIT.	[Cl. 9.2.1]
11.	The technical Bid will be intimated later after evaluation.	
12.	Address of the Employer: The Executive Engineer , Water Works Project, 2nd floor, room no.-210, Vadodara Municipal Corporation, Khanderao Market Building, Rajmahal Road, Vadodara-390001	
13.	Deleted	
14.	The bid should be submitted latest by As stated on online NIT	[Cl. 20.1 & 20.2]
15.	The bid will be opened at the office of the The Executive Engineer, Water works (Ele./Mech.) , As stated on online NIT	[Cl. 23.1]
16.	The Bank Draft in favor of Municipal Commissioner, Vadodara Municipal Corporation, Vadodara.	
17.	Deleted	
18.	Escalation factors (for the cost of works executed and financial figure to a common base value) for works completed	[Cl.4.5.2]



Year	Financial Year	Multiplying factor
Base year of inviting tender	2025-2026	1.00
-1	2024-2025	1.10
-2	2023-2024	1.21
-3	2022-2023	1.33
-4	2021-2022	1.46
-5	2020-2021	1.61
-6	2019-2020	1.77
-7	2018-2019	1.94



LIST OF KEY PLANT & EQUIPMENT TO BE DEPLOYED ON CONTRACT WORK

[Reference CL. 4.5.5]

The contractors shall also give a list of machineries in his possession and which they propose to use on the work.

Sr. No.	Plant or Machinery	Location	Age of Machinery (maximum 15 years)	Make	Capacity	Approximate Value	Remark
1	2(a)	2(b)	3	4	5	6	7



List of Key Personnel to be deployed on Contract Work

(Reference Cl. 4.5.4)

Employment of a qualified site Engineer by the Contractor.

The Contractor shall employ full-time technically qualified staff during the execution of this work as under: -

1. One graduate Electrical Engineer, one diploma Electrical engineer, one diploma mechanical engineer and one diploma civil Engineer **when cost of the work to be executed is more than Rs.50 lakhs.**
2. ~~One graduate & two Diploma, Electrical/Instrumentation Engineers when the cost of the work to be executed is more than Rs.15 lakhs but less than Rs.50 lakhs.~~
3. ~~Minimum one Diploma Civil Engineer when the cost of work is less than Rs.15 lakhs but more than Rs.5 lakhs.~~
4. ~~Minimum two Diploma Civil Engineers for the work when the cost of work to be executed is less than Rs. 5 lakhs. The Engineer so employed for the Government work must have sufficient experience to handle the work independently. Such an Engineer shall have to stay at the site of work and he shall not be entrusted with other duty except this work.~~

In case the contractor or partner of the contractor firm is a Graduate Engineer in respective field, Employment of a separate Engineer will not be necessary provided that the Engineer partner himself attends the execution of the work on the site.

Within 15 days of issue of work-order the Contractor will have to furnish to the Engineer-in-charge of the work the Name, Qualifications, copy of marksheet, Colour Photograph and the appointment order issued such engineers engaged for this contract work. If 15 days after issue of work order such designated Site Engineers do not resume or do not remain present on site of work, the recovery at the rate of Rs.15000/Month per Engineer will be made from the bills/deposit/dues of the contractor. Such recovery shall be non-refundable.



SECTION - 2
QUALIFICATION INFORMATION



QUALIFICATION INFORMATION

The information to be filled in by the Bidder in the following pages will be used for the purpose of post qualification as provided for in Clause 4 of the Instruction 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 constructions 2024-25~~
~~Work performed in the last Seven years 2023-24~~
~~(in Rs. Lakhs) 2022-23~~
~~_____ 2021-22~~
~~_____ 2020-21~~
~~_____ 2019-20~~
~~_____ 2018-19~~
~~_____ 2017-18~~

1.3.1 Work performed as prime contractor, ~~work performed in the past as a nominated sub-contractor will also be considered the sub-contract involved execution of all main items of work described in the bid documents, provided further that all other qualification criteria are satisfied (in the same name) on works of a similar nature over the last seven years** and in current year before the submission of the bid.~~

Project Name	Name of the Employer	Description of work	Contract No.	Value of contract (Rs. Crore)	Date of issue of work order	Stipulated period of completion	Actual date of completion*	Remark explaining reasons for delay & work Completed

*Attach certificate(s) from the Engineer(s)in-charge

** Immediately preceding the financial year in which bids are received.



#1.3.2 Quantities of work executed as prime contractor, work performed, in the past as a nominated sub-contractor, will also be considered provided the sub-contract involved execution of all main items of work described in the bid document, provided, further that all other qualification criteria are called (in the same name and style) in the last five years** and in current year before the submission of the bid.

Year	Name of the work	Name of the Employer	Quantity of work performed (Cum/MT)				Remarks* (indicate contract Ref)
			Cement Concrete (Including RCC & PCC)	Masonry	Earth Works	Bituminous Work	
2024-2025							
2023-2024							
2022-2023							
2021-2022							
2020-2021							

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 works	Place & State	Contract No.	Name & Address of Employer	Value Contract (Rs. Cr)	Stipulated Period of Completion	Value of Works* remaining to be completed (Rs. Cr)	Anticipated of completion
1	2	3	4	5	6	7	8

*Attach certificate (s) from the Engineer(s) in-charge

** Immediately preceding the financial year in which bids are received.

1.5 Availability of key items of Contractors Equipment for carrying out the works (Ref. Clause 4.5.5). The Bidder should list all the information requested below.

Item of Equipment	Requirement		Availability Proposals			Remarks (from whom to be purchased)
	NO	Capacity	Owned/ Leased to be procured	Nos/. Capacity	Age/ Conditions	



- 1.6 Qualifications and experience of key personnel required for administration and execution of the contract. Attach biographical data. Refer also to Sub Clause 9.1 of the Conditions of Contract.

Position	Name	Qualification	Year of Experience (General)	Year of experience in the proposed position
Project Manager				
Etc.				

- 1.7 Proposed sub-contract and firms involved

Sections of the works	Value of Sub-Contractor	Sub-Contractor (Name & Address)	Experience in similar work

Attach copies of certificates on possession of valid license for executing water supply/ sanitary work/ building electrification works.

- 1.8 Financial reports for the last five years: balance sheets, profit and loss statements, auditors' reports (in case of companies/corporations), 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 copied documents.
- 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 showing Present Status

1.12. Statement of compliance under the requirements of Sub Clause 3.2 of the instruction to Bidders. (Name of Consultant engaged for project preparations is *.....)

1.13 Proposed work method and schedule. The Bidder should attach descriptions, drawings and charts as necessary to comply with the requirements of the Bidding documents. (Refer ITB Clause 4.1)

1.14 Programme

2. Deleted

3. Additional Requirements

3.1 Bidders should provide any additional information required to fulfill the requirements of Clause 4 of the Instructions to the Bidders, if applicable.

(i) Affidavit

(ii) Undertaking



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

(CLAUSE 4.5.6 OF ITB)

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 during the contract period.

(Signature) Name of Bank

Senior Bank Manager Address of the Bank



AFFIDAVIT

1. I, the undersigned, do hereby certify that all the statements made in the required attachments are true and correct.
2. The undersigned also hereby certifies that neither our firm M/s. _____
_____ have not abandoned any work of Government of Gujarat/Government of India/any Board or Corporation under Government of Gujarat/Government of India nor any contract awarded to us for such works have been rescinded, during last five years prior to the date of this bid.
3. The undersigned hereby authorize(s) and request (s) any bank, person, firm or corporation to furnish pertinent information deemed necessary and requested by the Department to verify this statement or regarding any (our) competence and general reputation.
4. The Undersigned understands and agrees that further qualifying information may be requested, and agrees to furnish any such information at the request of the Department/Project implementing agency.

(Signed by an Authorized Officer of the Firm)

Title of Officer :

Name of Firm :

Date :



UNDERTAKING

I, the undersigned do hereby undertake that our firm M/s..... would invest a minimum cash up to 25% of the value of the work during implementation of the contract.

(Signed by an Authorized
officer of the firm)

Title of Officer :.....

Name of Firm :.....

Date :.....



SECTION - 3

CONDITIONS OF CONTRACT



Conditions of Contract

A	General	D.	Cost Control
1	Definitions	37	Bill of Quantities
2	Interpretation	38	Changes in the Quantities
3	Language and Law	39	Variations
4	Engineer's Decisions	40	Payments for Variations
5	Delegations	41	Cash Flow Forecasts
6	Communications	42	Payment Certificates
7	Sub-Contractors	43	Payments
8	Other Contractors	44	Compensations Events
9	Personnel	45	Tax
10	Employer's & Contractor Risk	46	Currencies
11	Employers Risks	47	Price Adjustment
12	Contractor's Risk	48	Retention
13	Insurance	49	Liquidated damages
14	Site Investigations Reports	50	Bonus
15	Queries about the Contract	51	Advance Payment
16	Contractors to Construct the works	52	Securities
17	The Works to be Completed By the Intended Completion Date	53	Deleted
18	Approval by the Engineer	54	Cost of Repair
19	Safety		
20	Discoveries	E.	Finishing the Contract
21	Possession of the Site	55	Completion
22	Access to the Site	56	Taking Over
23	Instructions	57	Final Account
24	Disputes	58	Operating and Maintenance manuals
25	Procedure for Disputes		
26	Deleted	59	Terminations
		60	Payment upon Terminations
B.	Time Control	61	Property
27	Programme	62	Release from Performance
28	Extensions of the Intended completion date		
29	Deleted	F.	Special Conditions of Contract
30	Delays Ordered by The	63	Labour
	Engineer	64	Compliance with labour regulations
31	Management Meetings	65	Arbitration
32	Early Warning		
C.	Quality Control		
33	Identifying Defects		
34	Tests		
35	Correction of Defects		
36	Uncorrected Defects		

CONDITION OF CONTRACT

A. GENERAL

- 1 Terms which are defined in the Contract Data are not also defined in the Conditions of Contract but keep their defined meaning.
- **Bill of Quantities** means the priced and completed Bill of Quantities forming part of the Bid
 - **Compensation Events** are those defined in Clause 44 hereunder.
 - The **Completion Date** is the date of completion of the Works as certified by the Engineer in accordance with Sub Clause 55.1
 - The Contract is the contract between the Employer and Contractor to execute, complete and maintain the Works **till the completion of Defects Liability Period**. It consists of the documents listed in Clause 2.3 below.
 - The **Contract data** defines the documents and other information which comprise the Contract.
 - The **Contractor** is a person or corporate body whose Bid to carry out the Work has been accepted by the Employer.
 - The **Contractor's Bid** is the completed Bidding document submitted by the Contractor to the Employer and includes Technical and Financial Bids.
 - 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.
 - The **Defects Liability Period** is the period named in the Contract Data and calculated from the Completion Date.
 - The **Employer** is the party who will employ the Contractor to carry out the Works.
 - **The Engineer** is the person named in the Contract Data (or any other competent person appointed and notified to the contractor to act in replacement of the Engineer) who is responsible for supervising the Contractor, administering the Contract, certifying payments due to the Contractor, issuing and valuing Variations to the Contract, awarding extensions of time, and valuing the Compensations Events.
 - **Equipment** is 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 work which is to have mechanical, electrical, electronic or chemical or biological functions.
- The **Site** is the area defined as such in the Contract Data.
- **Site Investigation Reports** are those which were included in the Bidding documents and are factual interpretive reports about the surface and subsurface conditions at the site.
- **Specifications** means the Specifications 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 **Subcontractor** is a person or corporate body who has a Contract with the Contractor to carry out a part of the work in the Contract which includes work on the Site.
- **Temporary Works** are works designed, constructed, installed, and removed by the Contractor which are needed for construction or installation of the Works.
- A **Variation** is an instruction given by the Engineer, which varies the Works. The **Works** are what the Contract requires the Contractor to construct, install, and turn over to the Employer, as defined in the Contract Data.

1. Interpretation

- 1.1 In interpreting these Conditions of Contract, singular also means plural, male also means female or neuter and the other way around. Heading 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 Conditions of Contract.
- 1.2 If sectional completion is specified in the Contract Data, references in the Conditions of Contract to the Works, the Completion date, and Intended Completion Date apply to any Section of the Works (other than references to the Completion Date and Intended

Completion date for the whole works)

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

- (1) Agreement
- (2) Letter of Acceptance, notice to proceed with works
- (3) Contractor's Bid
- (4) Contract Data
- (5) Conditions of Contract including Conditions of Contract
- (6) Specifications
- (7) Drawings
- (8) Bills of quantities and
- (9) Any other document listed in the Contract Data as forming part of the Contract.

2. Language and Law

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

3. Engineers Decisions

- 3.1 Except where otherwise specifically stated, the Engineer will decide contractual matters between the Employer and the Contractor in the role representing the Employer.

4. Delegation

- 4.1 The Engineer may delegate any of his duties and responsibilities to other people after notifying the Contractor and may cancel any delegation after notifying the Contractor.

5. Communications

- 5.1 Communications between parties which are referred to in the conditions are effective only when in writing. A notice shall be effective only when it is delivered (in terms of Indian Contract Act).

6. Sub-Contracting

- 6.1 The Contractor may subcontract any portion of work, up to a limit specified in contract data, with the approval of the engineer but may not assign the Contract without the approval of the Employer in writing. Subcontracting shall not alter the Contractor's obligations. **Sub-contracting of supply or specific items of work is not allowed.**
- 6.2 The sub-contractor must be registered in appropriate class and category for the part of work to be subcontracted.

7. Other Contractors

- 7.1 The Contractor shall cooperate and share the site with other contractors, public

authorities, utilities and the Employer between the dates given in the Schedule of other Contractor. The Contractors shall as refer to in the Contract Data, also provide facilities and services for them as described in the Schedule. The employer may modify the schedule of other contractors and shall notify the contractor of any such modifications.

8. Personnel

- 8.1 The Contractor shall employ the key personnel named in the Schedule of Key Personnel as referred to in the Contract Data to carry out the functions stated in the Schedule or other personnel approved by the Engineer. The Engineer will approve any proposed replacement of key personnel only if their qualifications, abilities, and relevant experience are substantially equal to or better than those of the personnel listed in the Schedule.
- 8.2 If the engineer asks the Contractor to remove a person who is a member of the Contractor Staff or his 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 work in the Contract.

9. Employer's and Contractors Risks

- 9.1 The Employer carries the risk which these Contract states are Employer's risks, and the Contractor carries the risks which these Contracts states are Contractors risk.

10. Employer's Risks

- 11.1 The employer is responsible for the excepted risks which are (a) in so far as they directly affect the execution of the Works, the risks of war, hostilities, 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), and contamination from any nuclear fuel or nuclear waste or radioactive toxic explosive.

11. Contractor's Risks

- 11.1 All risks of loss of or damages 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 are the responsibility of the Contractor.

12. Insurance

- 12.1 The Contractor shall provide, in the joint names of the Employer and the Contractor, insurance cover from the Start date to the end of the Defects 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) Loss of or damage to the works, Plant and materials,
- (b) Loss of or damage to Equipment



(c) Loss of or damages of property (except the Works, Plant, Materials and Equipment) in connection with the Contract; and

(d) Personal injury or death.

12.2 Policies and certificates for insurance shall be delivered by the Contractor to the Engineer for the Engineer's approval before the Start Date. All such insurance shall provide for compensation to be payable in the types and proportions of currencies required to rectify the loss or damage incurred.

12.3 If the Contractor does not provide any of the policies and certificates required, the Employer may affect the insurance which the Contractor should have provided and recover the premiums the Employer has paid from payments otherwise due to the Contractor or, if no payment is due, the payment of the premiums shall be a debt due.

12.4 Alterations to the terms of an insurance shall not be made without the approval of the Engineer.

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

12.6 Contractor has to submit CAR policy for the project.

12.7 Hon. Supreme Court/High Court guideline as well as implementation of manual Scavenging Act & Rules (2013 including latest amendment) must be strictly followed by bidder for Drainage work for better safety workmen. all Work must be carried out by using safety equipment and by mechanical equipment by the bidder.

12.8 The Bidder will be responsible to pay minimum Rs.30 Lakhs in addition to the compensation paid by the Government in case of Death of Workman while execution of the work.

12.9 In case contractor fails to provide CAR policy and WC policy, VMC will get it and recover the premium of the same from the bill/SD. Also, penalty of 0.5% of contract value will be recovered from Bill/Sd.

13. Site Investigation Report

13.1 The Contractor in preparing the Bid shall rely on any site Investigation reports referred to in the Contract Data, supplemented by any information available to the Bidder.

14. Queries about the Contract data

14.1 The engineer will clarify queries on the Contract Data

15. Contractor to Construct the Works

15.1 The Contractor shall construct and install the works in accordance with the specification and Drawings.



16. The Works to be completed by the Intended Completion Date

- 16.1 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

17. Approval by the Engineer

- 17.1 The Contractor shall submit Specifications and Drawings showing the proposed Temporary works to the Engineer, who is to approve them if they comply with the Specifications and drawings.
- 17.2 The Contractor shall be responsible for design of temporary works.
- 17.3 The Engineer's approval shall not alter the contractor responsibility for design of the Temporary works.
- 17.4 The Contractor shall obtain approval of third parties to the design of the Temporary works where required.
- 17.5 All Drawings prepared by the Contractors for the execution of the temporary or permanent work are subject to prior approval by the Engineer before their use.

18. Safety

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

SAFETY MEASURES

- a) The Contractor shall be responsible for the safety of all workmen and other persons entering or in the Works and shall take all measures necessary to ensure their safety to the approval of the Engineer's Representative.
- b) Provision of efficient safety helmets for all personnel including the Engineer's Representative and each of his staff and any authorised visitors to site;
- c) Provision and maintenance of suitable lighting to provide adequate illumination of Works with appropriate spares and standby equipment;
- d) Provision and maintenance of safe, sound mechanical equipment, each item of having an up-to- date testing certificates;
- e) Provision and maintenance of safe, sound ropes, slings, pulleys and other lifting tackle, each appliance having an up-to-date testing certificate where appropriate;
- f) Provision of notices 1.25m x 1.5 m size written in bold letters in English, Gujarati and Hindi to be erected on existing footpaths and at points of access likely to be used by the



public, which shall warn the public of the existence of the Works. These notices shall be in addition to any statutory requirements demanded of the Contractor.

- g) Provision of safety rails (wherever instructed by Engineer in charge)
- h) The Contractor shall submit for the approval of the Engineer's Representative detailed proposals under (a), above. When the regulations have been approved and before the work is started, the Contractor shall distribute copies in English or in their languages as appropriate to all his employees and to the Engineer's Representative.
- i) The Contractor shall ensure that all his employees are fully conversant with the regulation, emergency and rescue procedures etc. and the Contractor shall enforce the rule that any employee committing a serious breach of such a regulations shall be instantly dismissed and shall not be re-employed.
- j) Contractor shall provide and maintain at his own expenses all lights, guards, fencing and necessary watchmen when and where necessary or as required by Owner/Engineer for the protection of the works or for the safety and convenience of those employed on the works and the public.
- k) Contractor shall also provide at his cost traffic barricades, men for diverting and controlling traffic, necessary signboards for diversion of traffic, in night LED Blinkers LED rope Light near Excavated trench in the event of failure on the part of Contractor, Owner may with or without notice to Contractor put up a fence or improve a fence already put up or provide and/or improve the lighting or adopt such other measures as he may deem necessary, and all the cost of such work and procedures as may be adopted by Owner/Engineer shall be borne by Contractor. Maintenance of adequate warning and general lighting at nights at place of work is essential.
- l) Contractor shall take the necessary permission and clearance of all the authorities like department of Roads, Traffic, Water Supply and Drainage; Electricity Board, Telephone Company, etc. wherever necessary and observe the regulations regarding the execution of work in congested areas, heavy traffic areas, etc.

19. Discoveries

- 19.1 Anything of historical or other interest or of significant value unexpectedly discovered on the site is the property of the Employer. The contractor is to notify the engineer of such discoveries and carry out the Engineer's instructions for dealing with them.

20. Possession of the Site

- 20.1 The Employer shall give possession of all parts of the site to the Contractor. If possession of a part is not given by the date stated in the Contract Data the Employer is deemed to have delayed the start of the relevant activities and this will be a Compensation Event.



- 20.2 If within 25% of the time limit of the project, 80% of possession of the site is not handed over to the Contractor, then contractor/ Employer may fore-close the contract. Contractor/Employer has to foreclose the work within 30 days after lapse of 25%-time limit and after 30 days foreclosure option will be closed.

21. Access to the Site

- 21.1 The Contractor shall allow the Engineer and any person authorized by the Engineer access to the Site, to any place where work in connection with the Contract is being carried out or is intended to be carried out and to any place where materials or plants are being manufactured/ fabricated/ assembled for the works.

22. Instructions

- 22.1 The Contractor shall carry out all instructions of the Engineer pertaining to works which comply with the applicable laws where the site is located.
- 22.2 The Contractor shall permit the Employer to inspect the Contractor's accounts and records relating to the performance of the Contractor and to have them audited by auditors appointed by the Employer, if so required by the Employer.

23. Disputes

- 23.1 If the Contractor is of the view that a decision taken by the Engineer was either outside the authority given to the Engineer by the Contract or that the decision was wrongly taken, the decision

(A) Should be referred to as Designated and defined officer as Dy.MC/HOD/CE/ACE of repetitive Department and also as per GAD circular No.498/98-99/Dt.07.07.98 with revision time to time in future.

(B) In case disputes remains unsolved it shall be refer to Municipal Commissioner.

- 23.2 Procedure for Disputers

- 23.3 25.1 The arbitration shall be conducted in accordance with the arbitration procedure stated in the Special Conditions of Contract.

24. Deleted

25. Deleted

B. TIME CONTROL

26. Programme

- 26.1 Within the time stated in the Contract Data the Contractor shall submit to the Engineer for approval a Programme showing the general methods, arrangements orders, and timing for all the activities in the works along with monthly cash flow forecast.
- 26.2 An update of the Programme shall be a programme showing the actual progress achieved on each activity and the effect of the progress achieved on the timing of the remaining work including any changes to the sequence of the activities.
- 26.3 The Contractor shall submit to the Engineer, for approval an updated programme at intervals no longer than the period stated in the Contract data. If the Contractor does not submit an updated programme within this period, the Engineer may withhold the amount stated in the Contract data from the next payment after the date on which the overdue programme has been submitted.
- 26.4 The Engineer's approval of the programme shall not alter the Contractor's obligations. The Contractor may revise the programme and submit it to the Engineer again at any time. A revised programme is to show the effect of Variations and Compensations events.

27. Extension of the Intended Completion Date

- 27.1 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 work and which would cause the Contractor to incur additional cost.
- 27.2 The Engineer shall decide whether and by how much stoppage to provided/ to extend the Intended Completion Date within 35 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 give early warning of a delay or 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.
- 27.3 The Engineer shall within 14 days of receiving full justification from the contractor for extension of Intended Completion Date refer to the Employer his decision. The employer shall in not more than 21 days communicate to the engineer the acceptance or otherwise of the Engineer's decision. If the employer fails to give his acceptance, the Engineer shall not grant the extension and the contractor may refer the matter under Clause 24.1

28. Deleted



29. Delays Ordered by the Engineer

- 29.1 The Engineer may instruct the Contractor to delay the start or progress of any activity within the works.

30. Management Meetings

- 30.1 Either the Engineer or the Contractor may require the other to attend a management meeting. The business of a management meeting shall be to review the plans for remaining work and to deal with matters raised in accordance with the early warning procedure.
- 30.2 The Engineer shall record the business of management meetings and is to provide copies of his record to those attending the meeting and to the Employer. The responsibility of the parties for actions to be taken is to be decided by the Engineer either at the management meeting or after the management meeting and stated in writing to all who attended the meeting.

31. Early Warning

- 31.1 The Contractor is to warn the Engineer at the earliest opportunity of specific likely future events or circumstances that may adversely affect the quality of the work, increase the Contract price or delay the execution of works. The Engineer may require the contractor to provide an estimate of the expected effect of the future event or circumstance on the contract price and completion date. The estimate is to be provided by the Contractor as soon as reasonably possible.
- 31.2 The Contractor shall cooperate with the Engineer in making and considering proposals for how the effect of such an event or circumstance can be avoided or reduced by anyone involved in the work and in carrying out any resulting instruction of the Engineer.



C. QUALITY CONTROL

33. Identifying Defects/ Defect liability period

33.1 Defect liability period: 36 Month

The contractor shall be responsible to make good and remedy at his own expense any defect which may develop or may be noticed before the period mentioned here under from the certified date of completion. The Engineer in charge shall give the contractor a notice in writing about the defects and the contractor shall make good the same within 15 days of receipt of the notice. In the case of failure on the part of the contractor, the Engineer- in-charge may rectify or remove or re-execute the work at the risk & cost of the contractor. The Engineer-in-charge shall be entitled to appropriate the whole or any part of the amount of security deposit towards the expenses, if any, Incurred by him in rectification, removal or re-execution. The Defects Liability period shall be as under....

The defect liability period shall of duration mentioned in contract data and shall start from date of final completion of entire work and acceptance of work by VMC. During defect liability period, the Contractor shall make good any defect whatsoever nature observed in different works equipment, or in part of plant or equipment by modifying/replacing/repairing of such defective units or parts there at his own cost within a period of ten days on hearing from Engineer-in-charge/VMC about such defect during liability period. In case, if Contractor's fails to do so, it will be got done by VMC and entire cost shall be recovered from Contractor's Security deposit/performance guarantee or other dues as may be possible.

- ~~(a) For all works costing up to Rs. 50,000 (amount put to tender), the period shall be 3 Months from the certified date of completion.~~
- ~~(b) For all works costing more than Rs. 50,000 and up to Rs. 1 crore (amount put tender), the period shall be 12 (Twelve) months from the certified date of completion or one monsoon, whichever is later.~~
- (c) For major projects costing more than Rs. 1 crore, the period shall be **36 Months** from the certified date of completion which should include three monsoons.
- ~~(d) For original building works the defect liability period will be 4 years or elapse of 4 monsoon period following date of possession of building taken over by user agency following the certified date of completion, whichever is later.~~

For the purpose of deciding the monsoon period, as per government circular.

Modified vide R & B D Circular No. PAC-11-102008-2076-N dated 31/8/2009, PRCH/102013(2976) 2759-N, Dated 27/05/2013 and Circular No.TNC/10/2016/Clause 17A (Correction/(1)C Dated 12/05/2016]

33.2 ~~Free maintenance guarantee period for works of Road/Bridge construction~~

(a) ~~For resurfacing work of road free maintenance guarantee period one year from the date of completion.~~

(b) ~~In case of widening of the road/strengthening of the road/bridge, the contractor shall have to give four years free maintenance guarantee from the certified date of completion. During this period the contractor shall visit the site every six months along with the concerned Section Officer / Deputy Executive Engineer and will examine the work already carried out in this contract like road work, jungle cutting, side shoulders, side gutter, road furniture, patta etc. and will prepare Km. wise inspection report duly signed by all concerned and any defect observed shall be done within 15 days by the contractor at his risk and cost as per the direction of Engineer in charge. The contractor needs to do videography of these visits and require to submit at the time of release of FMG. If B.T. the surface during the maintenance period of 4 years is worn out then agency shall have to provide renewal coating as per tender item as directed by the Engineer in charge. The amount equivalent to 5% of each running bill shall be withheld and will be released after the free maintenance guarantee period (i.e. 4 years) is over.~~

~~However, this amount shall be released against fixed deposit or bank guarantee pledged in the name of Executive Engineer after completion certificate of work is issued.~~

(1) ~~The flakiness and elongation index (combined) for coarse aggregates under no circumstances shall exceed the allowable limit set forth in the relevant clause for the material in question.~~

(2) ~~2% of the amount eligible for the payment of bituminous items shall be withheld till the miscellaneous items like earthwork in embankment / cutting for side shoulders, side gutters, kilometer / indicator / guard stones, sign boards etc. are completed in all respect by the contractor. After completion of the miscellaneous items, the above said 2% withheld amount shall be released.~~

~~{Govt. of Gujarat's G.R. No.: TNC-10-2013-3(Part-3)/C, Dtd. 13/12/2013}.~~

(3) ~~Videography for the surface under Maintenance Guarantee is to be done as per Govt. letter No.: SSR/10/2015-16/26/C, Dtd. 26/11/15 for the work costing more than Rs. 5.00 Crore.~~

(4) ~~Setting up of adequate laboratory & deployment of quality engineers.~~

~~The contractor shall have to set up the laboratory with adequate equipment. Till the setting up of adequate laboratory is completed & reported of this to the engineer (subject to due verification by engineer's representative) by contractor in writing, Rs.2,00,000/- shall be withheld. The qualified quality Engineer shall be deployed exclusively for this contract by the contractors. If quality Engineer is not deployed by contractor within one month after the date of work order, the amount equivalent to Rs.20,000 per month shall be recovered till the actual deployment of quality engineer.~~



~~The amount so recovered towards the deployment of quality engineers shall not be refunded.~~

~~(5) Asphalt work will have to be cross checked as per G.R. No.: RGN/60/2006/35/C, dtd.31/05/07 before final bill is paid.~~

~~(6) Maintenance during Construction Period~~

~~During the Construction Period, the Contractor shall maintain, at his own risk and cost, the existing lane(s) of the road so that the traffic worthiness and safety thereof are at no time materially inferior as compared to their condition 10 (ten) days prior to the date of the Agreement, and shall undertake the necessary repair and maintenance works for this purpose; provided that the Contractor may, at his cost, interrupt and divert the flow of traffic if such interruption and diversion is necessary for the efficient progress of works and conforms to Good Industry Practice; provided further that such interruption and diversion shall be undertaken by the Contractor only with the prior written approval of the Executive Engineer which approval shall not be unreasonably withheld. For the avoidance of doubt, it is agreed that the Contractor shall at all times be responsible for ensuring safe operation of the road.~~

- 33.3 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:

34. Tests

- 34.1 If the engineer instructs the Contractor to carry out a test not specified in the Specification 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. If there is no defect the test shall be a Compensation Event.
- 34.2 All test and types of tests to be performed as per IS specifications and instruction of EIC. In case if it is not done or up to the mark by bidder, 1% deduction form the work done in particular RA bill should be done.
- 34.3 Testing shall be done by collecting samples from site in Govt. approved testing laboratory 10% of total Quantity in M.S.U. or GERI at the cost of the contractor. The Contractor has to deposit the testing fee for TPI as per rules separately.

34.4 THIRD PARTY INSPECTION

All the Major Items Like RMU, HT Panel, LT Panel, Cable tray (In case of Individual Tray's executed Cumulative Qty \geq 500 Mtr.), Cables (HT, LT, Instrumentation, Flexible Wires & Other) (In case of Individual Cable's executed Cumulative Qty \geq 500 Mtr.), Chequered plate, All type of LED Lights, Street light poles, Solar plant (Solar PV plate, Inverter & Other), EOT, Electric hoist and other item as directed by EIC shall be



subjected to third party inspection as stated in technical specifications from approved TPI Agency by VMC at manufacturer's place as well as at VMC's work site with their test certificates satisfying the IS requirements. Third party inspection charges for all above material shall be borne by the contractor.

If VMC/ PMC/ TPI Engineers intend to witness the testing at manufacturer's works Entire expenses of said testing, including to & from traveling by Air, lodging and boarding etc. of maximum Two VMC/ PMC Engineers and 1 Third Party Inspector shall be borne by the bidder.

During TPI, the PMC representative must be from relative field only for all the item whose inspection is being carried out.

All the Material Test certificate provided by OEM for all the Item must be tested from NABL accredited LAB or as decided by EIC.

35. Correction of defects

- 35.1 The engineer shall give notice to the Contractor of any defects before the end of the defects Liability Period, which begins at Completion and is defined in the contract data. The Defects Liability Period shall be extended for as long as Defects remain to be corrected.
- 35.2 Every time notice of a Defect is given; the Contractor shall correct the notified defect within the length of time specified by the Engineer's notice.

36. Uncorrected Defects

- 36.1 If the Contractor has not corrected a defect 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.



D.COST CONTROL

37. Bill of Quantities

- 37.1 The bill of Quantities shall contain items for the constructions, installation, testing and commissioning work to be done by the Contractor.
- 37.2 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.

38. Change in the Quantities

- 38.1 The Engineer shall have power to make any alterations in or addition to the original specifications, drawings, designs and 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 instruction in this connection which may be given to him in writing signed by the Engineer and such alteration 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 at the same rate as are specified in the tender for the main work.

Except that when the quantity of any item exceeds the quantity as in the tender by more than 130%, the contractor will be paid for the quantity in excess of 130%, at the rate entered in the SOR of the year during which the excess in quantity is first executed.

39. Variations

- 39.1 All Variations shall be included in updated programmes produced by the Contractor.

40. Payments for Variations

- 40.1 If the additional or altered work includes any class of work for which no rate is specified in this contract, then such class of work shall be carried out as under.

- (i) At the rate derived from the item within the contract which is comparable to the one involving additional or altered class of work; where there are more than one comparable items, the item of the contract which is nearest in comparison with regard to class or classes of the work involved shall be selected and the decision of the Add. City Engineer as to the nearest comparable item shall be final and binding on the contractor.
- (ii) If the rate cannot be derived in accordance with (i) above, such class of works shall be carried out at the rate entered in the Schedule of Rates of the division

for the year in which the tender was received, increased or decreased by the percentage by which the tender amount is more or less as compared to the amount

arrived at the rates in the "Schedule of Rates" of the Division in the year in which the tender was received. If the Schedule of rates of the Division does not contain all the items, the percentage increase or decrease of the tender shall be calculated considering such items which were included in the "Scheduled Rates" of the division for the year and for materials consumed on such item the rate to be charged would be the basic rate taken into account for fixing the rate in S.O.R. referred to above.

- (iii) If it is not possible to arrive at the rate from (i) and (ii) above, such class of work shall be carried out at the rate decided by the competent authorities on the basis of detailed rate analysis after hearing the contractor as per powers delegated to VMC officials.

402 If the additional or altered work, for which no rate is entered in the "Schedule of Rates" of the Division is ordered to be carried out before the rate is agreed upon, then the contractor shall within seven days of the date of receipt by him of the order to carry out the work, inform the Engineer-in-charge of the rate, which it is his intention to charge for such class of work and if the Engineer in charge does not agree to this rates, he shall by notice in writing be at liberty to cancel his order to carry out such class of work and arrange to carry it out in such manner as he may consider it advisable, provided always that if the contractor shall commence work or incur any expenditure in regard thereof before the rates shall have been determined as lastly herein before mentioned, then in such cases 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 the determination of the rate as aforesaid according to such rate or rates as shall be fixed by the Engineer-in-charge. In the event of the dispute, the decision of the Add. City Engineer, HOD of the Water Works Department shall 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 alternation above referred to shall be within the scope of such designs, drawings and specifications appended to the tenders.

The time limit for the completion of the work shall be extended in the proportion that the increase in the cost occasioned by alterations bears to the cost of the original work and the certificate of the Engineer-in-charge as to such proportion shall be final and conclusive.

41. Cash Flow Forecasts

41.1 When the programme is updated, the contractor is to provide the engineer with an updated cash flow forecast.

42. Payment certificates.

42.1 The Contractor shall submit to the Engineer monthly statements of the estimated value of the work completed less the cumulative amount certified previously.

42.2 The Engineer shall check the Contractor's monthly statement within 14 days and



certify the amount to be paid to the Contractor after taking in to account any credit or debit for the month in question in respect of materials for the works in the relevant amounts and under conditions set forth in sub-clause

32.3 of the Contract Data (secured Advance).

- 423 The value of work executed shall be determined by the Engineer.
- 424 The value of work executed shall comprise the value of the quantities of the items in the Bill of Quantities completed.
- 425 The value of work executed shall include the valuation of variations and compensation events.
- 426 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

43. Payments

- 43.1 Payments shall be adjusted for deductions for advance payments, retention, other recoveries in terms of the contract and taxes at source, as applicable under the law. The Employer shall pay the Contractor the amounts certified by the Engineer within 28 days of the date of each certificate.
- 43.2 Payment of GST (prevailing rates) on the amount payable under the contract to the Contractor will be made by the Employer. Hence, it is the responsibility of the contractor to pay the GST to the concerned Authority.
- 43.3 Items of the works for which no rate or price has been entered in will not be paid by the Employer and shall be deemed covered by other rates and prices in the Contract.

- Payment Condition as per payment schedule.

	Description	% of quoted price of particular equipment
1	On supply of material at site	75 %
2	On completion of Installation, testing & commissioning of Respective Item	15 %
3	On Completion of Entire work	10 %

44. Compensation events

- 44.1 The following are compensation Events unless they are caused by the Contractor:
- (a) The Employer does not give access to a part of the Site by the site Possession date stated in Contract data to the Contractor



44.2 In case of compensation event occurs and it prevents the work being completed beyond the Intended Completion Date then Authority will approve EOT (Extension of Time) with eligible contractual price escalation.

45. Tax

45.1 The rates quoted by the Contractor must be inclusive of all taxes prevailing on due date of bid submission **except GST**. However, any subsequent changes in the tax structure by Government after due date of bid submission will be compensated (+/-) on availability or submission of actual documentation. Contractor will have to intimate Engineer regarding changes occurred in the tax structure after bid submission. If the contractor fails to provide such information and if any financial obligation may arise due to change in tax structure, same will be recovered from the contractor.

45.2 GST will be paid separately on the bills. Hence, it is the responsibility of the contractor to pay the GST to the concerned Authority.

46. Currencies.

46.1 All payment shall be made in Indian Rupees.

47. Price Adjustment

47.1 Contract price shall be adjusted for increase or decrease in rates and price of ~~labour~~, materials (Cement, Steel, HR Coil & Pig Iron), ~~fuels and lubricants~~ in accordance with the following principles and procedures and as per formula given in the contract data:

(a) The price adjustment shall apply for the work done from the start date given in the contract data up to end of the initial intended completion date or extensions granted by the Engineer and shall not apply to the work carried out beyond the stipulated time for reasons attributable to the contractor.

(b) The price adjustment shall be determined during each month from the formula given in the contract data.

(c) Following expressions and meanings during to the work done during each month

R = Total value of work done during the month. It would include the amount of secured advance granted, if any, during the month less the amount of secured advance recovered, if any during the month. It will exclude value for works executed under variations for which price adjustment will be worked separately based on the terms mutually agreed.

47.2 To the extent that full compensation for any rise or fall in costs to the contractor is not covered by the provisions of this or other clause in the contract, the unit rates and prices included in the contract shall be deemed to include amounts to cover the contingency of such other rise or fall in costs.



48. Retention

- 48.1 The Employer shall retain from each payment due to Contractor the proportion stated in the Contract Data until Completion of the whole of the Works.
- 48.2 On Completion of the whole of the Works half the total amount retained is repaid to the Contractor and half when the Defects Liability Period has passed and the Engineer has certified that all Defects notified by the Engineer to the Contractor before the end of this period have been corrected.
- 48.3 On completion of the whole works, the contractor may substitute retention money with an “on demand” Bank guarantee.

In case, Contractor requests for refund of the Retention Money deducted by the Employer under the provision of this clause, Employer shall consider the said request of the Contractor provided that the refund hereunder shall be made in tranches of not less than 1% (One Percent) of the Contract Price and Contractor furnishes an irrevocable and unconditional Bank guarantee for an equal amount substantially in the format of Bank Guarantee for Performance Guarantee enclosed with SBD and valid up to 60 day beyond the scheduled / extended Defects Liability Period. On completion of the whole works, the contractor has however an option to submit a fresh irrevocable and unconditional Bank Guarantee for an amount equal to 2.5% of the total value of work executed substantially in the format of Bank Guarantee for Performance Guarantee enclosed with SBD and valid up to 60 days beyond the Defect Liability Period and yet refund the Retention Money Bank Guarantee submitted for refund of Retention Money.

49. Liquidated Damages

- 49.1 The Contractor shall pay liquidated damages to the Employer at the rate of 0.05% of total contract value for each day that the Completion Date is later than the Intended Completion Date (for the whole works or the milestone as stated in the contract data). The total amount of liquidated damages shall not exceed the 10% of the total contract amount. The Employer may deduct liquidated damages from payment due to the Contractor. Payment of liquidated damages does not affect the Contractor's liabilities.
- 49.2 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. The Contractor shall not be entitled for any interest on the over payment calculated from the date of payment to the date of repayment.
- 49.3 If the contractor fails to comply with the time for completion as stipulated in the tender, then the contractor shall pay to the employer the relevant sum stated in the Contract Data as Liquidated damages for such default and not as penalty for everyday or part of day which shall elapse between relevant time for completion and the date stated in the taking over certificate of the whole of the works on the relevant section,

subject to the limit stated in the contract data.

The employer may, without prejudice to any other method of recovery deduct the amount of such damages from any monies due or to become due to the contractor. The payment or deduction of such damages shall not relieve the contractor from his obligation to complete the works on from any other of his obligations and liabilities under the contract.

- 49.4 If, before the Time for Completion of the whole of the Works or, if applicable any Section, a Taking Over Certificate has been issued for any part of the Works or of a Section, the liquidated damages for delay in completion of the remainder of the Works or of that Section shall, for any period of delay after the date stated in such Taking-Over-Certificate, and in the absence of alternative provisions in the Contract, be reduced in the proportion which the value of the part so certified bears to the value of the whole of the Works or Section, as applicable. The provisions of this Sub-clause shall only apply to the rate of liquidated damages and shall not affect the limit thereof.

50 Bonus

- 50.1 If the contractor achieves completion of the whole of the works prior to the intended Completion Date prescribed in Contract Data the Employer shall pay to the contractor a sum stated in Contract Data as bonus for every completed month **but subjected to maximum amount as stated in Contract Data**; which shall elapse between the date of completion of all items of works as stipulated in the contract, including variations ordered by the Engineer and the time prescribed in Clause 17.
- 50.2 Bonus shall be paid only to works amounting to above INR 5 crore with time limit of the works is equal or more than 6 months. The bonus would be paid as under

% of Time Saved	% of Initial Contract Price entitled for Bonus
50 %	5%
40 %	4%
30 %	3%
20 %	2%
10 %	1%
Less than 10%	0%

51. Advance Payment.

- 51.1 The Employer shall make advance payment (not to be paid less than two installments except in special circumstances for which the reason to be Recorded in writing) to the Contractor of the amounts stated in the Contract Date by the date stated in the Contract Date, against provision by the Contractor of an Unconditional Bank Guarantee

in a form and by a bank acceptable to the Employer in amounts and currencies equal to be at least 110% of the advance payment. 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. The Mobilization advance would be deemed as interest bearing advance at an interest rate of 10 % to be compounded, quarterly.

512 The Contractor is to use the advance payment only to pay for Equipment, plant and Mobilization expenses required specifically for execution of the Works. The Contractor shall demonstrate that advance payment has been used in this way by supplying copies of invoices or other documents to the engineer.

513 The advance payment shall be repaid by deduction proportionate amount from payments otherwise due to the Contractor, following the schedule of completed percentages of the Works on a payment basis. No account shall be taken of the advance payment or its repayment in assessing valuations of work done, variations, price adjustments, Compensation Events, or Liquidated damages.

514 Deleted

52. Securities

521 The performance Security (including 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 an amount and form and by a bank or surety acceptable to the Employer, and denominated in Indian Rupees. The performance Security shall be valid until a date 60 days from the date of expiry of Defects Liability Period and the additional security for unbalanced bids shall be valid until a date 28 days from the date of issue of the certificate of completion.

53. Deleted

54. Cost of Repairs.

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



E. FINISHING THE CONTRACT

55. Completion

- 55.1 The Contractor shall request the Engineer to issue a Certificate of Completion of the works and the Engineer will do so upon deciding that the work is completed.

56. Taking Over

- 56.1 The Employer shall take over the Site and the Works within seven days of the Engineer issuing a certificate of Completion.

57. Final Account

- 57.1 The Contractor shall supply to the Engineer a detailed final account of the total amount that the Contractor considers payable as full and final settlement of all claims under the Contract for items before the end of the Defects Liability Period. The Engineer shall issue a Defect Liability Certificate and certify any final payment that is due to the Contractor within 56 days of receiving the Contractor's account if it is correct and complete. If it is not, the Engineer shall issue within 56 days a schedule that states the scope of the corrections or additions that are necessary. If the Final 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 56 days of receiving the Contractor's revised account.
- 57.2 If reversal in characteristic of tender (L1 becoming L2) on account of excesses and savings in final account is observed, the Engineer/Employer shall be at liberty to restrict the final payment of BOQ items to the lowest amount evaluated of the bids considering the final quantities and the rates quoted including the rebates if any. Payment of variation items shall however be made at the rates approved by the Employer, within 90 days from the physical completion of work.

58. Operating and Maintenance Manuals

- 58.1 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.
- 58.2 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.

59. Termination

- 59.1 The Employer or the Contractor may terminate the Contract if the other party causes a fundamental breach of the Contract.
- 59.2 Fundamental breaches of Contract include, but shall not be limited to the following:

1. The contractor stops work for 28 days when no stoppage of work is shown on the current programme and the stoppage has not been authorized by the Engineer
2. The Engineer instructs the Contractor to delay the progress of the Works and the instructions is not withdrawn within 28 days;
3. The Employer or the Contractor is made bankrupt or goes into liquidation other than for a reconstructions or amalgamation
4. A payment certified by the Engineer is not paid by the Employer to the Contractor within 56 days of the date of the Engineer's certificate
5. 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;
6. The Contractor does not maintain a security which is required;
7. The Contractor has delayed the completion of works by the number of days for which the maximum amount of liquidated damages can be paid as defined in the Contract data; and
8. If the Contractor, in the judgment of the Employer has engaged in corrupt or fraudulent practices in competing for or in executing the Contract.

For the purpose of this paragraph: "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 borrower, and includes collusive practice among Bidders (prior to or after bid submission) designed to establish bid prices at artificial non-competitive levels and to deprive the Borrower of the benefits of free and open competition.

593 When either party to the Contract gives notice of a breach of contract to the Engineer for a cause other than those listed under Sub Clause 59.2 above, the Engineer shall decide whether the breach is fundamental or not.

594 Notwithstanding the above, the employer may terminate the Contract for convenience.

60. Payment upon Termination

60.1 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 less advance payments received up to the date of the issue of the certificate, less other recoveries due in terms of the contract, less taxes due to deducted at source as per applicable law and less the percentage to apply to the work not completed as indicated in the Contract data. Additional Liquidated Damages shall not apply. If the total amount due to the Employer



exceeds any payment due to the Contractor the difference shall be a debt payable to the Employer.

- 602 If the Contract is terminated at the Employer's convenience or because of a fundamental breach of Contract by the Employer, the Engineer shall issue a certificate for the value of the work done, the cost of balance material brought by the contractor and available at site, the reasonable cost of removal of equipment, repatriation of the Contractor's personnel employed solely on the works, and the Contractor's cost of protecting and securing the Works and less advance payment received up to the date of the certificate, less other recoveries due in terms of the contract and less taxes due to deducted at source as per applicable law.

61. Property

- 611 All materials on the Site, Plant Equipments, Temporary Works and Works are deemed to be property of the Employer, if the Contract is terminated because of a Contractor's default.

62. Release from Performance

- 621 If the Contract is frustrated by the outbreak of war or by any other event entirely outside the control of either 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 commitment was made.



F. SPECIAL CONDITIONS OF CONTRACT

63. LABOUR

The Contractor shall, unless otherwise provided in the Contract, make his own arrangements for the engagement of all staff and labour, local or other, and for their payment of 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 labour from time to time employed by the Contractor on the site and such other information as the Engineer may require.

64. COMPLIANCE WITH LABOUR REGULATIONS

During continuance of the contract, the Contractor and his sub- contractor shall abide at all times by all existing labour enactments and rules made thereunder, regulations, notification and bye laws of the State or central Government or local authority and any other labour law (including rules), regulations, bye laws that may be passed or notifications that may be issued under any labour law in future either by the State or the Central Government or the local authority. Salient features of some of the major labour laws that are applicable to the construction industry are given below. 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 thereunder, 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 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 the 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 to time.

SALIENT FEATURES OF SOME MAJOR LABOUR AND OTHER LAWS APPLICABLE TO ESTABLISHMENTS ENGAGED IN BUILDING AND OTHER CONSTRUCTIONS 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 5 years' service or more on death, the rate of 15 days wages for every completed year of service. The Act is applicable to all establishments employing 10 or more employees.

- C) **Employees P.F. and Miscellaneous Provision Act 1952:-** The Act Provides for monthly contributions by the employer plus workers @ 10% or 8.33% The benefits payable under the Act are :
1. Pension or family pension on retirement or death, as the case may be.
 2. Deposit linked insurance on the death in harness of the worker.
 3. 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 Labour (Regulation & Abolition) Act 1970** : The Act provides for certain welfare measures to be provided by the Contractor to contract labour 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 20 or more contract labour.
- F) **Minimum Wages Act 1948 :-** The Employer is supposed 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. Construction of Building, Roads, Runways are scheduled employment.
- G) **Payments 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 remunerations 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 matter of transfer, training and promotions etc.
- I) **Payments of Bonus Act 1965 :-** The Act is applicable to all establishments employing 20 or more employees. The Act provides for payments of annual bonus subject to a minimum of 8.33% of wages and maximum of 20 % of wages to employees drawing Rs. 3500/- per month or less. The bonus to be paid to employees getting Rs, 2500/- per month or above Rs. 3500/- per month shall be worked out by taking wages as Rs. 2500/- per month only. The Act does not apply to certain establishments. The newly set-up establishments are exempted for five years in certain circumstances. Some of the State Governments have reduced the employment size from 20 to 10 for the purpose of applicability of this Act.
- J) **Industrial Disputes Act 1947 :-** The Act lays down the machinery and procedure for resolutions 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 100 or more workmen (employment size reduced by some of the State and Central Government to 50). The Act provides for laying down rules governing the conditions of employment by the Employer on matters provided in the Act and get the same certified by the designated Authority.
- L) **Trade Unions Act 1926:-** The Act lays the procedure for registration of trade unions of workmen and employers. The Trade Unions registered under the Act have given certain immunities from civil and criminal liabilities.
- M) **Child Labour (Prohibition & Regulation Act 1986 :-** The Act prohibits employment of children below 14 years of age in certain occupations and process and provides for regulation of employment of children in all other occupations and processes. Employment of Child labour 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 5 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, is an establishment to which this Act becomes applicable, are required to be provided certain facilities such as housing, medical aid, traveling expenses from home upto 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 constructions work and employ 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 workplace etc. The Employer to whom the Act applies has to obtain a registration certificate from the Registering Officers 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 10 persons or more with aid of power or 20 or more persons without the aid of power engaged in the manufacturing process.
- Q) **Royalty charges-**The contractor shall pay the royalty to the competent authority as per rule. The **royalty** charges paid shall be borne by the contractor and shall not be



reimbursed by the Employer.

R) Following Pollution control Acts and amendments made thereof from time to time shall be applicable.

1. Water (Preservation and control of Pollution) Act, 1974
2. Air (Prevention and Control of Pollution Act 1981
3. Environmental (Protection) Act 1986

The contractor must commit to adopting Environmental management plan for best energy use, waste management, the reduction of pollution as in EMS (Environmental Management system) ISO-14001- 2015

65. ARBITRATION (GCC Clause 24)

The procedure for arbitration will be as follows: -

- 24.1 If the Contractor is of the view that a decision taken by the Engineer was either outside the authority given to the Engineer by the Contract or that the decision was wrongly taken, the decision shall be referred to **Add. City Engineer** (HOD-Water Works) within 14 days of the notification of the Engineer's decision. If the issue is not resolved, any party can refer the matter for conciliation within 15 days from the decision given by the Add. City Engineer.

24.2

- (a) For the work up to Rs.100 Cr., if any of the parties is not satisfied with the decision of the Add. City Engineer, both the parties have to refer to the Municipal Commissioner, Vadodara concerned for the conciliation process.
- ~~(b) For the work more than Rs.100 Cr., if any of the parties is not satisfied with the decision of the Superintending Engineer, both parties have to refer to the #Secretary, Roads & Building Department, Government of Gujarat for the conciliation process.~~

If the dispute is not resolved through the conciliation process, contractor may refer the dispute to Arbitration. Arbitration and legal matters/proceedings associated within this scope/tender shall be subject to Vadodara Court's Jurisdiction only. If the Contractor fails to refer a claim / dispute to the Higher Authority within 14 days of the notification of the Engineer's decision, the Contractor shall not be entitled to any additional payment/claim if he doesn't follow the above sequence in stipulated time. However, during such period, he would not stop the work in any case.

66.

1. The contractor shall have to check the actual requirement of pipes/ materials on site, before placing the order for supply. VMC will neither be responsible for excess



quantity to the actual requirement on site nor for delay in the actual supply requirement.

2. The contractor shall make necessary storage arrangement for all items (one by one) supplied require for work, Security of all supplied equipment will be arrange by contractor till completion of whole work, for that require security staff shall also be provided at his own cost and risk till completion of whole work, otherwise any item/equipment stolen, misplace or created damages, contractor must necessary arrangement for re-supply and/or repair of the same item/equipment at his own cost and risk.
3. Contractor will be responsible for any damage created during transportation and loading- unloading for work, if found that require rectification/ replacement immediately to be done at contractor's cost and risk.
4. Contractor will be responsible for any accident during work, if found all require arrangement immediately to be done at contractor's cost and risk.
5. Except where otherwise specified in the Contract and subject to the powers delegated to the Engineer-in-charge by the VMC, the decision of the Engineer-in-charge for the time being shall be final conclusive and binding on all parties to the Contract upon all question relating to the meaning of the specifications, designs, drawings and instruction herein before mentioned and as to the quality of workmanship or material used on the work or as to any other question, claim, right, matter or thing whatsoever, in anyway 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 of failure to execute the same, whether arising during the progress of the work or after completion of abandonment thereof.
6. All items of supply shall be of relevant ISI or ISO whichever is applicable or as specified and the work done shall be with standard practices of Mechanical & Electrical engineering. All necessary equipments required for erection shall be arranged by the contractor, and Electrical work shall be carried out as per Electricity Rules.
7. The contractor shall provide all necessary materials equipments, labor and technical staff, Supervisor etc. for work at his cost and risk till completion. Contractor shall have to take necessary insurance cover for his personnel (for example CAR policy).
8. Any revision or amendment in the IS code shall be considered and items shall be supplied with prevailing IS code.
9. The Bidder shall be considered to have visited the site of work, fully acquainted himself with the local situations regarding materials, labour and other factors pertaining to work and studied the plans and estimates before submitting the tender. Bidder must have to upload confirmation for site visit along with tender documents.
10. Miscellaneous items for carrying out work shall be arranged by contractor. No extra



payment for this miscellaneous item will made to the contractor.

- 11.** If the work executed is found to be of inferior quality or of any substandard quality not confirming to the specifications at any point of time during the inspection of by Engineer-in- charge or any higher Authority, the contract shall be terminated without assigning any reasons thereof and no payment shall be made towards the probable damages or loss caused to the contractor and materials purchased by him for this work and no compensation whatsoever either shall be paid to contractor by Municipal Corporation.
- 12.** The contractor shall take ‘All contract risk insurance policy” for the estimated cost of work of “Work’s man compensation policy” for all workers and labours of contractor and clients working at site and “Third party insurance policy” to fully cover all third-party type risk. The insurance policy so taken by the contractor for such purpose shall be in the joint name of the contractor and the client and the policy shall be deposited with the clients.
- 13.** Contractor to provide necessary transportation facility 24*7 during Execution period.
- 14.** The price/rates quoted in the tender should include all charges for hire, if necessary, of any tools and plant, temporary plumbing, water connection, maintenance of sanitary and water connections, supply of water, cost of cisterns, sheds for materials and plant, charges for getting electric connection and use of electricity and maintaining the same, clearing the site, watering, rolling etc. as specified. All prices shall be inclusive of the all the Taxes, duties, levies, etc. applicable on the last date of submission of the Tender Document.
- 15.** The Tender Evaluation Committee may ask for meetings or presentation with the Bidders to seek clarifications or conformations on their bids. Inability to submit requisite supporting documents/documentary evidence by Bidders may lead to rejection of their bids.
- 16.** The Contractor shall give minimum wages as per the Govt. Norms to labour and workmen employed by him. If there is any dispute, it is the contractor’s own responsibility.
- 17.** Method of work must be approved by contractor before work at site as per direction of Engineer In charge.
- 18.** Tendered rates shall include all the material, labour and requirements of plants, machinery, equipment, supervision, handling, cleaning, testing etc. (whether mentioned in the item or specifications etc. or not) which is required and necessary to complete the item
- 19.** The Contractor shall have to Upload Site Photographs of Day-to-Day progress in WhatsApp Group and shall submit weekly progress over email and monthly progress through letter to track ongoing work.



20. VMC has appointed PMC, TPI, and/or any other agency deemed fit for third-party inspection or Project Monitoring Consultants of the project. Bidders are bound to comply with the comments given by them.”

All Item as specified in tender and/or as decided by EIC must be inspected as per approved QAP at manufacturer's premises. All Item inspection will be done at manufacturer premises as well as at site in presence if VMC, PMC and TPI agency's representative.

The VMC or its TPI agency shall have the right to inspect and/ or to test the Goods for confirm their conformity to the Contract. The Special Conditions of the Contract and/or the Technical Specifications shall specify what inspections and tests the employer requires and where they are to be conducted. If not specified or not withstanding any mention, the Contractor shall submit the inspection plan of all major bought-out items for approval with client and TPI agency the stages of in section as per manufacturer's quality plan and shall arrange to carry out the inspection along with client and it's TPI agency at manufacturer's works as per the approved plan. The VMC shall notify the Contractor in writing of the identifying of any representatives retained for these purposes. All the expenses pertaining to inspection viz. lodging & boarding, transportation, all facilities as required shall be borne by the Contractor for the VMC/TPI agency representatives.

VMC has right to inspect, test and where necessary, reject the Goods after the Good's arrival in India shall in no way be limited or waived by reasons of the Goods having previously been inspected, tested and passed by the VMC or its TPI agency prior to the Good's shipment from the country of origin.

All the major items as decided by Engineer-in-charge as per QAP shall be subject to third party inspection from any TPI agency approved by VMC e.g. RITES, CEIL etc. **Appointment of TPI agency will be done by VMC. Contractor shall produce receipt of payment to TPI Agency.** In case contractor fails to do payment to TPI agency, VMC will cut the whole amount from running bill.

At manufacturer's place as well as at work site, third party inspection charges for all above material including taxes and other charges shall be borne by the Contractor.

If VMC/ TPI Engineers intend to witness the testing at manufacturer's works or at ERDA / EQDC / GOVT. Institute or any other place approved by VMC, the entire expenses of said testing, including to & fro traveling by Air, lodging and boarding, etc. shall be borne by the Contractor.

21. Time Limit for Completion of work

The period of completion shall be 9 Months excluding 1 monsoon

Shutdown for work



The contractor shall request for Installations which requires shutdown in existing System. In case the shutdown is not given by the department due to operational constraints of department. The successful bidder will be provided stoppage for such events on producing valid justification of delay of work subject to approval from competent authority of VMC No financial compensation will be given for such delay.

In the live system, Department will give time and the work shall be performed within the given timeline, if work is not taken in the given timeline, the cost of such advertisement plus Rs. 10,000 will be recovered from successful bidder.

22. In case of work for which there is no such specification, work shall be carried out in accordance with the P.W.D. or I.S.I. specifications and in the event of there being no P.W.D. or I.S.I. specifications, the work shall be carried out in all respects in accordance with the instructions and requirements of the Engineer-in-charge.
23. INDEMNITY : The Contractor shall indemnify the VMC against all actions, suits claim and demands through or made against the department in respect of work of this contract and against any loss or damage to Department in consequence of any action or suit being brought against the Contractor for anything done or omitted to be done in execution of the work of this Contract.
24. No compensation shall be allowed for any delay in execution of the work on account of water standing in borrows pits or compartments. The rates shall be inclusive for hard or cracked soil excavation in mud sub-soil water, or water standing in borrow pits and no claim for an extra rate shall be entertained unless otherwise specified.
25. LIABILITY OF CONTRACTOR FOR ANY DAMAGE DONE IN OR OUTSIDE WORK AREA : Compensation for all damage done intentionally or unintentionally by Contractor's labours whether in or beyond the limits of the work site including any damages caused by the spreading of Fire mentioned in Cl ause 18 shall be estimated by the Addl. city Engineer or such other officer as the VMC may appoint and the estimates of the VMC shall be final and the Contractor shall have 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 Engineer-in-charge from any sums that may be due to or become due from the VMC to the Contractor under this Contract or otherwise. The Contractor shall bear the expenses of defending any action or other legal proceedings that may be brought by any person for injury sustained by him owing to neglect of precautions to prevent the spread of Fire and shall be also pay any damage and cost that may be the court in consequence. However, in any case VMC cannot be suit under any circumstances.
26. The Engineer will issue a stoppage/extension of time upon taking approval as per VMC Delegation of Power Order for the extended duration.
27. The approval for access-saving and extra items shall be obtained from competent authority according to Delegation of Power order of VMC.



28. TERMINATION/DETERMINATION OF THE CONTRACT

In any case, under any Clause/s of this tender, the contractor has rendered itself liable to pay compensation if a breach of any of the terms, conditions, specifications, etc. The VMC shall have power

If work is found unsatisfactory, VMC shall terminate the contract after giving notice period of 15 days and in this case decision of competent authority, for forfeiture of SD / EMD / Performance guarantee etc and debarring / blacklisting the agency shall be binding to the contractor.

This activity is under essential service, so contractor is not allowed to stop this work at any point of time.

Notwithstanding, if contractor stop / leave the work by his own discretion SD / EMD / Performance guarantee, Amount pending in running bill etc. shall be forfeited and additional expenditure for execution of remaining work shall be recovered through, if be needed, legal proceeding and Agency shall be debarred / blacklisted subject to approval of competent authority.

To terminate the contract of which a notice in writing to the Contractor by the VMC shall be conclusive and binding in which case the security deposit /Performance guarantee of the contractor shall stand forfeited, at the absolute disposal of the SMC.

To take such part of the work as shall be un-executed and to give it to another/other contractor to complete, in which case the expenses incurred, if any, in excess of the sum which would have been paid to the original contractor, if the whole work had been executed by him (the certificate of VMC for the excess amount shall be final and conclusive) shall be borne and paid by the original contractor and may be deducted from any money due to him by the VMC under the contract or otherwise or from the security deposit or the proceeds of sale thereof, or a sufficient part thereof.

In the event of any of the above courses being adopted by the VMC, the Contractor shall have no claim for compensation for any loss sustained by him by the reason of having purchased or procured any materials, or entered into any engagements, or made any advances on account of, or with a view to the execution of the work or the performance of the contract. And in case the contract shall be terminated under the provisions aforesaid, the contractor shall not be entitled to recover or be paid any sum for any work thereof or actually performed under this contract, unless and until VMC certifies in writing the performance of such work and the value payable in respect thereof, and the contractor shall only be entitled to be paid the value as certified by the VMC.

29. SAFETY

29.1 GENERAL



The Contractor shall be solely responsible for ensuring safety, health and welfare of all persons employed by him or his sub-contractors during entire contract period.

The Contractor shall comply with all applicable **Central Government, Government of Gujarat Acts, Rules, Regulations, Municipal By-laws, BIS Codes and statutory provisions** in force from time to time.

The Contractor shall take all necessary precautions to prevent accidents, injury to persons, damage to property and obstruction to municipal services and public movement.

29.2 STATUTORY ACTS, RULES & CODES

The Contractor shall strictly comply with the latest provisions of:

- a) **Electricity Act, 2003**
- b) **Indian Electricity Rules, 1956**
- c) **CEA Safety Regulations, 2011**
- d) **Factories Act, 1948** and Gujarat Factory Rules (where applicable)
- e) **Bureau of Indian Standards (BIS)** including:

- IS 5216 (Part 1 & 2) – Safety Practices in Electrical Works
- IS 3696 (Part I & II) – Safety for Scaffolding and Ladders
- IS 3016 – Safety for Welding and Cutting
- IS 10386 – Safety Code for Construction & Plant Machinery

- f) **CPHEEO Manual on Water Supply and Treatment**
- g) **Government of Gujarat – UD&UHD guidelines**
- h) **Vadodara Municipal Corporation specifications**
- i) Any other statutory requirements applicable to water supply works.

29.3 SAFETY MANAGEMENT & SUPERVISION

The Contractor shall deploy a **competent Safety Supervisor** throughout the contract period.

Only **trained, qualified and licensed personnel** shall be engaged for electrical and mechanical works.

Safety induction training shall be conducted for all workers before commencement of work and records shall be maintained.

29.4 PERSONAL PROTECTIVE EQUIPMENT (PPE)

The Contractor shall provide and enforce compulsory use of:

- Safety helmets
- Safety shoes
- Electrical / mechanical hand gloves
- Eye and face protection
- Reflective jackets



- Full body safety harness for ESR / reservoir work
- Respiratory masks for chlorination and confined spaces
- Arc-flash PPE for electrical works, wherever required

Non-use of PPE shall be treated as a serious violation.

29.5 ELECTRICAL SAFETY

All electrical installations at pumping stations, WTP and reservoirs shall comply with Indian Electricity Rules and CEA Regulations.

No live electrical work shall be permitted. Proper **Lock-Out / Tag-Out (LOTO)** procedures shall be followed.

All pumps, motors, panels and control systems shall be properly earthed and protected with **ELCB / RCCB**.

Rubber insulating mats, danger boards and barricading shall be provided near panels and switchgear.

Only licensed electricians shall work on electrical installations.

29.6 CIVIL & STRUCTURAL SAFETY

All excavations shall be properly **barricaded, shored and illuminated**.

Scaffolding and formwork shall conform to BIS standards and be regularly inspected.

29.7 PUBLIC SAFETY & TRAFFIC MANAGEMENT

As works are carried out within municipal limits, the Contractor shall ensure:

- Proper barricading of trenches and work areas
- Display of caution boards and warning lights
- Safe pedestrian and vehicular movement

Trenches across roads and footpaths shall be properly restored immediately after work to the satisfaction of VMC.

29.8 HOUSEKEEPING & SITE CONDITIONS

The site shall be maintained in a clean and hygienic condition at all times.

Safety sign boards shall be displayed in **Gujarati, Hindi and English**.

29.9 FIRE SAFETY & EMERGENCY MEASURES

Adequate fire extinguishers shall be provided at pumping stations, electrical rooms and chemical storage areas.

First-aid boxes and trained first-aiders shall be available at site.



Emergency contact numbers of VMC officials, hospitals and fire brigade shall be displayed.

29.10 ACCIDENT REPORTING & INSURANCE

The Contractor shall maintain accident registers and safety records.

The Contractor shall obtain and maintain valid:

- Workmen Compensation Insurance
- Third Party Liability Insurance
- Any other insurance as per tender condition

29.11 PENALTY FOR NON-COMPLIANCE

The Engineer-in-Charge, VMC may impose penalties for safety violations.

Repeated violations may result in suspension or termination of contract at Contractor's risk and cost.

29.12 RESPONSIBILITY & INDEMNITY

The Contractor shall be solely responsible for safety of workmen, VMC staff and the general public.

The Contractor shall indemnify against all claims, losses, damages or legal proceedings arising due to accidents, safety lapses.



SECTION - 4
CONTRACT DATA



#CONTRACT DATA

Item marked "N/A" do not apply to this Contract.

Clause Reference With respect To section 3

1. The Employers is [CL.1.1]
Name: THE EXECUTIVE ENGINEER
Address: 2nd floor, room no.-210,
Vadodara Municipal Corporation,
Khanderao Market Building,
Rajmahal Road,
Vadodara-390001
Name of authorized Representative (will be intimated later)
2. The Engineer is The Executive Engineer, Water Works Project, Vadodara Municipal Corporation.
Name of Authorized Representative: The Executive Engineer, Water Works Project, Vadodara Municipal Corporation, Vadodara.
3. The Defect Liability Period is 36 Months for all work from the date of Completion of work. [CL.1.1&33]
4. The Start Date shall be **7th** days for the date of issue of the Notice to proceed with the work. [CL.1.1]
5. The Intended Completion Date for the whole of the works is
09 Months excluding 1 monsoon and including trial run period [CL.1.1,17&2]
Milestone dates:
Physical works to be completed Period from the start date
Milestone 1 i.e. 25 %.....-- Month
Milestone 2 i.e. 50 %..... 6 Month [CL.2.2& 49.1]
Milestone 3 i.e. 75.%..... 8 Month
Milestone 4 i.e. 100%..... 9 Month
6. The Site is located at Across Vadodara city and Outside city area. [CL.1.1]
7. The name and identification number of the Contract is: [CL.1.1]
The works consist of Rs. 12,47,89,762/- with items as per B.O.Q.
8. The works shall, inter alia, include the following, as Specified or as directed: [CL.1.1]

9. Scope of work

Please refer section 5 of the same document

(C) Other Items [CL.1.1]

Any Other Items as required to fulfill all contractual obligations as per the Bid documents.



10. The following documents also form part of the Contract: [CL.2.3(9)]
As per clause 2-3
11. The law which applies to the Contract is the law of Union of India [CL.3.1]
12. The language of the Contract documents is English [CL.3.1]
13. Limit of subcontracting 25% of the Initial Contract Price [CL.7.1]
14. The Schedule of Other Contractors [CL.8]
15. The Schedule of Key PersonnelAs per Annex – II to Section I [CL.9]
16.
 - The minimum insurance cover for physical property, injury and death is [CL.13] Rs. 5 lakhs per occurrence with the number of occurrences limited to four. After each occurrence, the contractor will pay an additional premium necessary to make insurance valid for four occurrences always.
 - Contractor has to submit CAR policy for the project.
 - Hon. Supreme Court/High Court guideline as well as implementation of manual Scavenging Act & Rules (2013 including latest amendment) must be strictly followed by bidder for Drainage work for better safety workmen. all Work must be carried out by using safety equipment and by mechanical equipment by the bidder.
 - The Bidder will be responsible to pay minimum Rs.30Lakhs in addition to the compensation paid by the Government in case of Death of Workman while execution of the work.
17. Site Investigation report: VMC did not have any data readily available. Same shall be assessed by bidder before bidding. [CL.14]
18. The Site Possession dates shall be [CL.21]
19. The period for submission of programme for approval of the engineer shall be [CL. 27.1] 21 days from the issue of Letter of Acceptance.
20. The period between program updates will be days. [CL.27.3]
21. The amount to be withheld for late submission of an updated programme shall [CL. 27.3] be Rs 0.50 lakhs



22. The following events shall also be Compensation Events [CL. 44]

Substantially adverse ground conditions encountered during the course of execution of work not provided for in the bidding document.

- (i) Removal of underground utilities detected subsequently
- (ii) Significant changes in classification of soil requiring additional mobilization by the contractor, e.g. ordinary soil to rock excavation,
- (iii) Removal of unsuitable material like marsh, debris dumps, etc. not caused by the contractor.
- (iv) Artesian conditions
- (v) Seepage, erosion landslide
- (vi) River training requiring protection of permanent work
- (vii) Presence of historical, archeological or religious structures, monuments interfering with the works
- (viii) Restriction of access to ground imposed by civil, judicial, or military authority

23. The currency of the Contract is Indian Rupees [CL. 46]

24. **The formula (e) for adjustment of prices are as under:** [CL.47]

- If any of the commodities like Cement, Steel or Bitumen are not found applicable in a work, the weight component of that commodities {i.e. 'Cement' (Pc), 'Steel' (Ps) or 'Bitumen' (Pb) as indicated in SBD for the purpose of Price Adjustment} shall be clubbed with the weight component of 'Other Material' (Pm), such that the gross % weight of the components shall remain as 100%.
- The contractor shall maintain original purchase invoice and consumption register of materials.

R = value of work as defined in Clause 47.1 of Conditions of Contract

Adjustment for labour component

- (i) Price adjustment for increase or decrease in the cost due to labour shall be paid in accordance with the following formula:

$$VL = 0.85 \times (PI/100) \times R \times (Li - L0)/L0$$

VL = Increase or decrease in the cost of work during the month under consideration due to changes in rates for local labour

L0 = The consumer price index for industrial workers for the State on 28 days preceding the scheduled date of opening of technical Bids as published by Labour Bureau, Ministry of Labour, Government of India

Li = The consumer price index for industrial workers for the State for the month under consideration as published by the Labour Bureau, Ministry of Labour, Government of India.

PI = Percentage of labor component of the work.

Adjustment for cement component.

- (ii) Prices adjustment for increase or decrease in the cost of cement procured by the contractor

$$Vc = 0.85 \times (Pc/100) \times R \times (Ci - C0)/C0$$

Vc = Increase or decrease in the cost of work during the month under consideration due to changes in rates for cement.

C0 = The all India wholesale price index for Ordinary Portland Cement on 28 days preceding the scheduled date of opening of technical bid as published by the **Office of the Economic Adviser,**

Department for Promotion of Industry and Internal Trade,
Ministry of Commerce & Industry.

Ci = The all India average wholesale price index for Ordinary Portland Cement for the month under consideration as published by **Office of the Economic Adviser, Department for Promotion of Industry and Internal Trade, Ministry of Commerce & Industry.**

Pc = Percentage of cement component of the work

Adjustment for steel component

- (iii) Price adjustment for increase or decrease in the cost of steel procured by the contractor shall be paid in accordance with the following formula

$$Vs = 0.85 \times (Ps/100) \times R \times (Si - S0)/S0$$



V_s = Increase or decrease in the cost of work during the month under consideration due to changes in the rates for steel

S_o = The all India wholesale price index for steel (**Mild Steel - Long Products Rebars**) on 28 days preceding the date of opening of Bids as published by the **Office of the Economic Adviser, Department for Promotion of Industry and Internal Trade, Ministry of Commerce & Industry**.

S_i = The all India average wholesale price index for steel (**Mild Steel - Long Products Rebars**) for the month under consideration as published by **Office of the Economic Adviser, Department for Promotion of Industry and Internal Trade, Ministry of Commerce & Industry**.

P_s = Percentage of steel component of the work

Note : For the application of this clause, the index of **Mild Steel- Long products Rebars** has been chosen to represent the steel group.

Adjustments of bitumen component

- (iv) Price adjustment for increase in the cost of bitumen shall be paid in accordance with the following formula

$$V_b = 0.85 \times (P_b/100) \times R \times (B_i - B_0)/B_0$$

V_b = Increase or decrease in the cost of work during the month under consideration due to changes in rates for bitumen.

B_0 = The official retail price of bitumen at the IOC depot at the nearest centre on the day 28 days prior to the scheduled date of opening of technical bid.

B_i = The official retail price of bitumen of IOC depot at the nearest centre for the 15th day of the month under consideration.

P_b = Percentage of bitumen component of the work

Adjustment of POL (fuel and lubricant) component

- (v) Price adjustment for increase or decrease in cost of POL (fuel and lubricant) shall be paid in accordance with the following formula

$$V_f = 0.85 \times (P_f/100) \times R \times (F_i - F_0)/F_0$$

V_f = Increase or decrease in the cost of work during the month under consideration due to changes in rates for fuel and lubricants.

F_0 = The official retail price of High Speed Diesel (HSD) at the existing consumer pumps of IOC at the nearest centre on the day 28 prior to the date of opening of

Bids

F_i = The official retail price of HSD at the existing consumer pumps of IOC at the nearest centre for the 15th day of the month of the under consideration.

P_f = Percentage of fuel and lubricants component of the work

Note: For the application of this clause, the price of High-Speed diesel Oil has been chosen to represent the fuel and lubricants group.

Adjustment for Construction Machinery

- (vi) Price adjustment for increase or decrease in the cost of plant and Machinery spare procured by the Contractor shall be paid in accordance with the following formula

$$V_p = 0.85 \times (P_p/100) \times R \times (P_i - P_0)/P_0$$

V_p = Increase or decrease in the cost of work during the month under consideration due to changes in rates for plant and machinery spares

P_0 = The all India wholesale price index for **manufacturer of machinery for mining, quarrying and Construction** for the month under consideration as published **Office of the Economic Adviser, Department for Promotion of Industry and Internal Trade, Ministry of Commerce & Industry.**

P_i = The all India average wholesale price index for **manufacturer of machinery for mining, quarrying and Construction** for the month under consideration as published **Office of the Economic Adviser, Department for Promotion of Industry and Internal Trade, Ministry of Commerce & Industry.**

P_p = Percentage of plant and machinery spares component of the work.

Note: For the application of this clause, index of Heavy Machinery and parts has been chosen to represent the Plant and Machinery Spares group

Adjustment of other materials Component

- (vii) Price adjustment for increase or decrease in cost of local materials other than cement, steel, bitumen and POL procured by the contractor shall be paid in accordance with the following formula

$$V_m = 0.85 \times (P_m/100) \times R \times (M_i - M_0)/M_0$$

V_m = Increase or decrease in the cost of work during the month under consideration due to change in rates for local materials other than cement, steel, bitumen and POL.

M_0 = The All Indian wholesale price index (all commodities) on 28 days preceding



the scheduled date of opening of technical Bids, as published by the **Office of the Economic Adviser, Department for Promotion of Industry and Internal Trade, Ministry of Commerce & Industry.**

Mi= The All India wholesale price index (all commodities) for the month under consideration as published by the **Office of the Economic Adviser, Department for Promotion of Industry and Internal Trade, Ministry of Commerce & Industry.**

Pm = Percentage of local material components (other than cement, steel, bitumen and POL) of the work.

The following percentage will govern the price adjustment for the entire contract

For ESR, GSR, Transformer Room, HT Panel room:

1. Labour –Pl	26 %
2. Cement – Pc	14 %
3. Steel - Ps	20 %
4. Bitumen - Pb	0 %
5. POL – Pf	30 %
6. Plant & Machinery Spares P	0 %
7. Other Materials Pm	10 %
Total	100 %

The following percentage will govern the price adjustment for the entire contract

For PIPE LINE:

1. Labour –Pl	0 %
2. Cement – Pc	0 %
3. Steel - Ps	0 %
4. Bitumen - Pb	0 %
5. POL – Pf	0 %
6. Plant & Machinery Spares P	35 %
7. Other Materials(HR COIL & PIG IRON)Pm	65 %
Total	100 %

25. The proportion of payments retained (retention money) shall be 6% {CL. 48} from each bill subject to a maximum of 5% of final contract price.
26. Amount of Liquidated damages for For Whole of work {CL.49} delay in completion of works(1/2000)th of the Initial contract

price, rounded off to the nearest Thousand, per day. For sectional Completion (wherever specified In item 6 of Contract data) (1/2000)th of initial contract price for #5 km Section, rounded off to the nearest thousand per day.



27. Maximum limit of liquidated damages 10 percent of the Initial {CL. 49}
For delay in completion work Contract Price rounded off to the nearest thousand
28. Amount of Bonus for early completion Amount of bonus for early completion of work shall be given as per CL.50 of Section-3
29. Maximum limit of bonus for early **5 percent** of the Contract {CL. 50} Completion of work Price
30. The amount of the advance payment are: {CL. 51 & 52}

#Nature of Advances Amount (Rs.) Conditions to Be fulfilled

I. Mobilization 5% of the contract On submission of unconditional Price Bank Guarantee. (to be drawn before the end of 20% of the contract period). The contractor may furnish four bank guarantees of 2.5 % of each valid for the full period.

ii Equipment 90% for new and 50% of depreciated value for old equipment. Total amount will be subject to a maximum of 5% of the Contract Price After equipment is brought to site (provided the Engineer is satisfied That the equipment is required for performance of the contract) and on submission of unconditional Bank Guarantee for amount of advance

iii Secured **Deleted**

Advance for Non-persish able material Brought to site

(The advance payment will be paid to the Contractor no later than 28 days after fulfillment of the above conditions).

31. **Repayment of advance payment for mobilization and equipment** {CL. 51.3}

The advance loan shall be repaid with percentage deduction from the interim payments certified by the Engineer under the Contract. Deduction shall commence in the next Interim Payment Certificate following that in which the total of all such payments to the Contractor has reached not less than 20 percent of the Contract Price or 6 (six) months from the date of payment of first installment of advance, whichever period concludes earlier, and shall be made at the rate of 20 percent **(collectively for both Mobilization Advance and Equipment Advance)** of the amounts of all Interim Payment Certificate until such time as the loan has been repaid, always provided that the loan shall be completely repaid prior to the expiry of the original time for completion pursuant to Clause 17 and 28.

32. Deleted

33. The securities shall be for the following minimum amounts equivalent {CL. 52} As a



percentage of the Contract Price:

Performance Security for 5 percent of contract price plus Rs. (to be decided after evaluation of the bid) as additional security in terms of ITB Clause 29.5

The standard form of Performance security acceptable to the Employer shall be an unconditional Bank Guarantee of the type as presented in Section 8 of the Bidding Documents.

34. The Schedule of Operating and maintenance Manuals.....N/A. {CL. 58}
35. The date by which “as- built” drawings (in scale as directed) in 2 sets {CL. 58} are required within 28 days of the issue of certificate of completion of the whole or section of the work, as the case may be.
36. The amount to be withheld for failing to supply “as built” drawings {CL. 58} by the Date required is Rs. 1,00,000/- (One Lakh).
37. The following events shall also be fundamentals breach of contract: {CL.59.2} “The Contractor has contravened Sub- clause 7.1 and Clause 9 of GCC”
38. The percentage to apply the value of the work not completed representing {Cl 60} the Employer’s additional cost for completing the Works shall be 20 per cent.



SECTION - 5

TECHNICAL SPECIFICATIONS



TABLE OF CONTENTS

Sr. No.	Description
1	Scope of Work
2	Project Information
3	Technical Specification of 11KV Switchgear Panel
4	Technical Specification of HT XLPE Cable
5	Deleted
6	Technical Specification of Metal Enclosed Switchboard (LT Panel)
7	Capacitor and capacitor banks
8	Technical Specification of LT Cables
9	Technical Specification of Earthing
10	Safety Equipment
11	Technical Specification of Internal Wiring
12	Technical Specification of Lighting Fixture
13	Installation, Testing and Commissioning – Electrical Equipment
14	Technical Specification of Solar System
15	HT 2 Pole structure
16	Material Handling system (EOT/Electric Hoist etc.)
17	Expansion Bellow
18	Civil work Specifications
19	Approved vendor list

1. SCOPE OF WORK:

- 1.1. The scope of services covers the design, detailed engineering, preparation of construction drawing, manufacture, acceptance testing at manufacturer's works or at any accredited agency, supply, packing, forwarding and delivery from manufacturer's works/ place of storage to erection site including transit insurance, unloading, storage at site, moving from place of storage to place of installation, assembly, Cleaning/ lubricating, Touch up painting, erection, testing, commissioning & performance demonstration and handing over along with all necessary spares of original ratings & specifications on Design, Build and O&M as per tender (including a year of defect liability period). Inland and overseas transit insurance, transport, testing at site shall be Contractor's scope. Tender BOQ and drawings, if provided, are for reference purpose only which is the minimum requirements; Contractor shall ensure that design & equipment ratings shall be as per specification requirements.
- 1.2. The Contractor shall prepare design calculations based on parameters/ design criteria indicated in the specifications. The Contractor shall prepare detailed engineering and construction purpose drawings to make his/ her own estimate of ratings & quantities (minimum requirements as per price schedule, technical data sheets, reference electrical Single Line Diagram (SLD) & other relevant details) for entire electrical & instrumentation systems including all items, systems such as equipments, power & control cables/ cabling system, illumination system, earthing, lightning protection, main & auxiliary power distribution, instruments, civil works required for completion of Works.
- 1.3. Contractor shall take due care of the site Seismic conditions while design of all equipments/ components used in entire electrical & instrumentation systems covered in this specification. Contractor shall furnish list of additional design parameters considered in design to fulfill above requirement.
- 1.4. Design and detailed engineering of the materials procured by Contractor is included in scope. Contractor shall submit each document/ calculation of system which is included in scope to Purchaser/ Consultant for final review/ approval. All design documents/ calculations prepared by Contractor shall be with ISO documentation i.e. with duly signed by qualified authorities and stamped. Design documents/ calculations prepared by sub-Contractors shall be approved by Contractor and stamped copy of approval along with no-deviation sheet from sub-contractor shall be submitted by the Contractor to Purchaser/ Purchaser's representative for final review/ approval.
- 1.5. Expert or manufacturer supervision for sub-contractor supplied material shall be provided by Contractor and included in offer.



- 1.6. Contractor shall be solely responsible for any shortages or damages in transit for his supply scope, handling and/ or in storage of any materials and erection of the equipment, supply of erection tools at site. Contractor shall ensure that it will not affect any activity or project schedule. Any demurrage, wharf age and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.
- 1.7. Contractor shall identify activities and mile stones of the work forecasted for next month with optimistic and pessimistic dates of work completion. Contractor shall prepare program evaluation and review techniques to identify critical path of project and activity sequences. The project schedule shall be prepared and updated fortnightly in MS Project.
- 1.8. Nothing in this specification shall be constructed to relieve the Contractor of his/ her responsibilities towards following best engineering practices established in the country.
- 1.9. Obtaining approval including load sanction/ release from Gujarat Energy Transmission Corporation (GETCO)/ Madhya Gujarat Vij Company Ltd. (MGVCL)/Gujarat Electricity Board (GEB), No Objection Certificates from GETCO/ MGVCL /GEB, Electrical Inspector (CEIG), relevant Government Agencies, Statutory Authorities, as applicable is included in Contractor's scope.
- 1.10. All necessary legal fees required for various applications to GETCO/ MGVCL /GEB/ Electrical Inspector (CEIG), GPCB, relevant Government Agencies, Statutory Authorities shall be paid by the Purchaser upon production of valid receipts. The GETCO/ MGVCL /GEB deposit required to be paid for Load Release shall also be borne by the Purchaser.
- 1.11. The Contractor's scope shall also include measurement of soil resistivity at site by Wenner's four electrode method as per IS: 3043 – 1987(Reaffirmed in 2006) at minimum four locations at site (for individual pumping station). The earthing system shall be designed for the actual mean soil resistivity value obtained.
- 1.12. Even if all components of a system included in this specification are not explicitly identified and/ or listed herein, these shall be supplied under this contract to ensure completeness of the system and facilitate proper operation and easy maintenance of the plant. Any and all other works not indicated above but necessary/ required to complete the job in all aspects, are included in the Contractor's scope.
- 1.13. The Contractor shall include start up spares, essential spares, recommended spares and a set of special tools necessary for operation, routine maintenance of equipment supplied for a period of five years.
- 1.14. Whether specifically called for or not, all accessories required for normal and satisfactory operation (as deemed by the Purchaser) of the equipment shall be considered to be a part of the Contractor's basic scope of supply and/ or work and no claims whatsoever, for extra payment on these grounds, will be accepted.



- 1.15. Contractor should visit site and get himself/ herself ascertained regarding the scope of work for the complete Electrical & Instrumentation works before submission of quote/ offer.
- 1.16. Contractor's scope shall include design, engineering, manufacture, supply, testing, commissioning and handover of following electrical equipments/ systems as per tender specifications, BOQ and reference electrical SLD & other relevant details. Voltage level for supply shall need to be confirmed with GETCO/MGVCL/GEB by Contractor before the commencement of design.
- 1.17. Tariff metering equipment & electric supply connection shall be provided by GETCO/MGVCL /GEB for which necessary liaison shall be done by Contractor. Any augmentation in the incoming side owned by MGVCL, due to increase of electrical demand shall be solely owned by VMC. Any supporting documents like test reports, inspection report etc, restricted to the pumping station, required for the augmentation work, shall be provided by the contractor.
- 1.18. Healthiness of existing transformers and panels shall be checked and if reused, after client's approval, must conform to calculations provided by successful vendor. Revamping of the same shall be in contractor's scope.
- 1.19. LV metal enclosed switchgears including Power and Motor Control Centre (PMCC) including starter feeders, equipments (as per technical specification requirements and approved SLD during detailed engineering), PDBs, Sub DBs, Lighting DBs, Receptacles for utilities.
- 1.20. Cabling system shall consists of various earthed grade HV and 1.1 kV grade, XLPE/ PVC insulated, multi-stranded Al/ Cu, GI round wire/ flat strip armoured power, control & instrumentation cables, GI ladder/ perforated type Cable Trays & associated accessories including support structures.
- 1.21. Inspecting the healthiness of existing cables and taking approval from client before reusing or discarding the same, after preparation of detailed power cable schedule, shall be in the scope of contractor. If found unsuitable for re-use, new cable shall be considered. Additional charge for the same shall comply to latest GWSSB SOR/ approved rates per client.
- 1.22. Earthing for HV/ LV equipments and lightning protection system for all buildings in the Pumping works locations. The general design shall be on the basis of IS, IEC and CE regulations and standards (their latest amendments) in line with design criteria & specification requirements.
- 1.23. Lighting system for all indoor & outdoor areas of Water Pumping Station . The lighting system will be controlled by lighting panels installed in respective plant/ station areas, which will be fed from PCC/MCC/PDB.



- 1.24. Submission of drawings & documentation as specified under "General Technical & Particular Requirement" section for Electrical equipment/ systems.
- 1.25. Contractor's scope shall also include all civil works and structural works required for installation of all electrical equipment/ systems such as equipment / DG foundations, indoor & outdoor trenches, equipment support structures, Control rooms, all excavation works including those for earthing, cabling etc, de-tanking area, soak pits, burnt oil pits, chamber etc.
- 1.26. It is not the intent to completely specify all details of design and construction herein. Nevertheless, the Electrical system shall conform to high standard of engineering, design and workmanship in all respects and shall be capable of performing satisfactorily in continuous commercial operation under the specified environmental conditions.
- 1.27. Purchaser reserves the right to issue addendum to the technical specification to indicate modification/ changes in the requirements, if so required at a later date.
- 1.28. Any additional claim done by the contractor shall be in accordance with GWSSB SOR/ Approved rate of VMC.

DETAIL SCOPE OF WORK AS PER INDIVIDUAL SITE (PUMPING STATION)

(A) FAJALPUR PUMPING STATION:

- Modification / Dismantling / Removing / Installation of two pole structures with its allied accessories and necessary civil foundation work as per standard engineering practice and EIC instruction.
- Dismantling, Shifting and Removing of Existing HT / LT Cables and Control/Instrumentation Cables, Cable Trays, Tray supports, earthing, earthing strip, Cable Terminations, its allied accessories and Misc. work as per EIC instruction to complete the job.
- Shifting of Existing cables from cable trench, making/modification/restoration of new cable trench and laying cables in cable trench or cable tray. Cable Scrap/ debris shall be shifting to VMC central store or as per EIC instruction.
- Making of new cable trench / Modification / Breaking of existing cable trench and debris shall be removing from site as per EIC instruction to complete the job.
- SITC of Outdoor type RMU with necessary civil foundation work as per OEM recommendation / site condition.
- SITC of Single Peltier module Dehumidifier in existing HT Panel cubicles with necessary modification. If needed bidder can visit at site to understand the scope of work before bidding the Tender. Required modification in existing HT Panels to complete the job shall be contractor scope.
- SITC of Indoor and Outdoor 11 KV HT Termination kit shall be considered.
- SITC of GI Chain Link Fencing around existing Transformers, Entry Gates, Leveling of Existing Transformer yard using Gravels and Fine sand.
- SITC of LPBS as per BOM and site requirement.



- SITC of Lighting Distribution Board as per BOM and site requirement.
- SITC of LT power and control cables with Cable Terminations at both the ends in cable tray / trench with Cable tray supports and required civil work to complete the job as per site condition and EIC instruction.
- SITC of Chequered Plate as per EIC instruction.
- SITC work of Chemical Earthing with chamber and heavy duty cover, GI/Copper earthing strip as per site suitability and EIC instruction.
- SITC work of internal electrical wiring in existing panel room, pump house as per site requirement and EIC instruction.
- SITC work of External lighting / Area Lighting, Octagonal Pole, foundation work, lighting fixture, cable laying etc. to complete the job.
- Supply & fixing of safety accessories as per BOM.
- Fabrication work of shed over existing DG sets and at Intake well as per site suitability, Tender BOM and Specification. Fabrication design & drawings shall be submitted for approval before installation.
- Supply and Laying of Pavior block as per site suitability and EIC instruction.
- Construction of new Office / Panel room as directed by EIC.
- Painting work on existing panel room & Pump House inside/ outside as per EIC Instruction. All required material shall be in contractor scope.
- SITC work of CCTV for security and 24x7 monitoring with allied equipments as per Tender BOM and directed by EIC.
- SITC work of Solar Roof Top / Ground mounted power plant as per site space availability and Tender specification. Necessary NOC & Liasoning work from concern department/Authority shall be in contractor scope.
- Cable Testing : Physical and Performance Testing of Existing installed HT and LT Cables as per EIC instruction from Government recognized / approved laboratory like ERDA/CPRI and submit cable analysis report / recommendation to EIC.
- Scope includes Disconnect termination of existing cable, Perform IR Test and Line Impedance Resonance Analysis Test and make termination again. Cable sample may be given to Testing agency for Lab testing, If required.
- All other as per BOM and as directed by EIC.

(B) RAIKA PUMPING STATION:

- Modification / Dismantling / Removing / Installation two pole structures with its allied accessories and necessary civil foundation work as per standard engineering practice and EIC instruction.
- Dismantling, Shifting and Removing of Existing HT / LT Cables and Control/Instrumentation Cables, Cable Trays, Tray supports, earthing, earthing strip, Cable Terminations, its allied accessories and Misc. work as per EIC instruction to complete the job.
- Shifting of Existing cables from cable trench, making/modification/restoration of new cable trench and laying cables in cable trench or cable tray. Cable Scrap/ debris shall be shifting to VMC central store or as per EIC instruction.



- Making of new cable trench / Modification / Breaking of existing cable trench and debris shall be removing from site as per EIC instruction to complete the job.
- SITC of Single Peltier module Dehumidifier in existing HT Panel cubicles with necessary modification. If needed bidder can visit at site to understand the scope of work before bidding the Tender. Required modification in existing HT Panels to complete the job shall be contractor scope.
- SITC of GI Chain Link Fencing around existing Transformers, Entry Gates, Leveling of Existing Transformer yard using Gravels and Fine sand.
- SITC of LPBS as per BOM and site requirement.
- SITC of Lighting Distribution Board as per BOM and site requirement.
- SITC of LT power and control cables with Cable Terminations at both the ends in cable tray / trench with Cable tray supports and required civil work to complete the job as per site condition and EIC instruction.
- SITC of Chequered Plate as per EIC instruction.
- SITC work of Chemical Earthing with chamber and heavy duty cover, GI/Copper earthing strip as per site suitability and EIC instruction.
- SITC work of internal electrical wiring in existing panel room, pump house as per site requirement and EIC instruction.
- SITC work of External lighting / Area Lighting, Octagonal Pole, foundation work, lighting fixture, cable laying etc. to complete the job.
- Supply & fixing of safety accessories as per BOM.
- Fabrication work of shed over existing DG sets and at Intake well as per site suitability, Tender BOM and Specification. Fabrication design & drawings shall be submitted for approval before installation.
- Supply and Laying of Pavor block as per site suitability and EIC instruction.
- Painting work on existing panel room & Pump House inside/ outside as per EIC Instruction. All required material shall be in contractor scope.
- SITC work of CCTV for security and 24x7 monitoring with allied equipments as per Tender BOM and directed by EIC.
- SITC work of Solar Roof Top / Ground mounted power plant as per site space availability and Tender specification. Necessary NOC & Liasoning work from concern department/Authority shall be in contractor scope.
- Cable Testing : Physical and Performance Testing of Existing installed HT and LT Cables as per EIC instruction from Government recognized/approved laboratory like ERDA/CPRI and submit cable analysis report / recommendation to EIC.
- Scope includes Disconnect termination of existing cable, Perform IR Test and Line Impedance Resonance Analysis Test and make termination again. Cable sample may be given to Testing agency for Lab testing, If required.
- All other as per BOM and as directed by EIC.

(C) DODKA PUMPING STATION:

- Modification / Dismantling / Removing / Installation of two pole structures with its allied accessories and necessary civil foundation work as per standard engineering practice and EIC instruction.



- Dismantling, Shifting and Removing of Existing HT / LT Cables and Control/Instrumentation Cables, Cable Trays, Tray supports, earthing, earthing strip, Cable Terminations, its allied accessories and Misc. work as per EIC instruction to complete the job.
- Shifting of Existing cables from cable trench, making/modification/restoration of new cable trench and laying cables in cable trench or cable tray. Cable Scrap/ debris shall be shifting to VMC central store or as per EIC instruction.
- Making of new cable trench / Modification / Breaking of existing cable trench and debris shall be removing from site as per EIC instruction to complete the job.
- SITC of Outdoor type RMU with necessary civil foundation work as per OEM recommendation / site condition.
- SITC of 11 KV HT Panel as per tender SLD, BOM and Technical specification.
- SITC work of 11 KV HT cable in cable tray / trench / buried as per site suitability and EIC instruction.
- SITC of Single Peltier module Dehumidifier in existing HT Panel cubicles with necessary modification. If needed bidder can visit at site to understand the scope of work before bidding the Tender. Required modification in existing HT Panels to complete the job shall be contractor scope.
- SITC of Indoor and Outdoor 11 KV HT Termination kit shall be considered.
- SITC of GI Chain Link Fencing around existing Transformers, Entry Gates, Leveling of Existing Transformer yard using Gravels and Fine sand.
- SITC of LT Panel (MCC Panel), PDB, LPBS as per Tender SLD, BOM & Tender Specification.
- SITC of Lighting Distribution Board as per BOM and site requirement.
- SITC of LT power and control cables with Cable Terminations at both the ends in cable tray / trench with Cable tray supports and required civil work to complete the job as per site condition and EIC instruction.
- SITC of Chequered Plate as per EIC instruction.
- SITC work of Chemical Earthing with chamber and heavy duty cover, GI/Copper earthing strip as per site suitability and EIC instruction.
- SITC work of internal electrical wiring in existing panel room, pump house as per site requirement and EIC instruction.
- SITC work of External lighting / Area Lighting, Octagonal Pole, foundation work, lighting fixture, cable laying etc. to complete the job.
- Supply & fixing of safety accessories as per BOM.
- Fabrication work of shed over existing DG sets and at Intake well as per site suitability, Tender BOM and Specification. Fabrication design & drawings shall be submitted for approval before installation.
- Supply and Laying of Pavor block as per site suitability and EIC instruction.
- Construction of new Office / Panel room as directed by EIC.
- Painting work on existing panel room & Pump House inside/ outside as per EIC Instruction. All required material shall be in contractor scope.
- SITC work of CCTV for security and 24x7 monitoring with allied equipments as per Tender BOM and directed by EIC.



- SITC work of Solar Roof Top / Ground mounted power plant as per site space availability and Tender specification. Necessary NOC & Liasoning work from concern department/Authority shall be in contractor scope.
- Cable Testing : Physical and Performance Testing of Existing installed HT and LT Cables as per EIC instruction from Government recognized / approved laboratory like ERDA/CPRI and submit cable analysis report / recommendation to EIC.
- Scope includes Disconnect termination of existing cable, Perform IR Test and Line Impedance Resonance Analysis Test and make termination again. Cable sample may be given to Testing agency for Lab testing, If required.
- All other as per BOM and as directed by EIC.

(D) POICHA PUMPING STATION:

- Modification / Dismantling / Removing / Installation of two pole structures with its allied accessories and necessary civil foundation work as per standard engineering practice and EIC instruction.
- Dismantling, Shifting and Removing of Existing HT / LT Cables and Control/Instrumentation Cables, Cable Trays, Tray supports, earthing, earthing strip, Cable Terminations, its allied accessories and Misc. work as per EIC instruction to complete the job.
- Shifting of Existing cables from cable trench, making/modification/restoration of new cable trench and laying cables in cable trench or cable tray. Cable Scrap/ debris shall be shifting to VMC central store or as per EIC instruction.
- Making of new cable trench / Modification / Breaking of existing cable trench and debris shall be removing from site as per EIC instruction to complete the job.
- SITC of Outdoor type RMU with necessary civil foundation work as per OEM recommendation / site condition.
- SITC work of 11 KV HT cable in cable tray / trench / buried as per site suitability and EIC instruction.
- SITC of Single Peltier module Dehumidifier in existing HT Panel cubicles with necessary modification. If needed bidder can visit at site to understand the scope of work before bidding the Tender. Required modification in existing HT Panels to complete the job shall be contractor scope.
- SITC of Indoor and Outdoor 11 KV HT Termination kit shall be considered.
- SITC of GI Chain Link Fencing around existing Transformers, Entry Gates, Leveling of Existing Transformer yard using Gravels and Fine sand.
- SITC of Lighting Distribution Board, PDB & LPBS as per BOM and site requirement.
- SITC of LT power and control cables with Cable Terminations at both the ends in cable tray / trench with Cable tray supports and required civil work to complete the job as per site condition and EIC instruction.
- SITC of Chequered Plate as per EIC instruction.
- SITC work of Chemical Earthing with chamber and heavy duty cover, GI/Copper earthing strip as per site suitability and EIC instruction.
- SITC work of internal electrical wiring in existing panel room, pump house as per site requirement and EIC instruction.



- SITC work of External lighting / Area Lighting, Octagonal Pole, foundation work, lighting fixture, cable laying etc. to complete the job.
- Supply & fixing of safety accessories as per BOM.
- Fabrication work of shed over existing DG sets and at Intake well as per site suitability, Tender BOM and Specification. Fabrication design & drawings shall be submitted for approval before installation.
- Supply and Laying of Pavor block as per site suitability and EIC instruction.
- Painting work on existing panel room & Pump House inside/ outside as per EIC Instruction. All required material shall be in contractor scope.
- Liasoning of Existing meter shifting to new location as per EIC instruction.
- SITC work of CCTV for security and 24x7 monitoring with allied equipments as per Tender BOM and directed by EIC.
- SITC work of Solar Roof Top / Ground mounted power plant as per site space availability and Tender specification. Necessary NOC & Liasoning work from concern department/Authority shall be in contractor scope.
- Cable Testing : Physical and Performance Testing of Existing installed HT and LT Cables as per EIC instruction from Government recognized / approved laboratory like ERDA/CPRI and submit cable analysis report / recommendation to EIC.
- Scope includes Disconnect termination of existing cable, Perform IR Test and Line Impedance Resonance Analysis Test and make termination again. Cable sample may be given to testing agency for Lab testing, if required.
- All other as per BOM and as directed by EIC.

(E) OTHER WORK:

- SITC of 3 KVA UPS at various sources as per site requirement & as directed by EIC.
- SITC of 12 V 65 AH Battery at various sources as per site requirement & as directed by EIC.
- Supply & fixing of Enclosure for UPS & Battery with 3 KVA CVT, SPD and 3 Ph to 1 Ph Auto selector.
- Supply and fixing of Split Air conditioning units with required accessories at different location as directed by EIC.

2. PROJECT INFORMATION:

2.1. SITE/ ENVIRONMENTAL CONDITIONS:

2.1.1. Ambient temperature : 50°C

2.1.2. Relative Humidity : 5 - 95%

2.1.3. Area Classification :Non Hazardous

2.2. NOMINAL SYSTEM VOLTAGE:

2.2.1. Incoming supply : 11 KV, 3 ph, 3 wire, 50 Hz AC (to be confirmed with MGVCL/GEB by Contractor)



- 2.2.2. Plant power distribution supply: 415V, 3 ph, 4 wire, 50 Hz, AC
- 2.2.3. General lighting & space heating: 240V, 1 ph, 2 wire, 50Hz, AC
- 2.2.4. Control & protection & emergency lighting: 24 V or 30 V or 110V, 2 wire DC (as applicable) for HT switchgear; 240V AC for LT equipment.
- 2.2.5. Potential transformer secondary: 110 V, 3 ph, 50 Hz, AC
- 2.2.6. Voltage variation:
 - a. 11 kV supply : $\pm 10\%$
 - b. 415 V supply : $\pm 10\%$
- 2.2.7. Frequency variation : $\pm 5\%$
- 2.2.8. Combined voltage and frequency variation : $\pm 10\%$

2.3. SYSTEM EARTHING:

- 2.3.1. 11 kV, 3 ph AC system : Neutral solidly earthed
- 2.3.2. 415 V, 3 ph, AC system : Neutral solidly earthed
- 2.3.3. 240 V, 1 ph, AC system : Neutral solidly earthed

3.0 11 KV SWITCHGEAR PANEL / VCB PANEL

3.1 Design Criteria

- The Switchgear system shall be capable of continuous operation at specified rating under the design conditions specified here in.
- The switchgears will be located indoor / outdoor area as per BOQ.
- The de-rating of the Complete panel include Bus bar section shall be done taking 50°C as an ambient design temperature if it is designed at lower temperature. The maximum temperature in any part of the equipment at specified rating shall not exceed 85 deg C considering reference ambient temperatures as 50°C.
- Electro-mechanical Interlocking between two incomers shall be considered. Mechanical interlock shall be confirmed with castle key lock.

3.2 Specific Requirements

- The switchgear shall be metal-clad, floor mounted, draw-out type. Enclosure shall confirm to the degree of protection IP-5X as per IEC 60529.
- The minimum thickness of sheet steel used shall be 2mm CRCA steel & Gland Plate of 3mm thick.

- The switch gear assembly shall comprise a continuous, dead-front, line-up of free standing, vertical cubicles. Each cubicle shall have a front hinged door with latches and a removable back cover. All covers and doors shall be provided with recessed neoprene gaskets. All doors shall have pad locking arrangement. The swing of the door shall be more than 90 degree.
- The design shall be such that failure of one equipment shall not affect the adjacent units.
- Each cubicle shall be separated from adjacent one by grounded sheet steel barrier and bus sealing arrangement.
- The switchgear panel shall be of arc proof version and shall be as per DIN VDE 0670 part 601, IEC-694/IEC-298.
- Bus connection from bus compartment to breaker compartment & breaker compartment to cable compartment and bus compartment to adjacent panels shall be through sealed resin cast bushing assembly.

3.3 Bus and Bus Taps

- Bus bars shall be of uniform cross section throughout the entire length of the switch board and suitable for carrying rated current continuously and short circuit current for specified duration without overheating.
- The main bus bar and connections shall be of high conductivity electrolytic grade, Copper/aluminium as per BOM. The current density for sizing purpose of Copper bus bars shall not exceed 1.6 A/mm² and for aluminium bus bar shall not Exide 0.8 A/mm²
- All Bus bars, Jumpers connection shall be fully insulated for working voltage with adequate phase/ground clearances and shall be sleeved with R,Y,B color coded heat shrinkable sleeves. Bus bars, links, live parts, etc. shall have non-flammable Epoxy cast-resin shrouds. All jointing hardware shall have nylon caps.
- No paper/cotton based insulation shall be used anywhere in the switch gear.
- Safety shutter, phase barrier, Bus bar seal-off bushing plate, support insulators etc. shall be non-flammable high tracking fiber glass/epoxy insulation system.
- All buses and connections shall be supported and braced to withstand dynamic electro-magnetic stresses due to maximum short circuit current and also to take care of any thermal expansion.

3.4 Circuit Breaker

- Circuit breaker shall be triple pole, single throw, Vacuum type / SF₆ type as per BOQ, electrically operated (on/off), Draw out type.
- Circuit breaker shall have SERVICE, TEST and DISCONNECTED (ISOLATED) positions with positive indication for each position.
- Circuit breakers of identical rating shall be physically and electrically interchangeable.

- Circuit breaker shall have manual spring charge as well as motor wound charging facility with Mechanical & Electrical anti-pumping features and shunt trip. Motor wound mechanism spring charging shall take place automatically after each breaker closing operation. The motor shall be suitable for operation with voltage variation from 85% to 110% of rated voltage.
- Mechanical safety interlock shall be provided to prevent:
 - a) The circuit breaker from being raked in or out of the service position when the breaker is closed.
 - b) Raking in the circuit breaker unless the control plug is fully engaged.
 - c) Closing & opening of the breaker in an intermediate position between 'service' & 'test' and between 'Test' and 'Disconnected' position.
- Automatic safety shutters shall be provided to fully cover the female primary contacts when the breaker is withdrawn from service position.
- The manual trip device shall be located on the front door & Indicators with shrouds will be visible from front door even when breaker is closed.
- Each breaker shall be provided with following:
 - a) Auxiliary switch with 6 NO + 6 NC contacts, mounted on the draw-out portion of the switchgear.
 - b) Position/cell switch with minimum 3 NO + 1 NC contacts, one each for TEST and SERVICE position.
 - c) Auxiliary switch, with 4 NO + 4 NC contacts, mounted on the stationary portion of the switchgear and operated mechanically by a sliding lever from the breaker in SERVICE position.
 - d) Trip push button, mechanical ON-OFF indication, an operation counter and mechanism charge/discharge indicator.
- Limit/auxiliary switches & shall be convertible type i.e. facility for changing N.O. contact to N.C. and vice-versa. Switch contact shall be rated 10A A.C. and 2A D.C. at operating voltage.
- Each breaker shall be provided with suitable encased rollers.
- The trip coils shall be operated satisfactorily at voltage between 70 % and 110 % of rated control supply voltage.
- Each circuit breaker cubicle shall be provided with an earthing facility. Earthing facilities shall be fully interlocked to prevent faulty operation e.g. earthing of live parts.

3.5 PROTECTION & MEASUREMENT

Protective scheme shall be based on reliability, sensitivity, selectivity.

Protective Scheme Requirement

- All the main protective relays shall be microprocessor based numerical relays.



- Auxiliary relays, timers switches etc. required to make the scheme complete shall be considered as part of the scope of work.
- All CT-PT wires shall be brought to test terminal blocks before connecting to circuits.
- The circuits of various protections shall be connected to master trip relays through aux. relays (flag indicated).
- Aux. relays shall be provided for each transformer fault. Connection of the relay shall be through links to facilitate maintenance.
- Contact arrangement, number of poles/ways in control/selector switches shall be as per the approved drawing /scheme / requirement.
- For control supply distribution, panel to panel separate set of terminal blocks shall be provided. All items/accessories required for above in each panel and in incoming panels shall be provided by the supplier.
- All relays shall be self/hand-reset type with digital/flag indication. NO/NC contacts for relays shall be as per the requirement of approved protection, annunciation & interlock schemes. Wherever required, supplier shall provide aux. relays for contact multiplication.
- Annunciation facia shall be mounted on the switchgear panels and details shall be finalized during drawing approval stage.
- Line PT's shall be provided on all incomers with suitable 110V DC secondary two winding transformer.

Incomer of H.T. Breaker shall be with following as a minimum.

Sr. No.	Relay	Indicating and Monitoring	Meter
1	PT fuse failure relay	Breaker On	Ammeter
2	Trip circuit supervision relay	Breaker Off	Voltmeter
3	IDMT & Instantaneous O/C relay	Breaker trip	MFM (Min. Three line display) with Modbus Port
4	IDMT & Instantaneous E/F relay	Spring charge	P.F.
5	Under voltage relay with timer	Service position	
6	Over voltage relay	Trip circuit healthy	
7	Anti-pumping relay	Phase indication	
8	Master trip relay with hand reset contact (2 NO & 2 NC Contact)	8 window Annunciation panel	



Transformer H.T. Breaker shall be with following as a minimum.

Sr. No.	Relay	Indicating and Monitoring	Meter
1	Trip circuit supervision relay	Breaker On	Ammeter
2	IDMT & Instantaneous O/C relay	Breaker Off	MFM (Min. Three line display) with Modbus Port
3	IDMT & Instantaneous E/F relay	Breaker trip	
4	Anti-pumping relay	Spring charge	
5	Master trip relay with hand reset contact	Service position	
6	Lockout relay	Trip circuit healthy	
7	Aux. relay for Buchholz alarm indication & Trip	12 window Annunciation panel	
8	Aux. relay for winding & oil temp. alarm indication & trip		
9	Aux. relay for MOG Alarm indication and PRV trip		
10	Differential relay (For transformer rating 2 MVA & above only)		

Relays & Meters

- MFM (Min. Three line display type) shall be Microprocessor based numerical and communicable type with RS-485 Port. All instantaneous current protection relays shall be of 3 pole type.
- Relays shall be rated for operation on 110V secondary voltage and 1A secondary current. Number and rating of relay contacts shall suit the job requirements.
- All relays shall furnish, install & co-ordinate to suit the protection and interlock requirement of VCB Panel.
- Relay shall be Low burden, provided with RS 485 Computer communication Port for monitoring & operation from Remote location / PLC with suitable Software.

Current Transformer

- Current transformers shall be cast resin type and shall be as per IS/IEC: 60044/1(2003).
- CT's shall have shorting link on secondary side to facilitate insertion of meters on secondary side without opening CT circuits.
- Accuracy class of the Current Transformers shall be:



- a) Class PS for differential & restricted earth fault relaying.
- b) Class 5P10 for other relaying.
- c) Class 0.5 for MFM and other metering, Class 1 for relay and ISF < 5 for metering.
- The current transformer shall be capable of safely withstanding the short circuit stresses corresponding to the fault level as indicated & shall be able to meet the short-time requirement specified.
- All CT secondary shall be earthed through separate switch link on terminal block. CT terminals & their polarities shall be clearly marked.

Voltage Transformer

- Voltage transformer shall be provided in separate cubicle.
- PTs, connection, Insulation levels shall be similar to rating of associated breaker.
- VA burden shall be selected based on requirement for meters, closing, tripping & indicating circuit.
- Voltage Transformer shall be cast-resin, draw-out type and shall have an accuracy class 1.0 / 3P. Voltage Transformer mounted on breaker carriage is not acceptable.
- The PTs shall be of shell type single phase construction with HRC fuses at both ends and plug-in connection on primary side.
- High voltage windings of voltage transformer shall be protected by current limiting fuses. The voltage transformer and fuses shall be completely disconnected and visibly grounded in fully draw-out position.
- Low voltage fuses, sized to prevent overload, shall be installed in all ungrounded secondary leads. Fuses shall be suitably located to permit easy replacement while the switchgear is energized.
- The PTs shall be capable of operating continuously at 110% of the rated voltage, without any damage. When star-star connection is required in non-effectively or under grounded system, the PTs shall be suitable for continuous operation with a persistent phase to ground fault.
- Additional PT shall be considered to generate 230V AC supply for Transformer Marshalling box supply, Internal power pack 230vAc / 110v DC and other Aux Load. Min 1000VA burden shall be considered or as per Tender SLD/BOM. Burden calculation shall be submitted at the time of panel design documents and drawing approval stage.

Indication & Monitoring Instruments

- Control cabinet, mounted on top of breaker cabinet, provided with suitable anti-vibration facilities & one number heavy duty spring return type TRIP-NORMAL-CLOSE control switch with pistol grip lockable handle.
- Indicating lights in front of compartments as a minimum:

Green	:	Breaker Open
Red	:	Breaker Closed
Amber	:	Auto Trip
Blue	:	Trip Circuit Healthy
Yellow	:	Breaker Test Position
Blue	:	Breaker Service Position

- Indicating Lamp shall be 20ø LED type with series resistance with metal body. Lamp and lens shall be replaceable from the front.
- All indicating instruments shall conform to IS: 1248-1983 and IS: 2419-1979, Shall be capable of withstanding system fault current taking account CT saturation, back connected and located in the upper part of the panel.

Meters

- Indicating instruments shall be mini. 96 sq.mm dial flush mounted digital type with accuracy class 0.5/1.0 minimum.
- Digital type Multi-function Meter shall be of Accuracy Class: 0.5S (for Active)-IEC-687 / CBIP-88 and Suitable for measuring and digitally displaying the following parameters: kVA, kW, kWh, kVAr, A, V, P.F., frequency.
- Each meter shall be provided with at least two output signals of 4-20mA and communication port (RS 485) for all the above parameters for monitoring & operation from Remote location / PLC with suitable Software.
- Meter selector switches shall maintain firm contact, stay put type with knob handle. Ammeter selector switches shall be four-position type having make before break contacts to prevent open circuit of CT secondary.

Annunciation

- Shall be static type suitable to work on AC supply as specified. Hooter and bell for trip and alarm indication respectively.
- Test, accept and reset facilities (with push button) shall be provided on each panel.
- Suitable audio-visual indication shall be provided on DC failure. Audio alarm with reset facility shall be provided. Visual indication shall be panel-wise.
- Spare annunciation points shall be wired up to terminal blocks. 20% spare facia shall be provided
- Sequence shall be as follows:

	VISUAL	AUDIO
On Occurring of Fault	Flashing	On
On Accepting	Steady On	Off
On Reset (Fault Cleared)	Off	Off
On Reset (Fault Persists)	Steady On	Off



- Warning and emergency points shall be as per the list approved during detail engineering stage.
- One common point shall be provided to indicate operation of annunciation system of the complete board (in case of any trouble in the board in tie feeder, bus coupler, incomer, etc.). Remote and annunciation facia window detail shall be finalized during detail engineering.
- A common audible alarm for each switchgear line-up shall be provided to alert the operator that circuit breaker has tripped. Means shall be provided for silencing the audible alarm Whilst leaving it free to sound when any other alarm is initiated but the associated alarm indications shall continue until cancelled.

Secondary Wiring

- The switchgear shall be fully wired at the factory to ensure proper functioning of control, protection, transfer and interlocking schemes.
- Fuse and links shall be provided to permit individual circuit isolation from bus wires without disturbing other circuits. All spare contacts of relays, switches and other devices shall be wired up to terminal blocks.
- Wiring shall be done with flexible, 650V grade; FRLS PVC insulated wires with stranded copper conductors of 2.5mm² for control current circuits and voltage circuits. All power wiring like space heater supply, etc. shall be carried out with min. 2.5mm² PVC insulated Copper Conductor wire.
- Each wire shall be identified, at both ends, with dependent & cross addressing permanent markers bearing wire numbers. Trip circuit shall have red color ferrule.
- Wire termination shall be made with crimping type ring connectors with insulating sleeves. Wires shall not be spliced between terminals.
- The wires shall run preferably through PVC channel with cover adequately supported along its run to prevent sagging due to flexibility or vibration. The control & power wires shall be routed through separate channels.
- Inter-panel wiring PVC channel shall be furnished for wiring between switchgear cubicles. All wiring required for interlocking between the cubicles of any switchgear shall be furnished and installed. Wherever wires are passing through cut outs or openings they shall be protected by providing suitable grommet or gasket around the openings. Inter panel wiring at shipping sections shall be through terminal blocks placed suitably at intersection points.

The color of wire shall be taken as follows:

AC System	:	Black
DC System	:	Grey
Earthing System	:	Green
CT & PT Wiring System	:	Red, Yellow, Blue, color code



Terminal Blocks

- Terminal blocks shall be 660V grade box-clamp type with 10 mm² marking strips.
- Terminal for P.T. Secondary lead shall be disconnecting link type. Power wiring circuits and PT secondary wiring circuits shall be terminated by bolt type terminal blocks and rest by screw type terminal blocks.
- Not more than two wires shall be connected to any terminal. Spare terminals equal in number to 20% active terminals shall be furnished. Multi connection terminal strip to be used if required.
- Wiring shall be so arranged that an external cable can be connected to consecutive terminals. Terminal blocks for external / Space Heater wiring shall be separate from inter panel wiring. All control wire shall be terminated with ring type insulated lugs only.
- The terminal block shall be grouped according to circuit functions and individual terminals in each block shall be serially numbered in accordance with the drawings. Such numbering shall be legible, permanent and indelible.

Cable Termination

- Switchgear shall be designed for cable entry from the bottom. Sufficient space shall be provided for ease of termination and connection with suitable size gland plates with knock out plates for specified HT Cable connection.
- The design of the cable box shall be such that any type of jointing methods such as heat shrinkable/push on type/cold shrinkable type termination can be adopted.

Ground Bus

- A ground bus copper/ aluminum/ G.I. (min. 50x6 mm Flat as per Tender SLD/BOM) rated to carry maximum fault current, shall extend full length of the switchgear in all compartments includes cable compartments etc.
- Each stationary unit shall be connected directly to the ground bus. The frame of each circuit breaker and draw-out P.T. unit shall be grounded through heavy multiple contacts.
- C.T. and P.T. secondary neutrals shall be earthed through removable links so that earth of one circuit may be removed without disturbing other.
- All hinged doors shall be grounded using silver plated and braided copper flexible of adequate size.

Name Plates

- Name plates shall be provided as per standard.

Space Heaters and Plug Sockets

- Each cubicle shall be provided with thermostat controlled space heaters and 5/15A, 6 pin plug socket, panel illumination lamp. Cubicle heater, Plug/socket circuits shall have Individual MCBs.
- a) 230 V A.C Supply to the HT panel will be made provided by client.
 - Indication Circuit : 110 AC
 - Closing, Tripping Coil : 110 V DC
 - Panel space Heater, 3 pin socket & Panel illumination : 230 V A.C.
- b) Bus-wires of adequate (minimum 4sq.mm copper) capacity shall be provided to distribute the incoming supplies to different cubicles.
- c) Isolating MCB shall be provided at the switchgear for the incoming supplies 230 V A.C. supply.
- d) Battery backed Power pack unit for 110V AC / 110V DC for closing and trip CKT suitable for min. Two Successive open & close operations after failure of power.

Tropical Protection

- All equipment, accessories and wiring shall have fungus protection involving special treatment of insulation and metal against fungus, insects & corrosion.
- Screens of stainless steel shall be furnished on all ventilating louvers to prevent the entrance of insects.

Painting

- The HT Panel shall be treated with seven tank process with cleaning of scale, grease rust and foreign adhering matter & chemical de-rusting, sand blasting, degreasing, pickling in acid bath and phosphating as per IS: 6005 and primed.
- After cleaning, the surfaces shall be given 2 coats of epoxy primer.
- After seven tank process and primer coating the HT Panel paint shall be powder coated with RAL-7035 for inside and outside or as per client approval of the entire HT Panel.

Inspection & Tests

- The switchgear shall be completely assembled, wired, adjusted inspected and tested at the factory as per the relevant standards.

Routine Test

The tests shall include but not necessarily limited to the following for switchgear:

- Operation under simulated service condition to ensure accuracy of wiring, correctness of control scheme & proper functioning of the equipment.
- All wiring and current carrying part shall be given appropriate High Voltage test.
- Primary current and voltage shall be applied to all instrument transformers.



- Routine test shall be carried out on all equipment such as circuit breakers, instrument transformers, meters etc.
- Contact Resistance Measurement
- Electro- Mechanical Operation check
- Megger Test before and after HV
- Random checking of Relay by secondary Injection Test shall be a part of Routine test

Test Witness

The manufacturer shall perform factory tests as per IS / Specs. On equipment in presence of customer's representative / TPI agency, at Vendor / Contractor's cost.

Test Certificate

- a) Certified reports of all the tests carried out at the works shall be furnished in Four (4) copies for approval of the Owner.
- b) The equipment shall be dispatched from works only after receipt of Owner's written approval of the test reports.
- c) The test report shall furnish complete identification of the equipment such as serial no., rating, equipment designation as per schematic etc. & date of test.

List of Recommended Spares

- Manufacturer shall submit a list of recommended spare parts for two (2) years satisfactory and trouble free operation. Necessary consumable spares shall be also indicated specifically.
- Breaker rack in rack out Trolley – 1 No. (If breaker is not Trolley mounted) for ease of maintenance.

DOCUMENT: TECHNICAL DATA SHEET FOR H.T.VCB

Sr. No.	Particular	Details	Confirm/Data to be filled by the bidder
1.0	General:		
1.1	Make	As per Approved vendor list	
1.2	Model & Type No.	Pl. furnish	
1.3	Design Ambient temperature	50°C	
1.4	Atmosphere	Corrosive, Humid, Dusty	
1.5	Location	Indoor	
1.6	Degree of Protection	IP-5X	



2.0	Electrical Data:		
2.1	Type of breaker	Vacuum Circuit Breaker	
2.2	Service	Continuous	
2.3	Voltage	11kV \pm 10%	
2.4	System earthing	Solidly earthed	
2.5	Frequency	50Hz. +5% to -5%	
2.6	No. of phase	3	
2.7	System fault level	350MVA	
2.8	Rated short time current	18.37kA(1sec.)	
2.9	Max. system voltage	12Kv	
2.10	Auxiliary supply: (Battery backup Power Pack required)	110V DC derived from Power Pack connected on 110V AC P.T. supply	
2.11	Making capacity	46KA(peak)	
2.12	Busbar material & current rating	Copper, 800A or as per BOQ.	
2.13	Cable entry	Bottom	
2.14	Cable size	3C x 240 sq.mm, XLPE Armoured cable (E)	
2.15	Breaker particulars:		
	(a)Operating duty	Pl. furnish/show catalogue /IS	
	(b)Operating mechanism	Motor charged spring / manual trip & close	
	(c)Spring charging motor	230V AC,200W	
	(d)Trip/Closing coil	110V DC,180W	
	(e) Anti pumping feature/relay	Required	
	(f)Latching requirement	To be Provided Trip free	
	(g) Emergency trip push button	To be Provided Trip free	
	(h)Space heater and LED Light for Each Cubical	Required.	
2.16	Constructional requirements		
	(a) Thickness of sheet steel for frame, enclosure, doors, covers and partitions	CRCA sheet- 2mm, hinge type door with neoprene rubber gasket	
	(b)Color	Epoxy powder coating Light Gray RAL 7035 or as per client approval.	
	(c)Earth bus size	50x6mm Cu. Strip	
	(d)Foundation frame	ISMC-100, Suitable for	



		three/Four breakers or as per OEM approved Design, with necessary bed plate and foundations bolt.	
	(e)Over all dimension	Provide dimensions	
	(f)Over Load of equipment	Provide as per tender	
	(g)Minimum clear space required (i)front side (ii)rear side	Provide dimensions	
2.17	Annunciator / Hooter	To be Provided as per tender	
2.18	Relays	As per Specifications	
	(a)Relay no.& detail	Shall be as per tender	
	(b)Type of relay	Shall be as per tender	
	(c)Make of relay	Shall be as per tender	
	(d)Model no of relay	Provide details	
2.19	Current Transformer		
	(a)Type of CT	Cast Resin	
	(b)Accuracy class	Provide details as per tender	
	(c)VA burden	Provide details as per tender	
	(d)CT ratio	Provide details as per tender	
2.20	Potential Transformer		
	(a)Type of PT	Cast Resin	
	(b)Accuracy class	Provide details as per tender	
	(c)VA burden	Provide details as per tender	
	(d)PT ratio	Provide details as per tender	
2.21	Panel Accessories		
1	Toggle switch for space heater and socket	230VA.C,6A	
2	Socket	5/15A with DP MCB	
3	MCB for spring charging motor circuit	6A,DP MCB	
4	MCB for ON/OFF	Double pole, 16A, 110V D.C for D.C ckt. Double pole, 16A, 230V A.C for A.C ckt.	



5	Local / Remote selector switch	2 positions, 2 way without off	
6	Trip-Neutral-Close (TNC) Switch.	3 position, spring return to neutral, angular movement, non-lockable type, pistol grip handle.	
7	Space Heater	230 V A.C ,100 W or as per OEM	
8	Limit switch for test and service position.	Required	

4.0 HT XLPE CABLES

Scope

- The scope shall cover supplying, laying, testing and commissioning of 3 core cables of circular stranded aluminium conductors, XLPE extruded dielectric, copper tape screened and PVC overall sheathed. The cables shall be armoured with galvanized steel strip/wire armour.
- Cables shall be capable of operating at a sustained conductor temperature of 90°C and suitable for a maximum conductor short-circuits temperature of 250°C.

Operating Conditions: Electric system

- System Voltage : 11Kv
- Frequency : 50Hz.

Environment

- Ground temperature : 35°C.
- Ambient air temperature : 50°C.
- Atmospheric conditions : Humid and dusty

Construction

11 kV grade cross-linked polyethylene (XLPE) insulated, PVC outer sheathed GI strip armoured, Aluminum conductor (E) HT cable as per IS 7098 (part II) with latest amendment.

Cable Marking:

- Embossing on outer sheath:



- The PVC outer sheath shall be legibly embossed / Printed with the legend: "ELECTRIC CABLE 11000 VOLT", cable size, IS specification No., identification of manufacturer and year of manufacture etc. at each m length. Cable shall be supplied in non-returnable drums as per IS 10418 standard. Cable identification details as above shall be written on Drums also as per IS.

Testing:

- Routine tests and acceptance tests shall be carried out in accordance with the relevant IEC standards / IS. The copies of Type test results shall be submitted along with each drum length or part thereof.

DOCUMENT: TECHNICAL DATA SHEET OF HT XLPE CABLE

Sr.No	Description		Tender Requirement	Vendor To Specify
1	Company Name			
2	Rated Voltage	KV	6.35(UE)/11 KV(E) grade	
3	Reference Standard		IS 7098 Part 2 - 1985	
4	Cable Type		A2XFY	
5	Conductor			
5.1	Material		Aluminium (H4 Grade)	
5.2	Reference Standard		IS 8130	
5.3	Nominal Cross section area	Sq.mm	As per Tender BOM	
5.4	Shape of conductor		Compacted Circular	
5.5	Class of conductor as per IS 8130		Vendor to Specify	
5.6	Max. DC resistance at 20°C.	Ω/km	Vendor to Specify	
5.7	Approx. number/approx. dia of strands (before stranding & compaction)	Nos./m m	Vendor to Specify	
5.8	Voltage & Frequency Variation		$\pm 10\%$ (Voltage & Frequency combined)	
6	Conductor Screen			
6.1	Material		Extruded semi-conducting layer	
6.2	Approx. thickness	mm	Vendor to Specify	
7	Insulation			
7.1	Material		XLPE (Dry Cured)	
7.2	Reference Standard		IS 7098 Part 2 - 1985	
7.3	Nominal Thickness	mm	Vendor to Specify	
8	Insulation Screen(Non Metallic Part)			
8.1	Material		Extruded semi-	



			conducting layer	
8.2	Approx. thickness	mm	Vendor to Specify	
9	Insulation Screen (Metallic Part)			
9.1	Material		Copper Tape	
9.2	Approx. thickness	mm	Vendor to Specify	
9.3	Size of Copper Tape	Sqmm	Vendor to Specify	
10	No of Cores		3	
11	Identification of Cores		By coloured strips, Red, Yellow & Blue	
12	Laying up of cores		Cores laid up together with suitable fillers & taped with suitable holding tape	
13	Inner Sheath			
13.1	Material		PVC Type ST2 (Black)	
13.2	Reference Standard		IS 5831-1984	
13.3	Type		Extruded	
13.4	Minimum Thickness	mm	Vendor to Specify	
14	Armour			
14.1	Material		Galvanised Steel	
14.2	Form		Flat Strip / Round Steel wire	
14.3	Reference Standard		IS 3975	
14.4	Nominal Thickness	mm	Vendor to Specify	
14.5	Short circuit current of Armour	KA/S	Vendor to Specify	
15	Outer Sheath			
15.1	Material		FRLSH PVC Type ST2 / As per BOQ	
15.2	Reference Standard		IS 5831-1984	
15.3	Minimum Thickness	mm	Vendor to Specify	
15.4	Colour of Outer sheath		Black / As per Client Requirement	
16	Approx. overall dia of cable	mm	Vendor to Specify	
17	Continuous Current rating when			
17.1	Laid in ground, Ground Temp 30°C, Thermal resistivity of soil 150°C cm/watt, Depth of Laying 900mm			
(i)	Direct buried in Ground	Amps	Vendor to Specify	



(ii)	In duct	Amps	Vendor to Specify	
17.2	Laid in air at 40°C ambient	Amps	Vendor to Specify	
18	Short circuit rating of conductor for one second duration	kA	Vendor to Specify	
19	Approx. AC resistance of conductor at operating temperature	Ω/km	Vendor to Specify	
20	Approx. reactance at 50 Hz	Ω/km	Vendor to Specify	
21	Approx. Capacitance	$\mu\text{F}/\text{km}$	Vendor to Specify	
22	Cable Marking			
22.1	Following details shall be embossed / Printed on outer sheath at an interval not exceeding one meter. OEM name, Year of Manufacturing, Voltage grade, cable size, Cable grade/Type, IS specification No.			
23	Drum Type		Non-Returnable wooden /steel drum	
24	Drum Length		Vendor to Specify	

5.0 Deleted

6.0 MCC PANEL / 415V METAL ENCLOSED SWITCH BOARDS

6.1 SCOPE

- This Specification covers the Design, Engineering, Manufacture, Testing at manufacturer's works before dispatch, packing, forwarding and delivery, supervision of erection, testing at site and commissioning of cubicle type indoor, floor mounted, dust and vermin proof main free standing 415V LT distribution panel / sub distribution panels as per the rating and configuration stated in BOQ complete with all accessories such as protection relays, control wiring, auxiliary contacts, indicating lamps etc.

6.2 CODES AND STANDARDS

- In general, the equipment shall conform to all relevant IS/IEC standards. In case of any contradiction between the IS/IEC and this specification, the more stringent of the two shall apply.

STANDARD	DESCRIPTION
IEC 61439	Low-voltage switchgear and control gear assemblies



IEC 60228	Conductors of insulated cables
IEC 60255	Measuring relays and protection equipment
IEC 60529	Degrees of protection provided by enclosures (IP Code)
IEC 60831	Shunt power capacitors of the self-healing type for AC systems having a rated voltage up to and including 1000 V
IEC 60871	Shunt capacitors for AC power systems having a rated voltage above 1000 V
IEC 60898	Electrical accessories – Circuit-breakers for over current protection for household and similar installations
IEC 60947-6-1/EN 60947-6-1	low-voltage and control gear Multiple function equipment. Automatic transfer switching equipment.
IEC 60947-2/EN 60947-2	Specification for low-voltage switchgear and control gear circuit breakers
IEC 60947-1	Specification for low-voltage switchgear and control gear. Contactors and motor- starters. Electromechanical contactors and motor-starters.
IEC 61008	Residual current operated circuit-breakers without integral over current protection for household and similar uses (RCCBs)
IEC 62262	Degrees of protection provided by enclosures for electrical equipment against mechanical impacts (IK code)
IEC 61641	Enclosed low-voltage switchgear and control gear assemblies - Guide for testing under conditions of arcing due to internal fault.
IEC 61869/BSEN 61869	Instrument transformers
IS 13779	ac Static Watt-hour Meters, Class 1 and 2
IS 13947-5-2	Low-Voltage Switchgear and Control gear, Part 5: Control Circuit Devices and Switching Elements, Section 2: Proximity Switches
IS 13947-5-1	Low-Voltage Switchgear and Control gear, Part 5: Control Circuit Devices and Switching Elements, Section 1: Electromechanical Control Circuit
IS 13947-4-1	Low-Voltage Switchgear and Control gear: Part 4 - Contactors and Motor-Starters
IS 13947-3	Low voltage switchgear and control gear, part 3: switches, disconnectors, switch-disconnectors and fuse combination units
IS 13947-2	Low-Voltage Switchgear and Control gear, Part 2: Circuit Breakers
IS 13947-1	Low-voltage switchgear and control gear, Part 1: General rules
IS 5553	Reactors – Specification

6.3 SITE CONDITIONS



- The LV panel will be located indoors and shall be designed to operate satisfactorily at rated load under the service conditions. This equipment will be subject to the ambient temperature conditions at the site as specified in the Project Requirements.

Application	:	Indoor
Design Ambient Temperature	:	45 Deg. C
Relative Humidity Max	:	95%
Area Classification	:	Non Hazardous
Variation in Supply Voltage	:	± 5%
Variation in Supply Frequency	:	± 3%.

6.4 SWITCH BOARD CONSTRUCTIONAL FEATURES

i.) STRUCTURE

- The Panels shall be of compartmentalized design so that circuit arc / flash products do not create secondary faults and be fabricated out of high quality CRCA sheet, suitable for indoor installation having dead front operated and floor / wall mounting type.
- All CRCA sheet steel used in the construction of Panels shall be 2.0mm. thick for body and partitions, 1.6 mm for doors and shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet steel shall be seam welded, all welding slag grounded off and welding pits wiped smooth with plumber metal. Removable gland plates shall be provided for power and control cables. The gland plates shall be 3 mm thick and for single core cables shall be of non-magnetic material.
- The Panels shall be totally enclosed, completely dust and vermin proof. Gaskets between all adjacent units and beneath all covers shall be provided to render the joints dust proof. All doors and covers shall be fully gasketed with foam rubber and /or rubber strips and shall be lockable. Starter panel openings shall be covered with louvers and wire mesh (non ferrous) of proper size to prevent entry of foreign material or insects.
- All panels and covers shall be properly fitted and screwed with the frame and holds in the panel correctly positioned. Fixing screws shall enter into holes, taped into an adequate thickness of metal or provided with bolts and nuts. Self threading screws shall not be used in the construction of Panels.
- A base channel of min 75 mm. x 40 mm. x 6 mm. thick shall be provided at the bottom. A clearance of 300 mm. between the floor of the Panels and the bottom of the lower most unit shall be provided.
- Panels shall be preferably arranged in multi-tier formation. The Panels shall be of adequate size with a provision of 20% spare space to accommodate possible future additional switchgear. The size of the Panels shall be designed in such a way that the internal space is sufficient for hot air movement and the electrical component does

not attain temperature more than 50°C. If necessary, openings shall be provided for natural ventilation, but the said openings shall be screened with fine weld mesh. All the electrical component shall be de-rated for 50°C.

- Knock out holes of appropriate size and number shall be provided in the Panels in conformity with the number, and the size of incoming and outgoing conduits / cables.
- Alternately, the Panels shall be provided with removable sheet steel plates at top and bottom to drill holes for cable / conduit entry at site.
- The Panels shall be designed to facilitate easy inspection, maintenance and repair.
- The Panels shall be sufficiently rigid to support the equipment without distortion under normal and under short circuit condition. They shall be suitably braced for short circuit duty.
- Switchboard shall be readily extendible on both sides by addition of vertical sections after removal of the end covers.
- The LV panel shall have provision for Top/Bottom incoming and Bottom/Top outgoing respectively to suit site conditions of cable entries.

6.5 SWITCHBOARD DIMENSIONAL LIMITATIONS

- The LV panel shall have provision to provide different panels heights from 1800 to 2400 mm to suit site varied conditions.
- The LV panel shall have integral base frame of 75 or 100mm.
- The height of the operating handle, push buttons etc. shall be restricted between 300 mm to 1800 mm from finished floor level.

6.6 SWITCH BOARD COMPARTMENTALIZATION

- Switchboard design shall be completely compartmentalized with separate compartments for horizontal busbars, vertical busbars, Cable alleys and functional units consisting of ACBs, MCCBs or Motor Starter Components.
- Hinged lockable doors for each separate compartment shall be provided and duly interlocked with the breaker in "ON" and "OFF" position.
- For all Circuit Breakers separate and adequate compartments shall be provided for accommodating instruments, indicating lamps, control contactors and control MCB etc. These shall be accessible for testing and maintenance without any danger of accidental contact with live parts of the circuit breaker, bus bars and connections.
- Each switchgear cubicles shall be fitted with label in front and back identifying the circuit, switchgear type, rating and duty. All operating device shall be located in front of switchgear only. Minimum height from floor level for any device mounted on panel cover shall be 300 mm.
- Cable compartments shall be of adequate size for easy termination of all incoming and outgoing cables entering from bottom or top. The construction shall include necessary, adequate and proper support shall be provided in cable compartments to support and clamping the cable in the cable alley/ cable chamber.

6.7 SWITCH BOARD BUS BARS

- Busbars shall be made of high conductivity, and high strength EC grade Copper / Aluminum (As specified in BOM). Busbars shall be of rectangular cross sections, better suitable for full rated current for phase busbars and half/ full rated current for neutral busbar or as stipulated in schedule of quantities.
- The busbars shall be colour coded using identifying colour rings at regular interval. Red, Yellow & Blue colour shall be used for phases & Black for neutral for each shipping section of panels. The earth Busbar shall be identified with Green colour rings at regular intervals.
- The Busbar sizes shall be determined taking into consideration the continuous rating and fault level indicated, as applicable, without exceeding the temperature rise limits as per IEC / IS, over ambient temperature. Feeder in adjacent vertical to be fed with common vertical busbar / dropper.
- Bus bar supporting systems shall withstand the short circuit forces circuits, without deflection or deformation.
- The busbars shall be supported of regular intervals using SMC or DMC insulators at sufficiently close intervals – not more than 500 mm for panels above 1000 A, to prevent bus bars sag and shall effectively withstand electromagnetic stresses in the event of short circuit capacity as specified in respective SLD.
- Minimum clearance between phases / live parts shall be 25 mm and phases / live parts / neutral to ground shall be 19 mm except on the equipment terminals.
- Direct access to, or accidental contact with busbars and primary connections shall not be possible.
- Continuous earth bus sized for prospective fault current to be provided with arrangement for connecting to site earth at two ends of Switchboard.
- Panel to panel entry of bus bar shall be effectively sealed by electrical and thermal insulation barriers so that products of flashover do not travel from one panel to another panel creating multiple faults.

6.8 EARTHING

- GI earth bars of min. 50x6 mm or as specified in SLD (higher of two) shall be provided in the Panels for the entire length of the panel. The frame work of the Panels shall be connected to this earth bar. Provisions shall be made for connection from this earth bar to the main earthing bar coming from the earth pit on both side of the Panels. The earth continuity conductor of each incoming and outgoing feeder shall be connected to this earth bar.
- The earth continuity conductor of each incoming and outgoing feeder shall be connected to this earth bar. The armour shall be properly connected with earthing clamp, and the clamp shall be ultimately bonded with the earth bar.
- Suitable holes with bolts and nuts shall be provided at each end of earth bar of switchgear for connection to a main earthing grid.
- The earth bar shall be accessible in each cable entering compartment either directly or through a branch extension to ground the cable armour and shields.



- Door earthing shall be provided for all doors by multi-strand copper wires.
- Special care to be taken to ensure effective earthing of the frame and doors of the switchboards.

6.9 WIRING

- All wiring for relays and meters shall be with PVC insulated copper conductor wires.
- The wiring shall be coded and labelled with approved ferrules for identification.
- The minimum size of copper conductor control wires shall be 1.5 sq. mm.
- Runs of wires shall be neatly bunched and suitably supported and clamped.
- Means shall be provided for easy identification of wires.
- Identification ferrules shall use at both end of wires.
- All control wires meant for external connections are to be brought out on a terminal board.
- All the control cables shall be FRLS PVC insulated copper conductor.

6.10 CABLE TERMINATION

- Knockout holes of appropriate size and number shall be provided in the Switchboard in conformity with the location of incoming and outgoing conduits/cables.
- The cable terminations of the Circuit Breakers shall be brought out to terminal cable sockets suitably located.
- The cable terminations for the MCCB's shall be brought out to the rear in the case of rear access switchboards.
- Removable gland plates shall be provided for power and control cables. The gland plates shall be 3 mm thick and for single core cables shall be of non-magnetic material.

6.11 PAINTING AND FINISHING

- Sheet steel used in the fabrication of switchboards shall under go a rigorous cleaning and surface treatment seven tank process comprising of alkaline degreasing, de-scaling in dilute sulphuric acid and a recognized phosphating process after which a coat of primer paint with the final paint shall be applied over the treated surface.
- The painting of the sheet metal shall be done by electrostatic spraying of epoxy resin powder of minimum 80-100 micron thickness to give smooth finish to the equipment. Colour shade shall be confirmed with concern approval authority.

6.12 NAME PLATES AND LABELS

- Engraved PVC labels shall be provided on all incoming and outgoing feeders. Single line circuit diagram showing the arrangements of circuit inside the distribution board shall be pasted on inside of the panel door and covered with transparent laminated plastic sheet.



- A name plate with the Panel's designation in bold letters shall be fixed at top of the central panel. A separate name plate giving feeder details shall be provided for each feeder module door.
- Inside the feeder compartments, the electrical components, equipments, accessories like switchgear, control gear, lamps, relays etc. shall suitably be identified by providing stickers.
- Name plate shall be engraved of 3 ply, (Red-White-Red or Black- White-Black) lamincold sheet. However, black engraved perspex sheet name plates shall also be acceptable. Engraving shall be done with square groove cutters.
- Name plate shall be fastened by counter sunk screws and not by adhesives.

6.13 DRAWING& DOCUMENTS REQUIRED:

- Prior to fabrication of the switchgear, the contractor shall submit following for Purchaser Representative's approval - the dimensional drawing and design calculations indicating bus bar size, short circuit rating of all the electrical component used, power wiring diagram, control wiring diagram, detailed bill of material, single line diagram, components mounting details etc.
- The contractor shall submit manufacturers catalogues of the electrical components installed in the switchgear.

6.14 TESTING AND INSPECTION

- The switchgear shall be completely assembled; wired, adjusted and all routine tests as specified by the applicable standard code shall be conducted.
- Visual Inspection and Dimensional Check.
- Verification of Bill of Material.
- Check of conformity with wiring diagrams and plans.
- Mechanical operation tests and checking of interlocks.
- Testing of the interchange ability of moving parts.
- HV test on power and control wiring / bus bars.
- IR test
- Functional test for control circuits.
- Electrical & Mechanical operational checks.
- For equipment bought from other sub suppliers, certified test reports of tests carried out at the manufacturer's works shall be submitted. Normally, all routine tests as specified in the relevant standards shall be conducted by the sub supplier at his works.
- Switchgear OEM routine test verification (certification) for Busbar and Critical components such as Load Bearing Structure, Busbar support etc. used as per selected Switchgear manufacturer recommendation and type tested design.

6.15 DANGER NOTICE PLATES:

- The danger notice plate shall be affixed in a permanent manner on operating side of the switchgear.
- The danger notice plate shall indicate danger notice in Gujarati, Hindi and English.
- The danger notice plate, in general shall meet to requirements of local inspecting authorities.
- Caution name plate, "Caution Live Terminal" shall be provided at all the points where the terminals are likely to remain live and isolation is possible only at remote end i.e. incomer to the switchboard.
- The danger notice plate shall be made from minimum 1.6 mm thick steel sheet and after due pretreatment to the plate, the same shall be painted white with vitreous enamel paint on both front and rear surface of the plate.
- The letters, figures, the conventional skull and bones shall be positioned on the plate as per recommendations of latest edition of IS 2551-1982.
- The said letters, the figures and the sign skull and bones shall be painted in signal Red color as per latest edition of IS 5 - 1978.
- The danger plate shall have rounded corners. Locations of fixing holes for the plate shall be decided to suit the design of the switchgear enclosure.

6.16 COMPONENTS

6.16.1 GENERAL

- The type, size and rating of the components shall be as indicated on the relevant drawings. While selection of the capacity of the components resulting from the prevailing conditions like ambient temperature shall be allowed for the thermal and magnetic trip rating shall be compensated for the ambient temperature.
- The rating indicated on the drawing is ratings anticipated at prevailing site conditions.

6.16.2 AIR CIRCUIT BREAKER (ACB):

General Specifications:

- ACBs shall conform to IEC 60947-2.
- Plastic components used in all ACBs shall conform to Glow wire test as per IEC 60695-2-1.
- ACBs shall have 'CE' marking & suitable for Isolation.
- ACBs shall have rated impulse withstand voltage of 12kV for main circuit & 4kV for Auxiliary circuit.
- ACBs shall have Rated insulation voltage of 1000V.
- ACBs shall be with RoHS compliance.
- All ACBs shall have $I_{cu}=I_{cs}=I_{cw}$ for 1 Second with Combined Test Sequence Certification from Independent Testing Approved Authorities DEKRA/CPRI/ERDA/ASTA/KEMA, etc. The certification should not be more than 10 years old.



- It shall not be possible to open the racking shutter unless ACB is in OFF condition.
- For safety of operator, the ACB should remain in OFF condition during Racking Operation.
- ACBs shall offer Double Insulation from Front Face (Class 2 operating safety)
- ACBs shall offer option of pad locking the racking shutter to prevent the inadvertent racking operation and facilitates implementation of 'LOTO' system.
- 4 Pole ACBs shall have fully rated Neutral (100% w.r.t. Phase)
- ACBs up to 4000A shall be suitable for Aluminum as well as Copper termination. The same shall be available in ACB manufacturer's catalogue.
- ACB's above 3200A shall be highest frame size by the manufacturer and shall have split poles/ terminals for better heat dissipation.
- Front Facia of ACB shall have information on following: Rated Current, Poles, Release, Breaking Capacities, Serial Number, ON/OFF Status, Spring Charge/Discharge Status, Voltage Ratings of Shunt, Closing Coil, Motor, Under voltage Release

a) Mechanical:

- ACBs shall conform to Pollution degree - 4.
- ACBs shall have inbuilt Mechanical & Electrical anti-pumping to prevent auto reclosing on fault. Electrical anti-pumping shall be applicable to Electrical version ACBs.
- ACBs shall offer minimum IP54 Degree of Protection on Breaker Front.
- ACBs shall offer minimum IK08 Degree of Impact Protection on Breaker Front.
- It shall be possible to rack out a draw-out ACB to maintenance position for regular inspection.
- ACB shall be provided with in-built safety shutter & rating error preventer.
- For safety of users, interlock shall be provided between breaker operating mechanism & the arc chutes to prevent closing of ACB in case the arc chutes are not properly secured.
- It shall be possible to remove the arc chute without using any tool for quick preventive Maintenance / Inspection.
- Sliding shutter shall be provided for ON/OFF push button to avoid accidental / unwanted operation of ACB.
- Racking handle in case of draw-out ACB shall be accessible from front without opening the panel door.
- Silver plated copper/ copper alloy adapters shall be used for busbar termination, as recommended by OEM.
- ACBs shall have Break Time not greater than 25msec to reduce stresses on system while clearing high faults.
- ACBs shall be provided with minimum 4NO+4NC auxiliary change over contacts and all contacts should be available for use.

b) Accessories:



- Wherever under voltage release is specified, it shall have adjustable time delay with range of 0-5 sec to avoid any nuisance tripping during short-time voltage dips.
- Ratings of voltage-based accessories like UV, Shunt, Closing, ECD should be visible from Front Facia without opening the panel door.
- ACBs shall have operation counter indicating the number of operating cycles the circuit breaker has seen and shall be visible on the front-facia.
- It shall be possible to annunciate different types of faults to a remote location using common fault indication micro switch.
- It shall be possible to interlock breaker at different positions in the cradle. (Service/Test/Isolated).
- Provision shall be available to interlock between ACBs using key lock scheme.
- ACB should have provision of neutral configurator to provide flexibility of choosing neutral in 4P Breakers
- Provide ACB accessories to show Status (ON – OFF – Trip) and control (ON – OFF) over RS-485 Communication.
- The 100%N ACB shall facilitate the feature of changing the Neutral position on site without disturbing the existing busbar arrangement.
- Incomer ACB should have counter to check mechanical operation

c) ACB Release:

- Protection release shall be Microprocessor based RMS current sensing type.
- Release should be without BCD switch or potential meter to avoid tampering.
- It shall be possible to enable or disable any protection setting as per system requirement.
- Release shall be accessible from front without opening panel door.
- Micro-processor healthiness shall be indicated by Power ON LED.
- Release should have overload, Short-circuit, Instantaneous, Earth-Fault & neutral protection with adjustable current & time-delay setting.
- Protection against under/overvoltage, voltage unbalance, residual voltage, Under/over frequency, under-current, current unbalance, reverse power, Leading & Lagging power factor, over-temperature sensing at Cradle terminals Double Short Circuit Selectivity and the same shall be with Adjustable Time Delay.
- Protection release shall be provided with Test button to check healthiness of microprocessor and test socket in front.
- It shall be possible to interchange protection release without changing the CT and upgrade release for both way communication.
- Release shall conform to EMI/EMC tests.
- In case wherever 3 Pole ACBs with O/L, S/C, E/F (In-built E/F mandatory in all ACBs) are specified, Neutral CT should be provided from ACB Manufacturer for accurate E/F Protection.
- ACB shall have communication facility via RS485 Port Modbus Protocol providing Status of ACBs (ON/OFF) & shall also be capable of Controlling the ACB (ON/OFF) through Remote (User's Computer Interface)

- The protection release shall offer option of lowering the In (Nominal Current) value through protection release itself without adding any additional hardware.
- The release shall offer Real Time Temperature Monitoring Protection of ACB by sensing temperature of ACB Terminals.
- Pre-Alarm function shall be available for Overload, Short-Circuit & Earth fault.
- The protection release shall offer feature of Directional Short Circuit to protect system from the Short Circuit faults in the reverse direction.
- The ACB shall facilitate the feature of changing the Neutral position on site without disturbing the existing busbar arrangement.
- The Protection Releases of the ACB shall provide Ground Fault Protection from 10% of In.
- Protection unit shall have Query, to store last trip information & shall have a backup for at least 72 hours after the tripping occurred.
- Release shall have in-built thermal memory with activate & deactivate mode to take care of thermal stresses due to repetitive overloads.
- Protection setting in the release shall be password protected to prevent unauthorized access to release settings.
- The protection release shall have minimum 20 trip records

6.16.3 MOULDED CASE CIRCUIT BREAKER (MCCB):

- The MCCBs shall conform to IEC 947 & the latest applicable standards.
- All MCCBs shall be of Adjustable type unless otherwise specified in the specifications elsewhere.
- MCCBs shall be of four pole/ triple pole with neutral construction arranged for simultaneous four/ three-pole manual closing and opening and for automatic instantaneous tripping on short circuit.
- All the incomer & bus coupler MCCBs for Main LT PMCC panels shall be FP type with microprocessor based O/L +S/C + inbuilt E/F release & all outgoings MCCBs shall be TPN with thermal magnetic based O/L +S/C + E/F releases or specified.
- For achieving the Earth Fault protection in thermal magnetic (TM) based MCCBs, external CBCT, Earth Fault relay & shunt trip provision shall be considered as part of complete TM based MCCB.
- The ON, OFF and TRIP positions of the MCCB shall be clearly indicated by using LED indications.
- MCCBs shall be with ICS = ICU = 100%
- MCCB shall be capable of withstanding the thermal stresses caused by overloads and locked rotor currents of values associated with protective relay settings of the motor starting equipment and the mechanical stresses caused by the peak short circuit current of value associated with the switch gear rating.
- All the MCCBs shall be of current limiting type and shall provide a cut off in 4-8 milli seconds for prospective currents during faults.
- All the MCCBs shall be provided with rotary operating handle with door interlock.

- MCCB terminals shall be shrouded and designed to receive cable lugs for cable sizes relevant to circuit ratings.
- All MCCBs shall be provided with additional Trip & Alarm contacts, exclusively for Purchaser's use.
- All the switchgear selection for motor feeders shall be Type-2 co-ordinated.

6.16.4 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 characteristics of 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.

6.16.5 DIRECT ON LINE STARTER (DOL STARTER)

Direct-On-Line Starters: Direct on line motor starter shall have following components / features:

- Direct-on-line starters shall be suitable for Class AC 3 utilization category as per IS: 13947 (Part 4), unless otherwise mentioned in tender.
- DOL starter shall have MCCB/ MPCB, Overload Relay with SPP, Contactor etc.
- Type 2 Co-ordination shall be ensured.

6.16.6 AUTOMATIC STAR DELTA STARTER:

Automatic star-delta motor starters shall have following components/ features:

- Three sets of contactors one for the line, one for the star point and one for the delta, and a timer to automatically change the connections from star to delta.
 - Star Delta Starters shall consist of MCCB/ MPCB, Overload Relay with SPP, Contactors, electronic timer etc.
 - Star-delta contactors shall be electrically interlocked to permit starting of the motor in the proper sequence, namely star contactor closing, line contactor closing, timer energized after time delay, timer contact de-energizing the star contactor, and delta contactor closing.
- a) Star-delta starters shall be suitable for AC-3 utilization category as per IS: 13947 (Part 4), unless otherwise mentioned in tender.
- b) Type 2 Co-ordination shall be ensured.

6.16.7 REVERSING STARTERS:

Motor Reversing starter shall have following components/ features:

- 1) Forward and reverse contactors, electrically interlocked with each other.
- 2) Reversing starters shall be suitable for Class AC-4 duty as specified in applicable standards, unless otherwise mentioned in tender.

6.16.8 AUTO TRANSFORMER STARTER (ATS):

Auto Transformer starter shall have following components/ features:

- Auto transformer shall be air cooled type having 3 tapings of 50%, 65% and 80%. The same should be wound with Copper wire. The size of the wire should be determined to suit the associated motor rating. The tapping requirement indicated is minimum required & Contractor to ensure proper tapping selection based on motor starting requirement.
- Stamping of reputed make and winding wire with 'B' class insulation should be used. This should also be suitable for minimum 6 starts per hour. Core shall be of CRGO material.
- Maximum temperature rise should not be more than 115°C. Kordnoffer circuit (Closed Transition type) should be adopted in ATS panel. There shall be an acrylic/ Hylam sheet over & below the transformer. Also to absorb humming rubber sheet shall be provided below auto transformer.
- Auto transformer shall be vacuum impregnated.
- Testing of transformers should withstand full load starting current for six starts per hour, as per relevant IS.
- ATS shall be provided with thermal overload protector in each coil of transformer from to give protection overheating. Thermal overload protector rating shall be 900°C with 10% tolerance.
- ATS shall consist of MCCB/ MPCB, Overload Relay, and Contactors etc.

6.16.9 MICROPROCESSOR BASED SOFT STARTER FOR MOTORS

Fully automatic microprocessor based soft starters with External / Inbuilt bypass contactors for pump control application shall be considered.

The features/ requirements of the starters shall be as per following but not limited to:

- The soft starter shall be designed, built and tested according to the latest editions of applicable IEC standards/ IEC 947-4-UL, CE.
- Input Voltage – 3Ph, 415V, $\pm 10\%$
- Input Frequency – 50 Hz, $\pm 5\%$
- Control Voltage – 100 - 240 V AC
- Ambient Conditions:
- Temperature – 50 Deg C. (Operating range -5 to 70°C)
- Relative Humidity of 5 to 95%
- Control Method – Torque Control/ Reduced Voltage/ Ramp
- Motor Protection – Thermal overload protection



- Starter Protection – S/C, Phase imbalance, Phase failure, Phase reversal, O/ V, U/ V,
- Locked rotor, excessive starts per hour for application, Phase loss input/ output, Motor output loss.
- EMC standard – IEC 61000-4-2 level-3, IEC 61000-4-3 level-3
- Built-in communication port for RS 485.
- Type 2 Co-ordination shall be ensured.
- The soft starter shall be complete with the following acceleration and deceleration settings & display requirements as a minimum-
 - Starting Torque: Initial torque shall be adjustable from 0-100% of maximum locked rotor torque.
 - Ramp Time: The time between starting torque and maximum torque shall be adjustable between 1 to 60 seconds. The time between maximum torque & stop shall be adjustable between 2 to 120 seconds
- The current limit feature shall have the following characteristics:
 - The maximum allowed current during start shall be adjustable from 150% to 500% of soft-starter maximum current rating.
 - Starting torque shall be fixed at 40% when utilizing the current limit function.
- Voltage Ramp start & Full voltage DOL start shall be possible.
- For stop function – Linear torque control, Quadratic Torque Control, Voltage ramp control, soft break etc. functions shall be provided.
- The soft-starter shall be provided with a functional ground to remove and/ or minimize electrical noise injected on the soft starter control board.
- Normally open output relays shall be provided for faults and status indications.
- Normally closed contacts for fault relays shall be provided as an option.
- The soft-starter shall be provided with a 2-position dip switch to select between the normal in-line connection (3-lead motor) and inside the delta (6-lead or 12 lead delta wound motors).
- The soft-starter shall be controlled completely through solid state design algorithms. No moving electromechanical contacts shall be allowed.
- All adjustments shall be made from the front of the soft starter through keyboard (soft keys)
- Shaft Power measurement without the use of external electro mechanical sensors.
- Shaft overload and under load protection shall be available through the controller, even in a by-pass configuration.
- When fault conditions are detected, the controller shall inhibit starting or shut down SCR pulse firing.
- The standard feature pump control shall be implemented to provide closed loop control of a motor to match the specific torque requirements of centrifugal pumps for both starting and stopping. This shall aid in eliminating the phenomenon commonly referred to as “water hammer”.
- The soft-starter shall be designed for three-phase control with two anti parallel SCRs in each phase. SCR-Diode combination shall not be acceptable.

- The PCB shall provide digital microprocessor control and supervision of all controller operation, including SCR pulse firing control.
- The PCB power supply shall be self-tuning to accept control power input from 100 to 240 or 380 to 500 V AC, 50/ 60 Hz.
- The SCR firing circuitry shall incorporate an RC snubber network to prevent false SCR firing.
- When fault conditions are detected, the controller shall inhibit starting or shut down SCR pulse firing.
- SCRs shall have the following minimum repetitive peak inverse voltage ratings:
 - 200 to 525V: 1600 V
 - 200 to 690V: 1800V

a) APPLICABLE STANDARDS

The Soft starter shall conform to the latest applicable standards specified below. In case of conflict between standards and this specification, this specification shall govern.

Microprocessor Soft Starter	IEC:947.4.2/EN50081-1,50082-2&60204-
Metal Enclosed Switchgear	IS:3427
Current Transformers	IS:2705/BS:7626
Degree of protection	IS:13947(Part-1)/IEC:947-1/BSEN:60529
Electrical Relays for Power System protection	IS:3231,3842/BS:142/IEC:255
Electrical Indicating Instruments	IS:1248/BS:89/IEC:51
AC Electricity Meters	IS:722 /BS:2692
Specification for copper rods and bars for electrical purposes	IS:613
Code of practice for phosphating iron and steel	IS:6005/BS:3189

b) CONTROLLER'S FEATURES AND MODES

Following Starting modes require for controller:

- Linear Torque control for Start
- Pump Control
- Current Limit Start
- Voltage ramp Start
- Voltage ramp with current limit Start
- Full Voltage DPL Start
- Remote analogue control
- Soft Start with Selectable Torque Boost

- Slow Speed time controlled
- Slow Speed external controlled
- Dual Ramp Start
- Bypass control
- Bypass contactor mode with all the protection parameter working

Following **Stopping modes** require for controller:

- Adaptive Acceleration required.
- Linear Torque control for Stop
- Quadratic Torque control for Stop.

Pump Control

- Remote analogue control Stop
- Slow Speed time controlled
- Slow Speed external controlled
- Dual Ramp Stop
- Bypass control

a) Following Additional features also require for controller:

- a) Analog output
- b) Built in Display (LCD/LED)

b) Following Operation features require for controller:

- Keyboard
- Remote

c) Following Protection features require for controller:

- Motor Thermal Overload
- Soft Start thermal overload
- PTC input
- Phase imbalance
- Phase reversal
- Over voltage
- Under voltage
- Locked Rotor
- Excessive Starts per hour for application
- Phase loss input / output
- Current(Asymmetry)
- Negative Phase sequence Earth fault
- Limitation of Starting

d) Following Viewing functions require for controller :

- Motor Current
- Three Phase Voltage
- Shaft Power in kW / HP (selectable)



- Motor thermal capacity
- Motor Energy consumption (kWh)
- Power factor
- Run time in hours

e) Following Fault Indication functions require for controller: (Optional)

- Line failure
- Phase imbalance
- Over temperature–motor
- Over temperature
- Locked Rotor
- Motor output loss
- Overload–Shaft Torque Under load–Shaft Torque Phase imbalance
- Over voltage
- Under voltage
- Excessive Starts
- Phase reversal
- Event List of 15 latest fault indications/occurrence

b) DRAWINGS AND DATA

The following shall be furnished as part of the Tender:

- General arrangement showing plan, elevation and typical sectional views.
- Technical Details of soft starters including Make, Model No. during approval stage.
- Technical literature on the Microprocessor based Electronic Soft starter offered along with authorization letter from the company stating the service back up confirmation during warranty period & there after

The following shall be furnished after award of contract for Purchaser's approval:

- General arrangement showing plan as per actual construction, elevation and typical section views. Foundation plan showing location of fixing channels, floor opening etc.,
- Schematic power and control wiring drawings for each feeder.

TECHNICAL DATASHEET FOR SOFT STARTER

SR. NO.	PARTICULAR	DETAILS	DATA TO BE FILLED BY THE BIDDER
1.0	Make	Pl. Furnish.	
2.0	Model No.	Pl. Furnish.	
3.0	Rated Insulation Voltage	Pl. Furnish.	
4.0	Rated Operational Voltage	Pl. Furnish.	
	Rated Control Supply	Pl. Furnish.	



5.0	Voltage		
6.0	Rated Control Circuit Voltage	Pl. Furnish.	
7.0	Starting Capacity at Operational Current	Pl. Furnish.	
8.0	Number of starts per hour	Pl. furnish	
9.0	Overload Capability (Overload class)	Pl. furnish	
10.0	Ambient Temperature	Pl. furnish	
10.1	During operation	Pl. furnish	
10.2	During storage	Pl. furnish	
11.0	Degree of Protection	Pl. furnish	
11.1	Main Circuit	Pl. furnish	
11.2	Supply & Control Circuit	Pl. furnish	
12.0	Main Power Circuit	Pl. furnish	
12.1	Cooling System	Required, Pl. furnish	
16.0	Human Machine Interface	Pl. furnish	
17.0	Control Circuit	Please Furnish	
17.1	Number of inputs	2(start, stop)	
17.2	Number of additional programmable inputs	Required, Pl. furnish	
18.0	Protections	Pl. furnish	
18.1	Electronic overload	Required, Pl. furnish	
18.2	Dual overload	Required, Pl. furnish	
18.3	Over Heating Protection	Required, Pl. furnish	
18.4	Locked Rotor Protection	Required, Pl. furnish	
18.5	Underload Protection	Required, Pl. furnish	
18.6	Phase Unbalance	Required, Pl. furnish	
18.7	High current	Required, Pl. furnish	
18.8	Phase Reversal Protection	Required, Pl. furnish	
19.0	Warnings	Pl. furnish	
19.1	High Current	Required, Pl. furnish	
19.2	Low Current	Required, Pl. furnish	
9.3	Over Load Trip	Required, Pl. furnish	
19.4	Over temperature	Required, Pl. furnish	
20.0	Communication Protocol	Required, Pl. furnish	
21.0	Remote Operation through PLC	Required.	

6.16.10 Deleted

6.16.11 CONTACTORS:

The power contactors used in switchboard shall have following features:

- a) The Contactors shall confirm to IS 13947 & the latest applicable standards
- b) The power contactors shall be of, air break, single throw, triple pole, electromagnetic type.
- c) The insulation class of contactor's coil should be B or higher.
- d) Operating coils of all contactors shall be suitable for operation on 110/240 V, single phase, 50 Hz supply.
- e) Contactors shall be provided with at least two pairs of NO and NC auxiliary contacts.
- f) Contactors shall not drop out at voltages down to 70 % of coil rated voltage.
- g) All the switchgear selection for motor feeders shall be Type-2 co-ordinated.
- h) Motor starters shall be complete with auxiliary relays, timers and necessary indications.

6.16.12 RELAYS:

- a) Main protective relays shall be Numerical type. They shall be suitable for semi-flush mounting with only flanges projecting on the front with connections from the rear.
- b) All relays shall be enclosed in rectangular shaped, dustproof cases and shall be suitable for flush mounting.
- c) All protective relays shall be in draw out cases with built in test facilities.
- d) Auxiliary relays and timers shall be rated to operate satisfactorily between 70 % and 110 % of the rated voltage
- e) Test block and switches shall be located just below each relay for testing unless otherwise specified. All auxiliary relay and timers shall be supplied in non-draw out cases.
- f) All protective relays shall be provided with at least two pair of potential free output contacts, exclusively for Purchaser's use.
- g) Relay cases shall have adequate number of terminals for making potential free connections, to the relay coils and spare contacts. Paralleling of contacts if any shall be done at the terminals on the casing of the relay.
- h) Each relay shall have provision for easy isolation of trip circuit for the purpose of testing and maintenance.
- i) All relays shall withstand a test voltage of 2 KV, 50 Hz RMS voltages for one minute.
- j) Auxiliary seal in units provided on the protective relay shall be shunt reinforcement type.
- k) 132 kW & above rated motors shall be breaker controlled with motor protection relay Siemens '7SK 80' OR equivalent from approved make list.

6.16.13 THERMAL OVERLOAD RELAY:

- a) Starters shall be complete with a three element, positive acting, ambient temperature compensated, time lagged thermal overload relay with adjustable settings. The setting range shall be properly selected in accordance with the rating of the motor.
- b) Thermal overload relays shall be hand reset type



- c) 'Stop' push button of the starter and hand-reset device shall be separate from each other.
- d) Overload relay hand reset push button shall be brought out on the front of the compartment door. Overload relay shall be provided with at least 1 'NO' and 1 'NC' or one changeover contact.

6.16.14 TIMERS:

Electronics timer for change over in star-delta and ATS panel should be provided.

6.16.15 SWITCH AND CONTACTOR RATING:

Switch and contactor rating for various motor starter modules shall be selected by the Contractor, based on the specifications. Contractor shall also select appropriate ratings & ranges for thermal overload relays. These details shall be subject to the Purchaser's approval.

6.16.16 SINGLE PHASING PREVENTER:

- a) Single phasing preventer relay shall be provided to protect motors against single phasing.
- b) It should operate satisfactory from 320/ 480V. Timing range of delay start 0 - 45 seconds.
- c) Toggle switch for Auto SPP by pass should be provided on front of unit.
- d) The relay shall not operate for supply voltage unbalance of $\pm 5\%$. After sensing single phasing, the relay shall operate with a time delay of 2 to 3 secs.
- e) The relay shall not operate for a 3- phase power supply failure. The relay shall be of the hand-reset type with a hand-reset push button. Resetting shall be instantaneous and independent of the adjusted time delay in the tripping of the unit. Visual indication for the operation of the relay shall be provided.
- f) The relay shall be suitable for application to protect reversible and non reversible motors.
- g) The relay operation shall be independent of the motor KW rating, the loading conditions prior to the occurrence of the single phasing and RPM of the motor.
- h) The relay shall be of the fail-safe type and shall operate to trip the motor when the relay internal wiring is accidentally open circuited.

6.16.17 POWER & CONTROL WIRING CONNECTION:

- a) Terminals for both incoming and outgoing cable connections shall be suitable for 1.1kV grade Al/ Cu conductor XLPE armoured cable and shall be suitable for connections of solder less sockets for the cable size.
- b) Main PMCC incomer feeder shall be suitable for bus duct connections using Aluminum Bus bars for transformer ratings greater than 1000kVA.
- c) Both control and power wiring shall be suitable for Bus Duct/ Cable termination as per guidelines mentioned in transformer specifications.



- d) Both control and power terminals shall be properly shrouded. Power terminals shall be of stud type.
- e) 20 % spare terminals shall be provided on each terminal block. Sufficient terminals shall be provided on each terminal block so that not more than one outgoing wire is connected to per terminal.
- f) Suitable barriers of enclosures shall preferably separate terminals strips for power and control from each other.
- g) Wiring inside the modules for power, control, protection and instruments etc shall be done with use of 1.1 kV grade, multistranded Cu, PVC FRLS wiring.
- h) Power wiring inside the starter module shall be rated for full current rating of respective contactor but not less than 4.0 Sq. mm. 2.5 Sq. mm copper wire shall be used for current transformer circuits.
- i) Other control wiring shall be done with 1.5 Sq. mm copper conductor wires.
- j) Wires for connection to the door shall be flexible. All conductors shall be crimped with solder less sockets at the ends before connections are made to the terminals.
- k) There shall be control transformer for control power supply (110/ 240V AC) and separate control bus.
- l) Particular care shall be taken to ensure that the layout of wirings is neat and orderly. Identification ferrules shall be filled to all the wirings terminations for ease of identification and to facilitate checking and testing.
- m) Washers shall be used for all Copper and Aluminum connections.
- n) Final wiring diagram of power and control circuit with ferrules nos. shall be submitted along with the panel as one of the documents against the contract.

6.16.18 TERMINALS:

- a) The outgoing terminals and neutral shall be brought to a cable alley suitably located and accessible from the panel front.
- b) The current transformer for instruments metering shall be mounted on the disconnecting type terminal blocks. No direct connection of incoming or outgoing cables to internal components of the distribution board is permitted; only one conductor may be connected in one terminal.

6.16.19 INDICATING INSTRUMENTS:

- a) All digital indicating meters shall be 96 x 96 mm.
- b) Ammeters for motor feeders shall have suppressed scale up to 6 times beyond full load.
- c) Dials shall be parallax free and white with black numbers and letterings & pointer shall be of knife-edge type. Such instruments shall be provided with zero adjustor accessible from the front.
- d) Instruments shall have an accuracy class 1.0 or better.
- e) Instrument dials shall be white with black numbers and lettering.
- f) Ammeter and current coils of wattmeter's and ammeters shall continuously withstand 120 % of rated current and 10 times the rated current for 0.5 second without loss of accuracy.



- g) Voltmeters and potential coils of voltmeters shall withstand 120% rated voltage continuously and twice the rated voltage for 0.5 seconds without loss of accuracy.

6.16.20 METERING INSTRUMENTS:

- a) Multifunction meters shall be provided as per single line diagram. Size of the MFM shall be 96 x 96 sq. mm.
- b) MFM shall be provided with following metering features:
- c) Current, Voltage, Energy (kWh), MD (kW, kVA), PF & Hz etc.
- d) MFM shall be with accuracy class 1.0 or better & having RS 485 communication port.
- e) Watt-hour meters shall be of 3-phase two- element type suitable for measurement of unbalanced loads in three phases, three wire circuits. They shall be suitable for semi flush mounting on vertical panels.
- f) Watt hour meters shall be of the induction type and shall be provided with reverse running stops.
- g) Watt-hour meters shall be suitable for operation from the secondary of CTs and PTs. They shall be provided with a separate 3 phases, 4 wires type test terminal blocks for testing of meters without disturbing CT and PT secondary connections.
- h) Meters shall be provided with potential indicating lamps and shall have reverse running stops.
- i) Meters shall have pointer as well as cyclometer type of register. They shall read KWH, KVARH, and PF as the case may be without the use of multiplication factor which, if unavoidable, shall be 10. The number of digits provided shall be adequate to cover 1000 hours of operation.
- j) Current coils of meters shall have a continuous overload capacity of 120 % for both accuracy as well as thermal limits. Also the coil shall withstand at least 10 times rated current for 0.5 second without loss of accuracy.

6.16.21 CURRENT TRANSFORMER:

- a) Current transformers shall be of cast resin type. Insulation Class shall be Class 'E' or better.
- b) Current transformer shall have a short time withstand rating equal to the short time withstand rating of the associated switchgear for one second for breaker feeders.
- c) Unless otherwise specified, the minimum performance requirement of current transformers is as follows:
- d) Measuring CTs -15VA, accuracy class 1.0 and.
- e) Protective CTs - 15 VA, accuracy class 5P10.
- f) The above mentioned burdens are minimum required & it will be Contractor's responsibility to coordinate the current transformer burden with the requirements of relays, instruments and leads associated with that particular current transformer. Contractor has to provide sufficiency calculations for the same.
- g) Current transformer (CT) shall have polarity markings indelibly marked on each transformer and at the lead terminations at the associated terminal block

- h) CT shall be able to withstand the thermal and mechanical stresses resulting from the maximum short circuit current
- i) Test links shall be provided in both secondary leads of the CTs to easily carry out current and phase angle measurement tests.
- j) Identification labels giving type, ratio, output and serial numbers shall be provided.

6.16.22 VOLTAGE TRANSFORMER:

- a) Voltage transformers shall be of cast resin type. Insulation Class shall be Class 'E' or better.
- b) Unless otherwise specified, the minimum performance requirements of Voltage transformers are as follows:
 - i. Measuring VTs - 50 VA per phase and accuracy class 1.0
 - ii. Protective VTs - 50 VA per phase and accuracy class 3.0.
 - iii. Dual purpose VTs - 100 VA and dual accuracy class 1.0/ 3P for metering and protection respectively. VA is per phase.
 - iv. The above mentioned burdens are minimum required & Contractor has to provide sufficiency calculations for the same.
- c) All secondary windings of voltage transformers including open delta windings shall be rated for $110\text{ V} / \sqrt{3}$, 110V/ 3 per phase.
- d) Voltage transformer shall have a continuous over voltage factor of 1.2 and short time over voltage factor as follows:
 - i. 1.5 for 30 seconds in case of effectively earthed system.
 - ii. 1.9 for 8 hours in case of non-effectively earthed system.
- e) Voltage transformers shall be complete with suitable rated primary, fuses. Primary fuses shall have a rupturing capacity equal to the rupturing capacity rating of the associated switchgear. All the secondary circuits of the PT shall be protected by MCBs.
- f) It shall be possible to replace voltage transformers without having to de-energize the main bus bars.
- g) The terminals of PT secondary and tertiary windings, which are required to be connected to earth, shall be earthed by an isolating link without a fuse.
- h) Identification labels giving type, ratio, output and serial numbers shall be provided.

6.16.23 PUSH BUTTON:

- a) Push buttons shall have two normally open and two normally closed contacts unless otherwise specified. The contacts shall be able to make and carry 5A at 110V DC and shall be capable of breaking 1A inductive load at 110V DC. They shall be provided with inscription plates engraved with their functions.
- b) Emergency stop' push buttons shall be of Mushroom type, lockable in the pushed position and shall be shrouded to prevent accidental operation. Key shall not be required for the operation of the push button.
- c) The Internal wiring and terminal blocks shall meet the relevant requirements.

6.16.24 AUXILIARY TRANSFORMER:



Any auxiliary voltage required for any of the component inside the switchgear shall be derived from the main supply by providing adequately rated auxiliary transformer mounted inside.

6.16.25 INDICATING LAMP:

Indicating lamps shall be:

- a) Clustered LED type and of low watt consumption.
- b) Provided with series resistors.
- c) Provided with translucent lamp covers of colors 'Red', 'Green' and Amber' etc. as required.
- d) Indicating lamp shall be of the double contact, bayonet cap type rated for operation at either 110 V AC or at the specified AC/ DC system voltage as applicable.

6.16.26 CONTROL & SELECTOR SWITCH:

Control and selector switches shall be:

- a) Rotary type with enclosed contacts.
- b) Adequately rated for the purpose intended (Minimum acceptable rating is 10A continuous at 230V AC and 1A (inductive break) 220V D.C.
- c) Provided with escutcheon plates clearly marked to show the positions.
- d) Control switches shall be spring return to normal type & provided with pistol grip type handles.
- e) Selector switches shall be maintained contact stay put type. Switches in ammeter circuits shall be of break type contact. Selector switches shall be provided with oval handles.

6.16.27 SPACE HEATER:

- a) Adequately rated anti-condensation space heaters shall be provided, one for each control panel, for each switchboard and for each marshalling kiosk.
- b) Space heater shall be of the industrial strip continuous duty type, rated for operation on a 240 V, 1 phase, 50 Hz, AC system.
- c) 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 350 C.
- d) Space heater indicated in the breaker modules represents the space heater for each vertical section of the switchboard. Where breakers are mounted in two-tier formation, then only one space heater with associated MCB and thermostat is adequate for the vertical section.

6.16.28 CUBICLE LIGHTING / RECEPTACLE:

- a) Each control cabinet, marshalling box, etc. shall be provided with interior lighting by means of 9/11 W LED luminaries with door operated On/ Off switch.



- b) A 240 V, 1 phase, AC receptacle (socket) plug point shall be provided in the interior of each panel with a MCB.

6.16.29 DRAWING / DOCUMENTS REQUIRED:

After award of contract Contactor has to submit drawings/ documents for Purchaser's approval as mentioned below but not limited to:

- a) General arrangement diagram showing dimensions of enclosure, length, widths and depth of enclosure and bill of quantity indicating the rating, make of each components and quantity.
- b) Complete assembly drawings of the switchboard/ distribution board/ MCC showing plan, elevation and typical sectional views and location of cable boxes and control cable terminal blocks for external wiring connections, etc.
- c) Foundation plan showing the location of channel sills, foundation, anchor bolts and anchors, floor plans and openings.
- d) Schematic power and control wiring diagrams with bus bar rating with material, instrument & control transformers, switchgear rating, control interlocks, relays, instruments, space heaters details etc.

TECHNICAL DATA SHEET FOR MEDIUM VOLTAGE PANEL BOARD

SR. NO.	PARTICULAR	DETAILS	DATA TO BE FILLED BY THE BIDDER
1.0	SITE CONDITION		
1.1	Type/Make	Indoor/As per tender	
1.2	Mounting	Floor	
1.3	Ambient Temperature	50°C	
1.4	Atmosphere	Corrosive, Humid and Dusty	
2.0	CONSTRUCTION		
2.1	Housing	2.0mm thick CRCA sheet for body and all partitions	
2.2	Protection Class	IP-4X	
2.3	Doors	1.6 mm thick CRCA sheet with Hinges	
2.4	Gland Plate	3 mm thick	
2.5	Base channel / Stand	75x40mm C Channel	
3.0	OPERATIVE CONDITION		
3.1	Voltage	415V±10%	
3.2	No. of phase	3	
3.3	System	3 phases, 4 wire	

3.4	Frequency	50Hz,+5%/-5%	
3.5	Fault Current	50KA or as per SLD	
3.6	Neutral Grounding	Solid	
4.0	CONTROLSYSTEM		
4.1	Voltage		
	For Indication	230VA.C.	
	For Metering	230VA.C.	
	For Protection	230VA.C.	
4.2	Control Supply Through Control Transformer	230VA.C.for MCC & APFC only	
4.3	Control Wiring	1.5/2.5mm ² FRLS Cu. Wire	
5.0	BUSBAR		
5.1	Phase Busbar		
A.	Material	Copper	
B.	Support	SMC/DMC	
C.	Insulation	PVC sleeves	
D.	Isolating Barriers	Fiber Glass/ Poly Carbonate of minimum 1.5 mm thickness	
E.	Current Density	1.6A/mm ² (Temperature rise calculation for selection of busbar shall be submitted)	
5.2	Neutral Busbar Material	Same as Phase Bus	
5.3	Earth Busbar Material	Cu. Or as per BOM/SLD	
6.0	PLC Based System	As per requirement	
7.0	PAINTING		
7.1	Sheet should be 7 tank processed, Oven Baked at 310°C. With powder coating.	Required	
7.2	Colour	RAL 7035 or As per Approved by client	
8.0	PANEL TEMPERATURE RISE		
8.1	Max. temperature rise inside the panel (°C)	40°C above ambient	
8.2	Pump Starter Cubicle	Adequate ventilation & cooling arrangements to be provided in all soft starter	
		compartment with supporting calculations	

9.0	Control Wiring		
9.1	Wire Size	Min. 1CX1.5 mm ²	
10.0	Hardware (Zinc Plated)	YES	
11.0	Space Heater	230VA.C.with thermostat	
12.0	Pocket For Drawings at door	YES	
13.0	Degree of protection	Minimum IP42	

Note: Other specifications not mentioned in data sheet shall be considered as per Tender specifications.

7.0 CAPACITOR & CAPACITOR BANK

7.1 SCOPE

- This specification covers supply, installation, testing and commissioning of capacitor banks suitable for continuous duty.

7.2 CODES AND STANDARDS

- The design, manufacture and performance of the capacitor banks shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment will also conform to the latest applicable Indian / British / IEC standards. In particular the equipment shall conform to the latest revisions of the following:

IS : 2834 Shunt capacitors for power system.

IS: 9224 Low voltage fuses

- When the above standards are in conflict with the stipulation of this specification, this specification supersedes them.

7.3 CONSTRUCTION

7.3.1 CAPACITOR BANK

- Capacitor banks shall comprise of identical delta connected three phase units. The individual capacitor unit shall be manufactured out of **Heavy duty APP** design comprising of double hazy and thick polypropylene film between two electrodes of thick aluminium foil. Each individual element of the capacitor unit shall be provided with silver fuse wire. The capacitor unit shall consist of many such elements in series / parallel combinations for getting the desired KVAR output. The capacitor shall be vacuum impregnated with liquid dielectric having high thermal stability.

- The phase terminal connections of the capacitor unit shall be brought out at the top through metal insulators which should be soldered to the fabricated top cover. The capacitor shall be provided with suitably rated discharge resistors. The capacitor shall be designed to withstand the Electro dynamic and thermal stresses caused by transient over current during switching. Space heaters and cubicle lighting shall be as per requirement.

7.3.2 BUSBARS CHAMBER

- Capacitor bank shall be provided with a busbar chamber. The chamber shall be dust and vermin proof in construction, fabricated from 2 mm thick sheet steel. Continuous neoprene rubber gaskets shall be provided on all mating surfaces. TP Bus-bars shall be of Copper / As per SLD supported on epoxy insulators of adequate rating and strips.
- The bus bar sizes and clearances shall be suitable for connection of cables through crimping type cable lugs. Busbar chamber shall be extended suitably on one side to enable termination of cable. There shall be a provision of cable end box at the end of busbar chamber undrilled removable gland plate and access covers to be provided for cable entry as required.
- Capacitor shall be switched through 8/12 stage APFC Relay.

7.3.3 EARTHING

- The enclosure of capacitor unit shall be provided with 2 nos. 10 mm earth terminals each complete with two plain and one spring washer, nuts etc. These terminals shall be effectively bonded to the common sheet steel frame work. Each bank will have two external earth terminals in the busbar chambers complete with hardware.

7.3.4 PAINTING

- The painting shall be of 7 tank process with powder coating same as Motor control centre specification nonly.

7.3.5 DRAWINGS

- i.) General arrangement drawing showing overall dimensions, weight, internal arrangement and mounting details, Bill of material along with Make and model no of each component.
- ii.) Terminal chamber, showing bus-bar arrangement with all dimensions.
- iii.) Technical detail, Make and Model No of APFC relay.

7.3.6 TEST & TEST CERTIFICATES



- Vendor shall carry out all routine tests in the presence of purchaser's representative/TPI [if desired by client] as specified in IS: 2834 and shall furnish the test certificates.
- The vendor shall also carry out the thermal stability test on the units in the presence of purchaser's representatives.
- The capacitor units shall be tested from electric supply authorities like state / local electricity board and the test certificates in duplicate shall be furnished to client and also the copy shall be submitted to the electric supply authority while getting the power supply released from them.

8.0 LOW VOLTAGE (LT) CABLES

8.1 GENERAL:

- The scope shall be inclusive of supply, installation, testing & commissioning of power & control cables, cable terminations, cable accessories, stripping of cable insulation, supplying and fixing of Aluminum lugs for aluminum cables & tinned plated copper lugs for copper cables and crimping the same to the conductor, supply and fixing of double compression cable glands including all labour supply and consumable material required for jointing/ termination. The rate shall also include the laying of cable in ground/ in cable trays / cleating to structure etc.

8.2 APPLICABLE STANDARD:

- The cables shall confirm to the latest applicable standards specified below. In case of conflict between standards and this specification, this specification shall govern.

PVC insulated cables(for voltage up to 1100 V)	IS: 694
HRPVC & PVC insulated cables heavy duty	IS: 1554
Cross linked polyethylene insulated PVC sheathed cables	IS: 7098
Low frequency cables and wires with PVC insulation and sheath	IEC: 189-1 & IEC-189-2
PVC insulation and sheath of electric cables	IS: 5831
Polyethylene insulation and sheath for electric cables	IS: 6474
Conductors for insulated electric cables	IS: 8130
Methods of test for cables	IS: 10810
Specification for drums of electric cables	IS: 10418
Specification for PVC insulated cables for electricity supply	BS: 6346
Specification for PVC insulation and sheath of electric cables	BS: 6746

8.3 CONSTRUCTIONAL FEATURES:

- a) The LV Power cables shall be 1.1kV grade, 4/ 3.5/ 3 Core, multi-stranded, Al/ Cu conductor, XLPE insulated as per IS 7098 Part-1 1988, inner sheath shall be extruded PVC Type ST-2 as per IS:5831-1984 & outer sheath shall be extruded PVC type ST-2 as per IS:5831-1984 with FR-LSH properties (as specified in Tender BOM) Armouring shall be Galvanized Flat strip / round wire (as specified in Tender BOM). Anti rodent and anti termite properties shall be considered as specified in Tender BOM.

Other details shall be considered as per LT Cable data sheet.

- b) All the control cables shall be 1.1kV grade, no. of cores (as per requirement/ application with minimum 2 spare cores for 7C & above) multi-stranded, Copper conductor, XLPE insulated, extruded inner PVC & outer PVC FRLS sheath compound type ST2 and galvanized steel round wire armoured.
- c) All control cables shall be with following specific requirements:
- i. Copper conductor stranded class 2.
 - ii. XLPE Insulated
 - iii. Provided with inner extruded PVC and outer PVC FRLS sheath (as specified in BOM) of extruded black PVC compound.
 - iv. Galvanized steel armouring in the form of GI round wire.
 - v. Core identification shall be by printed numerals.
 - vi. The insulation over the individual conductor core will be colour coded.
 - vii. Minimum 2 spare cores for above 7C.
- d) The DC power supply cable shall be two core, multistranded copper conductor, armoured cables with inner extruded PVC & outer PVC FRLS sheath. All control wiring shall be PVC FRLS insulated.
- e) All the power & control cables used in the Hazardous area shall be flame proof type suitable for the intended application.
- f) Earthing Cable shall be Single core multi-stranded Cu, 1.1 kV grade, XLPE insulated, un-armoured green coloured outer sheath with yellow strips/ band cable to be laid in trays, underground, trenches etc. as applicable.

- g) Submersible Cables: Multi core flexible Cu conductor XLPE insulated & PVC sheathed heavy duty cable suitable for submersible application (in case of submerged pumps) shall be manufactured as per governing standards. High purity electrolytic grade, annealed Cu conductor shall be used. Cables shall be extruded inner & outer PVC sheathed. PVC compound shall be dielectric grade & shall be impervious to water, oils & grease etc. Similarly double PVC sheathing shall also be done as per IS: 5831/ 1984. Flexible inner sheath & high abrasion resistant flexible outer sheath is required for these cables. Double PVC sheathing shall be done so as to withstand abrasion & prevent ingress of water along the interstices of the cable. Core identification shall be by printed numerals. Conductors shall be as per IS 8130. Cable shall be constructed as per relevant IS/ IEC standards.

8.4 CABLE COLOURS:

- a) All cable cores shall be colour coded throughout their length and shall be so connected between switchboard, distribution board, plant and accessories, that the correct sequence or phase colours are preserved throughout the system.
- b) The colour coding should be as follows:
- | | | |
|------|---------------------------|---------------------------------------|
| i. | 3 phase | Red, Yellow and Blue |
| ii. | single phase or dc supply | Red and Black |
| iii. | earth | Green/Green with Yellow coloured band |
| iv. | control | Gray (DC) |

8.5 CABLE CONDUCTORS:

- c) Cables upto 4.0 sq.mm shall be Cu multi-stranded conductor with galvanized steel round wire armoured & balance cables shall be Al multi-stranded conductor with galvanized steel round wire/ flat strip armoured.
- d) Single core cable shall have nonmagnetic material armouring.
- e) Lighting final distribution circuits shall be of a minimum cross-section of 1.5 mm².
- f) Small control cables shall be of a minimum cross-section of 1.5 mm².
- g) Internal wiring of control panels shall be of a minimum cross-section of 1.5 mm² flexible and multi stranded.
- h) Instrumentation and control cabling shall be of a minimum cross-section 1.5 mm² for external use and 1.0 mm² for internal use.
- i) Cable Sizing shall be done as per design criteria specified in specifications.

8.6 CABLE NUMBERING:

- All cables shall be allocated a unique number which shall be fixed to each end of the cable using a corrosion resistant label. Necessary loop at both ends shall be provided for future use and cables of different categories shall be tagged with the following subscripts and three digit number.



HV power HV-P___

LV power P___

Control C___

Instrumentation I___

Protection PR___

Telecommunication T___

8.7 CABLE TERMINATION:

a) Cable Lugs

- i. Cable lugs shall be of tinned copper, solder less crimping type for Cu cables & AL lugs for the AL cables.
- ii. The current rating of the lugs shall be same as that of the respective cable conductors.
- iii. Bi-metal strip/ Bi-metallic lug shall be used whenever two different metals are to be connected together.
- iv. Double holes extended neck (long barrel neck) type lugs shall be used in case of cables above 185 sq. mm.
- v. Anticorrosion/ anti-oxidation compounds shall be used for crimping lugs. This shall especially be ensured for Al cable terminations & bimetallic terminations shall be used wherever required.
- vi. If termination is done with crimping tool employing crimping die then forming dies shall be used to make the sector shaped conductor into a round conductor before crimping the lugs on the conductor. The lug must not be crimped directly on the sector conductor. Before crimping the lug, the conductor shall be thoroughly cleaned and special jelly applied over it to prevent further oxidation.

b) Cable Glands

- i. Glands shall generally be of the double compression hexagonal type brass glands. Earth continuity of brass glands shall be assured.
- ii. Double compression type cable glands shall be used. Cable glands shall be brass casting, machine finished and Nickel-plated to avoid corrosion and oxidation. Rubber components used in cable gland shall be of neoprene.
- iii. For single core cables, gland shall be with brass ring.
- iv. Glands for single core cables shall be constructed from non-magnetic materials.
- v. Cable glands shall be with metric threads.
- vi. Where holes for cable entries are not provided it shall be the responsibility of the Contractor to mark out and drill such holes. Burrs and swarf shall be removed, care being taken to ensure that swarf and filings, etc do not enter the equipment.



- vii. For non-hazardous areas cable glands in situations where moisture may be present shall be double seal weatherproof type, gland shrouds shall be used and entry shall be sealed.
 - viii. For dry indoor situations, standard industrial glands with shrouds are acceptable.
 - ix. For hazardous areas, glands conforming to EEE standard shall be used with double seal and shroud.
- c) Trefoil Clamps for Single Core Cables.
- i. All the single core cables shall be laid in trefoil formation only.
 - ii. The grouping & sequencing of three single core cables arranged in trefoil formation shall be done in such a way to ensure balanced current distribution.
 - iii. Trefoil clamp of suitable size & having nonmagnetic material shall be used.
 - iv. The Trefoil groups shall be held in trefoil clamps at an interval not exceeding 3.0 meters.
 - v. In addition to trefoil clamps as mentioned above, the tre-foil groups of cables shall be additionally tied by means of 3.0 mm dia. nylon cord clamp at an interval not exceeding 750 mm.
- d) Where ever applicable, supply & installation provision of bimetallic strip for connection between Al to Cu strip & GI to Cu strip shall be provided.

8.8 CABLE DRUMS:

- a) Cables shall be supplied in non-returnable wooden/steel drums. The wood used for construction of the drum shall be properly seasoned and free from defects and wood preservative shall be applied to the entire drum. All ferrous parts shall be treated with a suitable rust preventive coating to avoid rusting during transit or storage.
- b) Before winding the cables on drums, Contractor shall obtain Purchaser's approval for the drum lengths. Cable ends shall be sealed by non-hygroscopic sealing caps.
- c) Contractor has to ensure reference of an arrow and suitable accompanying wording which shall be stenciled on the sides of the drums indicating which way it should be rolled. The number on each drum shall be either branded at the end of the drum or stamped on the metal attached to an end of the drum. The cable shall be placed on the drum in such a manner that it will be protected from injury during transit. Each end of the cable shall be firmly and properly secured to the drum. The drum shall be securely blocked in position so that the cable will not be displaced during transit. Cable ends shall be sealed by non-hygroscopic sealing caps.
- d) It shall be the Contractor's responsibility to prepare the drum cutting schedule so that cable wastage is minimum while cutting.
- e) Contractor shall obtain Purchaser's approval for the drum lengths.

8.9 MANUFACTURER TESTING FACILITY (Mandatory):



Apart from Tender Approved Cable Vendor. Following criteria shall be fulfilled by the successful bidder while selecting Cable OEM before submitting cable technical data sheet and documents.

- All type, routine, and acceptance testing of cables shall be conducted in laboratories accredited by the National Accreditation Board for Testing and Calibration Laboratories (NABL), in accordance with ISO/IEC 17025:2017. The laboratory must hold a valid accreditation scope covering all relevant tests as per applicable Indian and international standards such as IS 694, IS 1554, IS 7098, IEC 60228, IEC 60502, or equivalent. Test reports submitted for quality assurance, regulatory compliance, or customer approval shall be valid only if issued by NABL-accredited laboratories with an appropriate scope for cable testing.
- The manufacturer shall submit NABL test reports for each batch/type of cable manufactured, covering electrical, mechanical, thermal, and flammability characteristics, as applicable. In-house laboratories must also be NABL-accredited if their reports are to be accepted.
- The cable shall be manufactured with an outer sheath compound that is Anti-Rodent, Anti-Termite, and UV (ultraviolet) resistant (if specified in Tender BOM). The compound shall be tested and verified as per relevant test methods to ensure long-term resistance to rodent attack, termite infestation, and degradation from UV radiation.
- The following tests shall be carried out at NABL-accredited laboratories as per ISO/IEC 17025:2017:
 - I. Anti-Rodent Test: As per IS 10810 Part 55 or IEC/TR 62039 or equivalent method.
 - II. Anti-Termite Test: As per ASTM D3345, IS 10810 Part 55, or equivalent.
 - III. UV Resistance Test: As per ASTM G154, ISO 4892, or IS 10810 Part 53.
 - IV. All compound test reports shall be submitted from NABL-accredited laboratories and must include:
 - Tensile Strength and Elongation Before and After UV Exposure
 - Observations of Physical Damage due to Rodent and Termite Exposure
 - Compliance Certificate from the Compound Manufacturer specifying anti-rodent and anti-termite additives used
- The outer sheath of the cable shall be made from Flame Retardant Low Smoke Halogen (FRLSH) compound (if specified in Tender BOM). The sheath shall have low emission of smoke and toxic halogen gases when exposed to fire, and shall comply with all the performance parameters as per IS 7098 (Part 1/2), IS 10810 test methods, and IEC equivalents where applicable.
- The FRLSH sheath shall be tested at a NABL-accredited laboratory and meet the following requirements:
 - i. Oxygen Index (OI) IS 10810 Part 58 / ASTM D2863 $\geq 30\%$



- ii. Temperature Index (TI) IS 10810 Part 64 $\geq 250^{\circ}\text{C}$
- iii. Smoke Density Test ASTM D2843 / IS 10810 Part 63 Maximum Light Absorption: $\leq 60\%$
- iv. Acid Gas Generation (Halogen Acid) IEC 60754-1 / IS 10810 Part 59 Halogen acid $\leq 0.5\%$ by weight
- v. pH and Conductivity of Aqueous Extract IEC 60754-2 / IS 10810 Part 60 pH ≥ 4.3 ; Conductivity $\leq 10 \mu\text{S}/\text{mm}$
- vi. Flammability Test (Vertical Flame Test) IS 10810 Part 53 / IEC 60332-1 Flame should not reach the upper marker.

8.10 TEST TO BE PERFORMED AT ERDA

- Following tests on each sizes of HT and LT cables, cable sample will collect from cable drums in presence of EIC or his/her direction and samples shall be given at ERDA – Baroda.
- Cable Analysis / testing shall be performed as per relevant IS/IEC standard and test reports shall be submitted to client.
- All expenses like cable sample collection, testing charges, required cable length for concern reports shall be in contractor scope. (Specified in BOM). No extra cost will be paid to contractor.
 - Annealing test
 - Tensile test
 - Wrapping test
 - Test for thickness of insulation & sheath
 - Physical test for insulation & sheath
 - Tensile strength and elongation at break of insulation and sheath
 - Loss of mass test
 - Shrinkage test
 - Heat shock test
 - Insulation resistance test
 - High voltage test
 - Flammability test
- EIC or Client has authority to add or alter certain test from the above list. No additional charges will be paid to contractor.
- In case cable samples will not pass as per relevant IS/IEC standard or offered data during testing at ERDA, cable lot will be rejected. All the expenses like cost of offering new cables, fees for testing by ERDA, client & TPI inspection fees and mobilization from factory to ERDA, in former case and also in later case shall be borne by contractor only.



- The VMC reserves the right to retain the rejected Cable lot and take it into service until the bidder replace, at no extra cost, the defective cable lot by a new cable lot.

Note : Testing of cables at ERDA shall not be limited to the tests listed in this clause of the tender specifications. The EIC/Client reserves the right to carry out various tests from all tests available at ERDA, including type tests, as per the relevant applicable IS standards. No extra cost will be paid for the same.

8.11 TESTS BEFORE AND AFTER LAYING OF CABLES AT SITE:

- Following Routine & acceptance tests on each drums as per IS 10810, IS 7098 standard & other specified relevant standards shall be performed by the manufacturer and witnessed by Purchaser/Purchaser's Representative.
 - a) For 1.1 kV Power & Control cables:
 - I. Dimensional & visual check
 - II. Conductor resistance test
 - III. Insulation Resistance Test
 - IV. High voltage test
 - b) For 11 kV power cables:
 - I. Design and visual check
 - II. Conductor resistance test
 - III. Very low frequency AC HV test (instead of DC test)
 - IV. Insulation resistance including P.I. at rated voltage
 - V. AC leakage current
 - VI. Partial discharge measurement
 - c) All HV cables shall be subjected to DC or AC (preferably DC) high voltage test after terminating but before commissioning as per Table 6.0 in IS: 1255 (Code of practice for Installation & Maintenance of Power Cables up to and including 33kV).
 - d) Cables shall be checked for insulation resistance before and after jointing. The voltage rating of the Megger for cables of different voltage grades shall be as indicated below.

Voltage Grade	Megger rating
1.1kV	500V
11kV	1000V

- e) Following tests in the presence of Purchaser/ Purchaser's representative shall be carried out at site before commissioning of cables.
 - i. Insulation Resistance test between phases and phase to Neutral and phase to earth.
 - ii. Continuity test of all the phases, neutral and earth continuity conductor.
 - iii. Sheathing continuity test.



- iv. Earth resistance test of all the phases and neutral.

8.12 DRAWINGS / DOCUMENTS REQUIRED:

- a) As a part of the Bid, Contractor shall furnish the following :
 - i. General information
 - ii. Principal technical data
- b) After award of contract it shall be the responsibility of Contractor to work out a detailed layout for the complete plant cabling system. The layout drawing shall be furnished for the approval of Purchase/ Purchaser's representative before commencement of installation including cable trays, cable racks/ trenches, accessories, tray supports, conduits etc.
- c) Contractor to submit following Drawings/ Details after award of contract
 - i. Cable Sizing calculations
 - ii. Details of Installation of cables in trenches, on cable trays, directly buried etc at all locations inside the plant.
 - iii. Cable routing layout inside and outside the plant with route marker provided at 15 meter interval.
 - iv. Bill of quantities of cables, lugs and glands.
 - v. HV Cable termination and mounting Kit Layout drawing.
- d) Following Type Tests reports as per relevant standard to be submitted for the same rating & type of Cables conducted in past for review of Purchaser/ Purchaser's Representative by the Contractor at the time of inspection & testing of equipment.

Type test reports should be valid and not be older than the 5 years.

- i. Annealing test
- ii. Tensile test
- iii. Wrapping test
- iv. Test for thickness of insulation & sheath
- v. Physical test for insulation & sheath
- vi. Tensile strength and elongation at break of insulation and sheath
- vii. Loss of mass test
- viii. Ageing in air oven
- ix. Shrinkage test
- x. Heat shock test
- xi. Insulation resistance test
- xii. High voltage test
- xiii. Flammability test


DOCUMENT: TECHNICAL DATA SHEET OF LT XLPE CABLE

Sr. No.	Description		Tender Requirement	Vendor To Specify
A	GENERAL			
1	Company Name			
2	No of Cores		As per Tender BOM	
3	Area Sq.mm.		As per Tender BOM	
4	Cable Type		A2XFY / A2XWY / As per Tender BOM	
5	Voltage Grade		1100 Volts	
6	Standard Applicable		IS:7098 (Part 1) 1988, IS:5831-1984, IS:8130-2013, IS 3975-1999	
B	Conductor			
1	Material		Stranded(Cl.2) H2/H4 Grade Aluminium conductor as per IS:8130-2013	
2	Shape		Compacted sector Shaped	
3	Cross sectional area (Main)	Sq.mm	Vendor to Specify	
4	Cross sectional area (Reduced Neutral)		Half of the Main	
C	Insulation			
1	Material		Extruded XLPE as per IS 7098 Part-1 :1998	
2	Nominal Thickness (Main)	mm	Vendor to Specify	
3	Nominal Thickness (Reduced Neutral)	mm	Vendor to Specify	
4	Core Identification		Vendor to Specify	
D	Inner Sheath			
1	Material		Extruded PVC Type ST2 as per IS:5831-1984	
2	Colour		Black	
3	Minimum Thickness	mm	Vendor to Specify	
E	Armour			
1	Material		Galvanized Steel as per IS :3975-1999	
2	Type		Upto 10 sq.mm Round Steel wire / Above 10 sq.mm Flat Strip	



3	Size – Nominal	mm	Vendor to Specify	
F	Outer Sheath			
1	Material		Extruded PVC Type ST-2 as per IS:5831-1984 with FRLSH Properties/ Specified in BOM	
2	Minimum Thickness	mm	Vendor to Specify	
3	Colour		Black / As per Client Requirement	
4	Approx. overall dia of cable	mm	Vendor to Specify	
5	Tolerance on overall dia		As per IS / Vendor to Specify	
G	FRLSH Properties (If Specified in BOM)			
1	Oxygen Index at room Temp °C		As per ASTM-D-2863	
2	Temperature Index		As per ASTM-D-2863	
3	Smoke Density Rating		As per ASTM-D-2863	
4	Acid Gas Generation		As per IEC 60754-1	
5	Flammability Test		As per IEC 60332-1	
H	Electrical Data			
1	Max DC resistance at 20 deg C (Main)	Ω/km	Vendor to Specify	
2	Max DC resistance at 20 deg C (Neutral)	Ω/km	Vendor to Specify	
3	Max AC resistance at 90 deg C (Main)	Ω/km	Vendor to Specify	
4	Capacitance	$\mu\text{F}/\text{km}$	Vendor to Specify	
5	Reactance at 50 Hz	Ω/km	Vendor to Specify	
6	Current Ratings			
i.	In Ground at 30°C	Amps	Vendor to Specify	
ii.	In air at 40°C ambient	Amps	Vendor to Specify	
7	Short circuit rating of conductor for one second duration	kA	Vendor to Specify	
8	Volume Resistivity	$\Omega.\text{cm}$		
i.	At 27°C		Vendor to Specify	
ii.	At 90°C		Vendor to Specify	
9	Conductor Temperature			
i.	Under Normal Operating Conditions		Vendor to Specify	
ii.	At the termination of		Vendor to Specify	



	short circuit			
I	CABLE DATA			
1	Cable Marking			
2	Following details shall be embossed / Printed on outer sheath at an interval not exceeding one meter. OEM name, Year of Manufacturing, Voltage grade, cable size & Type, IS specification No. , Client Name (VMC)			
3	Drum Type		Non-Returnable wooden /steel drum	
4	Drum Length		Vendor to Specify	

Note: Anti Rodent and Anti Termite properties shall be considered as specified in Tender BOM.

8.13 CABLE TRAY AND ACCESSORIES:

- a. Cable trays shall be of Galvanized Steel and of ladder/ perforated/ solid type, complete with all necessary coupler plates, elbows, tees, bends, reducers, stiffeners and other accessories and hardware as detailed in the relevant drawings. All hardware (i.e. bolts, nuts, screws, washers, etc) shall be hot dip galvanized.
- b. Cable trays of ladder and perforated types and the associated accessories such as coupler plates, tees, elbows etc., shall be fabricated from 14 gauge (2.0 mm thick) mild steel sheets. Cable tray covers shall be fabricated from 16 gauge perforated (1.60 mm thick) M.S. sheets.
- c. The cable trays shall be supplied in standard lengths of 2500 mm and clear inside widths of trays shall be as follows:
 - i. Perforated type trays: 50,100,150, 300, 450 mm.
 - ii. Ladder type trays: 300, 450, 600 mm
- d. Cable trays, accessories and covers shall be painted with one shop coat of red oxide zinc chromate primer and two site coats of aluminium alkyd paint for indoor use.
- e. For outdoor use, cable trays, accessories and covers shall be either galvanized (min 80-100 micron) or made of aluminium as specifically mentioned in the tender BOM.
- f. For use in corrosive atmospheres both indoors and outdoors, the cable trays, accessories and covers shall be as per serial no.(e) above.
- g. The spacing of rungs for ladder type of trays shall be 250 mm unless otherwise noted.
- h. All finished cable trays and accessories shall be free from sharp edges, corners, burrs and unevenness.



8.14 CABLE TRENCH:

- Construction of Cable Trench in brick or bela stone masonry, locally available in C.M. 1:6 foundation concrete 150mm thick in C.C. 1:3:6 of trap metal size 25 to 40mm thick, inside cement plaster in C.M. 1:3 upto 1.20 Height & 0.90M Width including complete civil work, excavation and refilling with cast in situ RCC slab in one single piece with 230 mm thick brick masonry wall in CM 1:6.

9.0 EARTHING:

9.1 Scope:

- The scope includes collection of data, design of the system as per relevant National/International Standards preparation of layout drawing supply of earthing conductors, earth electrode, earthing strips installation and approval to the satisfaction of electrical inspector under this tender specification.
- Earthing system shall be provided to ensure equipment safety, personnel safety and facilitate designed operation of protective switching during earth fault conditions in the associated system.

9.2 Applicable Standards:

- The earthing and lightning protection system shall conform to the CEA guidelines and the latest applicable standards indicated below:

Code of Practice for Earthing	IS: 3043
Code of Practice for the Protection of	IS/IEC 62305
Hot dip galvanizing	IS: 2629, 2633, 4759
Structural steel	IS: 2062 & 808

9.3 Earthing:

- The design basis for designing earthing conductor is indicated under design criteria for electrical system. Earthing system shall be provided for complete plant i.e. pumping stations, switchyard and all electrical equipments as per the latest edition including all official amendments and revisions of IS-3043 and CEA guidelines.
- All materials and fittings used in the earthing installation shall conform to the relevant Indian Standards or shall be approved by the Engineer's representative & CEIG.
- Contractor has to carry out soil resistivity test at, at least 4 locations for which locations shall be provided by Purchaser's representative. Testing to be done at each site.
- Soil resistivity shall be carried out by Wenner four electrode method as described in IS 3043. Contractor has to carry out the test in presence of Purchaser's representative & test shall be carried out keeping electrode spacing as 1, 2, 4, 6, 8, 10, 15, 25 M (each, along all 8 directions) as per normal practice and report has to be submitted. Polar curves shall be used for measurement of mean soil resistivity, which shall be used in finding earthing resistance at a particular location. Mean soil resistivity values shall be approved by Purchaser's representative.=



- e. The Contractor shall base his earthing calculations on actual measurement carried out by him in the presence of Purchaser/ Purchaser's Representative.
- f. Galvanized Iron flat / wire shall be used as earthing conductor.
- g. The underground joints in the system shall be properly welded or brazed and the bolted type connection shall be made with structures/ equipments. Petroleum jelly shall be applied to contact surface of the bolted joints, which will be covered with bituminous compound and tapes.
- h. Earthing conductor shall be protected against mechanical damages considering the installation conditions.
- i. The earthing system shall comprise one or more earth electrodes, earthing grid or a combination of these in order to obtain the required earth electrode resistance of less than 1 Ohms.
- j. For equipment earthing, two earthing leads will be used if rated voltage of the equipment is 250 volts & above and one earthing lead will be provided for equipment rated below 250 volts.
- k. The earthing conductors in outdoor areas shall be installed at a minimum depth of 600 mm below FGL.
- l. For each 11 KV DP Structure, minimum 2 nos. of Chemical earthing with earthpit of minimum bore dia. 225mm 2 Mtrs. long Earthing Electrode consisting Pipe-in-Pipe Technology as per IS 3043-1987 made of corrosion free G.I.Pipes having Outer pipe dia of 80 mm having 80-200 Micron galvanising, Inner pipe dia of 40 mm having 200-250 Micron galvanising, connection terminal dia of 14 mm with constant ohmic value surrounded by special back filling chemical compound and bricks masonry block and CI Cover complete as per IS 3043 with necessary length of double GI earth flat 50 x 6mm / 25x6 mm bolted with lug to the earth electrode complete connected to the required point of DP with end socket as per direction and duly tested by earth tester conforming to IS as per drawing and specifications complete.
- m. For each Transformer and DG neutral, minimum 2 nos. of Chemical earthing with earth pit of minimum bore dia. 225mm 3 Mtrs. long Earthing Electrode consisting Pipe-in-Pipe Technology as per IS 3043-1987 made of corrosion free G.I.Pipes having Outer pipe dia of 80 mm having 80-200 Micron galvanizing, Inner pipe dia of 40 mm having 200-250 Micron galvanising, connection terminal dia of 14 mm with constant ohmic value surrounded by highly conductive compound with high charge dissipation. The earthing electorde shall be buried in specifically prepared earth pit 3 mtr. below ground surrounded by special back filling chemical compound and bricks masonry block CI Cover complete as per IS 3043 with necessary length of 70sq.mm. YWaY cable with lug to the plate complete connected to the transformer and DG neutral with end socket as per direction and duly tested by earth tester conforming to IS as per drawing and specifications.



- n. For other equipment & area, Earth electrodes shall be of heavy duty galvanized mild steel of not less than 40 mm NB and minimum 3000 mm long. Where multiple rods are used they shall be separated by a distance of not less than 2000mm.
- o. Each earth electrode pipe shall be welded at the top to a mild steel plate to which the earthing strips shall be connected. These connections shall each be housed in individual inspection chamber set which shall project 100 mm above the finished ground level and shall allow disconnection for testing of individual electrodes. The chamber shall be permanently marked 'Electrical Earth'.
- p. All materials used for the earth electrode installation shall be purpose made for the application and site conditions and shall be approved by the Purchaser's Representative.
- q. All civil works, such as excavation, boring, provision of charcoal & salt in adequate quantity, backfilling for the installation of the earth electrodes and the earth pit/ inspection pit shall be in the scope of Contractor.
- r. After the earth installation has been completed the Contractor shall demonstrate to the Purchaser/ Purchaser's Representative that the resistance of the electrodes to earth and the continuity of the earth network are within the limits specified. Any additional earth electrodes and test instruments required for the tests shall be provided by the Contractor.
- s. Main Equi-potential Bonding Conductor: Main equi-potential bonding conductors shall be provided to connect the earth electrode system to conductive parts forming the Works.
- t. Circuit Protective Conductors: An independent circuit protective conductor shall be provided for each circuit and may comprise one or any of the following as appropriate:
 - i. A separate core within a multicore cable
 - ii. A separate conductor installed within a conduit or trunking. Steel conduit or trunking shall not be used as a circuit protective conductor.
 - iii. The metal sheath of an armoured cable. The sheath shall be bonded to the metal work of the apparatus and to the apparatus earth bar, if any.
 - iv. the copper sheath of a mineral insulated copper sheathed cable
 - v. An independent earthing conductor MS or GS run adjacent to the circuit it protects.
 - vi. The size of the circuit protective conductor shall be calculated in such a manner as not to take into consideration the contribution of any other parallel or fortuitous earth paths.
 - vii. The armoring of the supply cable shall not form the sole means of earthing a switchboard or large electrical load.

9.4 Instrumentation Earth:

- a) An instrumentation earth bus shall be provided in each control panel. This shall comprise a GI flat of cross section not less than 25 x 6 mm and length to suit the number of connections. It shall be mounted on at least two insulated supports and be provided with a single earth connection to the control panel electrical power earth.
- b) If due to the physical size of a control panel more than one instrument earth bar is required the additional bar shall be connected again with a single earth connection to the same point as before on the control panel electrical earth bar. In this fashion all instrument earths shall be connected radially from the same earth point.
- c) All signal cable screens (analogue and digital) shall be terminated on to the instrument earth bar. Signal cable screens shall be earthed at the control panel end only. Screens at the field end shall be tied back and insulated.
- d) Surge Protector Devices (SPDs) associated with the control and instrumentation system shall be earthed to the instrument earth in accordance with the SPD manufacturer's recommendations.

9.5 Important Instructions for Earthing:

- a) Each pole of lightning arrestors shall be earthed with separate earth pit.
- b) Two-earth conductor shall connect outdoor CT secondary winding to earth grid.
- c) The switchyard fencing shall be earthed at every alternate block and the switchyard gate shall be earthed with flexible GI wire.
- d) All the earthing material with laying etc. shall be included in the scope.
- e) The entire plant will have an earth grid laid in trenches/ trays/ buried in the ground outside. The main earthing grid shall be embedded at a minimum depth of 600 mm below FGL which shall be connected to earth electrodes.
- f) All interconnections of the earthing grid conductors will have welded type joints except at electrodes with disconnecting facility and at equipment with bolted connections. All indoor earthing grids will be suitably interconnected to the external earthing grid.
- g) Each steel/ RCC column of the building will be interconnected to the floor-earthing grid. Steel columns, steel strips / conduits, cable trays etc. will not be used as earth continuity conductors.
- h) Disconnecting type facility shall be provided between Earthing grid & each earth electrode.
- i) All connection between the conductors shall be welded/ brazed type. Metallic pipe, conduit, structures shall be bonded to lightning protection conductors to prevent the side flashover. But no metallic pipe, conduit, structure shall be used as air termination conductor or down conductor.
- j) The down conductors shall be fixed with embedded brass posts (on concrete columns) with nuts & bolts used for fixing the saddle/ clamp (direct drilling of down comer and fixing with screw shall not be acceptable).
- k) Cleats for 'earthing and lightning protection systems' shall be of GI.



- l) The lightning protective conductor shall not be connected with the earthing above ground however both the systems shall be interconnected below ground.
- m) The earth pits may require boring & drilling in the soil. The same shall be considered in Contractor's scope.
- n) Earth electrode with disconnecting facility shall be provided so that the resistance of the independent earth electrode may be measured.
- o) Internal earth Bus of each panel shall be connected to both ends to the earthing system by means of earthing conductor.
- p) Metallic frames of all current carrying equipment, structures supporting and adjacent to current carrying conductors, lightning protection system conductors, metallic structures, metallic stairs, hand rails, fences shall be connected to a single earthing system. Neutral points of various systems shall be connected to the dedicated treated earth pits and these earth pits shall be interconnected to each other below ground.
- q) All connections in the equipment earth conductors buried in ground (or otherwise) shall be cad welded/ brazed, whereas connection at equipment end shall be of bolted type. All connections shall be of low resistance. All bimetallic connection shall be treated with suitable compound to prevent moisture ingress. For Bimetallic bolted connection, bimetallic washers shall be used. All bolted joints shall have minimum two bolts to ensure proper surface contact. Termination of stranded conductors at earth inserts shall be with ring type/ lugs.
- r) Galvanized conductors shall be touched up with zinc-rich paint where holes are drilled at site for bolting to equipment/structure.
- s) Suitable earth risers approved by the Engineer shall be provided above finished floor/ ground level, if the equipment is not available at the time of laying of the main earth conductor. The minimum length of such risers inside the building shall be 200 mm and outdoor shall be 500 mm above ground level.
- t) Metallic conduits and pipes shall be connected to the earthing system unless specified otherwise.
- u) All cable trays will be earthed at minimum two places by suitable sized GI flats to main earthing system earth conductor. The cable trays shall also be earthed at a regular interval of not more than 10 meters by 25 x 3 mm GS flat.
- v) Earthing Pits
 - i. Adequate number of earthing pits shall be provided in conjunction with earthing grid for the earthing system. The minimum spacing between two adjacent earthing pits shall not be less than 2000mm and shall be kept 1500 mm away from footings of the structure.
 - ii. Earthing pits shall be located in ground, which has a reasonable chance of remaining moist.

- iii. A galvanized iron strip of adequate size (as per calculations) shall be provided from plate electrode to about ground level to facilitate jointing with earth conductors. Each earth electrode ending at the pit shall be connected to suitable linking strips to connect and disconnect the earthing suitably.
- iv. Earthing chamber shall be of RCC/ brick chamber of 600 mm x 600 mm, with Hinged cast Iron chequered cover plates. The covers shall have holes for handling. Earthing pits (chambers) shall be painted Green and the earth-pit number shall be marked on it.
- v. Earthing cables crossing other metallic structures such as conduits pipelines etc shall be minimum 300 mm away from such structures.
- vi. Earthing conductors shall be protected against mechanical damage.
- vii. All earth lead connections shall be as short and direct as possible and shall be without kink.
- viii. The main earth loop in plant area shall be generally routed along cables. When equipments are located away from main earth loops, suitable sub-loops shall be run up to them for deriving connections for individual equipment. The entire earthing system shall fully comply with the CEA guidelines and requirements.
- ix. The contractor shall have to carry out any changes as desired by the Electrical inspector or the Engineer in charge, in order to make installation conforming to the CEA guidelines 2010 and IS 3043.

9.6 Drawings/ Documents Required:

- The Contractor should prepare Layout drawings, after award of contract and before commencement of work for Purchaser's approval, showing the location of earthing grid, electrodes, interconnection grids and earthing leads to various equipment, down comers, isolating links etc. should be accompanied by design calculations.

10.0 SAFETY EQUIPMENTS / REQUIREMENTS AND MISCELLANEOUS ITEMS:

- Following safety procedure and practice should be provided by Contractor in switchgear room/ sub-station as per latest edition of I.S. 5216.
 - a) 900 mm wide antiskid insulating mat as per IS 15652 and of reputed make to be spread in front of the 11kV, 415V switch gear panels & power DBs, DCDB etc.
 - b) First aid box with all the standard contents.
 - c) First aid chart made of cloth for electrical shock treatment printed in English, Hindi and Gujarati duly framed with front glasses.
 - d) Charts / drawings duly framed with front glass.
 - e) 11kV and 415V Single line diagrams in adequate sizes approved by Purchaser's representative & in line with the local electrical inspector
 - f) Routine maintenance schedule for High Voltage Switchgear, Distribution Transformers, Low voltage Switchgears, APFC panels, Fire Alarm System, UPS system etc.



g) Provision of portable type Class A, B, C, and D type fire extinguishers at various locations in line with the statutory requirements.

h) **FIRE SAFETY:**

The requirement of hand appliance in switchgear room, electrical equipment room shall be provided as per Clause 4.0 of Fire Protection Manual by Regional Tariff Committee, 10th edition 1988.

Water Sealing & Fire Barriers at appropriate locations as specified in this specifications & good engineering practices.

i) **DEGREE OF PROTECTION:**

The enclosures of the control cabinets, junction boxes and Marshalling boxes, panels etc. to be installed shall provide minimum degree of protection as detailed here under

Installed outdoor – IP 55

Installed indoor – IP 42, 52, 54.

The degree of protection shall be in accordance with IS 13947 (Part I)/ IEC 947 (Part I)/ IS 2063/ IEC 529.

11. INTERNAL WIRING

This section covers, definition of point wiring, system of wiring and supply, installation, connection, testing and commissioning of point wiring for light points, ceiling fan points, exhaust fan points, convenience socket outlet points, power socket outlet points etc. including fixing of light fixtures, ceiling fan, exhaust fan, wall fan etc.

11.1 STANDARDS

The following standards and rules shall be applicable:

STANDARD	PARTICULAR
IS:732	Code of practice for electrical wiring installation (System voltage not exceeding 650V)
IS:1646	Code of practice for fire safety of buildings (General) Electrical installation.
IS:2509	Rigid non-metallic conduits for electrical wiring.
IS:6946	Flexible (Pliable) non-metallic conduits for electrical installation.
IS:1293	3 pin plugs and sockets.
IS:8130	Specifications of conduits for electrical installation.
IS:3854	Switches for domestic purpose.



IS:3415	Fittings for rigid non-metallic conduits.
IS:4648	Guide for electrical layout in residential building Indian electricity act and rules.

All standards and codes mean the latest.

11.2 POINT WIRING

- A point shall consist of the branch wiring from the distribution board together with a switch as required, including the ceiling rose or pendant holder or swan holder, or ceiling fan box or socket or suitable termination. A point shall include, in addition, the earth continuity conductor / wire from the distribution board to the earth pin / stud of the outlet / switch box and to the outlet points.

The point wiring shall be carried out in the under mentioned manner:

- Supply, installation, fixing of conduits with necessary accessories, junction / pull / inspection/ switch boxes and outlet boxes.
- Supplying and drawing of wires of required size including earth continuity wire.
- Supply, installation and connection of flush type switches, sockets, cover plates, switch plates, etc.
- The point shall be complete with the branch wiring from the distribution board to the outlet point, through switch board, conduit with accessories, junction, pull, inspection boxes, control switch, socket, outlet boxes, ceiling roses, button / swan holder, connector etc.

11.3 POINT RATE

- The rate per point shall include supply, installation, connection, testing and commissioning of point as described under “point wiring”. The measurements of the points will be enumerated.

11.4 SYSTEM OF WIRING

- Unless otherwise mentioned on the drawings, the system of point wiring shall be as follows:
- The system of wiring shall consist of single core, PVC insulated, 650/1100 volt grade, copper conductor FRLS wires laid through exposed (surface mounted) PVC conduits as directed.

11.5 GENERAL

- The contractor shall submit for approval, the shop drawing of conduit layout indicating the route of the conduits, number and size of the conduits, location of junction / inspection / pull / outlet boxes, size and location of switch boxes, number and size of wires pulled through each conduit and all other necessary relevant details prior to laying of conduits. Only after the drawings are approved,



the contractor shall proceed the work of conduit laying.

11.6 MATERIAL

11.6.1 PVC CONDUITS:

- All non-metallic PVC conduits shall conform to IS: 9537. The conduit shall be plan and type as specified in IS: 9537 and shall be used with the corresponding accessories (Refer IS: 3419 specification for fittings for rigid non PVC metallic conduits). PVC conduits shall be rigid unplasticised, heavy gauge having 2.0 mm. wall thickness upto 20 mm. diameter conduits and 2.5 mm. wall thickness for all sizes above 20 mm. diameter.

11.6.2 BOXES:

- All the boxes for switches, sockets and other receptacles, junction boxes, pull boxes and outlet boxes shall be fabricated from 2.0 mm. thick mild sheets painted with two coats of red- oxide and then two coats of enamel paints as called for. Colour of the paints shall be as approved by the client. The boxes shall have smooth external and internal finished surface. Boxes in contact with earth or exposed to the weather shall be of 2 mm. mild steel and hot dip galvanized after fabrication. Separate screwed earth terminal shall be provided in the box for earthing purpose. All boxes shall have adequate no. of knock out holes of required diameter for conduit entry. Switch boxes to receive switches, socket outlets, power outlets, telephone outlets, fan regulators, etc. shall be fabricated to the approved shape and size to accommodate all the devices without overcrowding. Outlet boxes to receive ceiling fan shall be fitted with adequately sized rod / hook to fix ceiling fan. The boxes shall be of minimum depth of 65 mm.

11.6.3 COVER PLATE:

- The cover of the boxes to receive outlet points shall be of best anodized sheet cut to shape and size or plate of approved manufacturers of switches.

11.6.4 CABLES:

- i.) The cables shall conform to IS: 694. For all internal wiring FRLS wires of 650 / 1100 volts grade, single core shall be used.
- ii.) The conductors shall be plain annealed copper conductors complying with IS: 1554.
- iii.) The conductors shall be circular copper conductor.
- iv.) The insulation shall be XLPE compound complying with the requirements of IS: 694. It shall be applied by an extrusion process and shall form a compact homogenous body.
- v.) The thickness of XLPE insulation shall be as set out in the relevant standards
- vi.) The cores of all cables shall be identified by colours in accordance with the



following sequence.

a)	Single phase	- Red
b)	Three phase	- Red, Yellow, Blue
c)	Neutral	- Black
d)	Earth	- Green or Green/Yellow

vii.) Means of identifying the manufacturer shall be provided throughout the length of cable.

viii.) Unless otherwise specified in the drawings the size of the cables used for internal wiring shall be as follows:

ix.) In case of circuit wiring for lights, exhaust fans, convenience socket outlet points (P+N+E) :

(A) 1.5 mm.² - From MCB at Panel to switch boards.

(B) 1.5 mm.² - From switch boards to outlet points

(C) 4.0 mm.² - From MCB at Panel to 20 Amp socket.

11.6.5 SWITCHES:

- Switches shall conform to IS: 3854, IS: 1293 and IS: 4615. The switches shall be single pole, single or two way and shown on the drawings or as specified. They shall be of moulded type rated for 250 volt, and of full 5 / 15A capacity. They shall be provided with insulated dollies and covers.
- The switches shall be rocker operated with a quite operating mechanism with bounce free snap action mechanism enclosed in an arc resistant chamber. The switches shall have pure silver and silver cadmium contacts. The switches shall be flush modular type The make of the switches shall be as indicated in the drawings or BOQ or make of material or as suggested and approved by the client. The switches installed in outdoor area shall be industrial, metal clad type, and shall be provided in weather proof enclosures, complete with weather proof gasketed covers.

11.6.6 SOCKETS:

- i.) The sockets shall conform to IS: 1293. Each socket shall be provided with control switch of appropriate rating. The sockets shall be moulded type, rated for 250 volts, and either of full 5 A or 15 A capacity, as mentioned on the drawings.
- ii.) Sockets shall be of three pin type, the third in being connected to earth



continuity conductor. The socket shall be flush modular type. The sockets installed in machine room, plant room or wet / damp area shall be metal clad weather proof type. The finishing and make of all the sockets shall be same as light switch. The socket shall have fully sprung contacts and solid brass shrouded terminals to ensure positive electrical connections.

- iii.) The sockets shall be provided with automatic shutters, which open only when earth pit of the plug inserts in the socket.
- iv.) The socket shall be provided with three pin plug top suitable to the socket and of the same make as socket.

11.7 DRAWING OF CONDUCTORS

- 11.7.1 The drawing and joining of copper conductor or wires shall be executed with due regard to the following precautions, while drawing insulated wires into the conduits, care shall be taken to avoid scratches and kinks which may cause breakage of conductors. There shall be no sharp bends.
- 11.7.2 Insulation shall be shaved off for a length of 15 mm at the end of wire like sharpening of a pencil and it shall not be removed by cutting it square or ringing.
- 11.7.3 PVC insulated copper conductor wire ends before connection shall be properly soldered (at least 15 mm length) with soldering flux / copper solder, for copper conductor. Strands of wires shall not be cut for connecting to the terminals. The connecting brass-screws shall have flat ends. All looped joints shall be soldered and connected through terminals block / connectors. The pressure applied to tighten terminal screws shall be just adequate, neither too much nor too less. Conductors having nominal cross section are exceeding 4 sq. mm shall always be provided with crimping type cable sockets. At all bolted terminals, brass flat washer of large area and approved steel spring washers shall be used. Brass nuts and bolts shall be used for all connections.
- 11.7.4 Only certified wire man and cable jointers shall be employed to do joining work.
- 11.7.5 For all internal wiring PVC insulated wires of 650 / 1100 volts grade shall be used. The sub-circuit wiring for point shall be carried out in looping system and no joint shall be allowed in the length of the conductors. No wire shall be drawn in to any conduit, until all work of any nature that may cause injury to wire is completed. Care shall be taken in pulling the wires so that no damage occurs to the insulation of the wire. Before the wires are drawn into the conduits the conduits shall be thoroughly cleaned of moisture, dust, and dirt or any other obstruction by forcing compressed air through the conduits.

11.8 JOINTS

- The wiring shall be by looping back system, and hence all joints shall be made at



main switches, distribution boards, socket outlets, lighting outlets and switch boxes only. **No joints shall be made inside conduits and junction boxes.** Joints where unavoidable, due to any specified reasons, prior permission in writing shall be obtained from the client before making such connections. Joints by twisting conductors are prohibited.

11.9 LOAD BALANCING

- Balancing of circuit in three phase installation shall be planned before the commencement of wiring and shall be strictly adhered to.

11.10 EARTHING

- All earthing systems shall be in accordance with IS: 3043 - 1985 code of practice for earthing.

11.11 TESTING OF INSTALLATION

- Before a completed installation is put into service, the following tests shall be complied with

11.11.1 INSULATION RESISTANCE

i.) The insulation resistance shall be measured by applying 500 volt megger with all fuses in places, circuit breaker and all switches closed.

ii.) The insulation resistance in gega ohms of an installation, measured shall not be less than 50 mega ohms divided by the number of points on the circuit.

iii.) The insulation resistance shall be measured between

EARTH TO PHASE

EARTH TO NEUTRAL

PHASE TO NEURAL

PHASE TO PHASE

11.11.2 EARTH CONTINUITY PATH:

- The earth continuity conductors shall be tested for electrical continuity and the electrical resistance of the same along with the earthing lead but excluding any added resistance or earth leakage circuit-breaker measured from the connection, with the earth electrode to any point in the earth continuity conductor in the completed installation and shall not exceed one ohm.

11.11.3 POLARITY OF SINGLE POLE SWITCHES:

- A test shall be made to verify that every no-linked, single pole switch is connected to



one of the phase of the supply system.

11.11.4 COMPLETION CERTIFICATES:

- All the above tests shall be carried out in presence of client and the results shall be recorded in prescribed forms. Any default during the testing shall be immediately rectified and that section of the installation shall be re tested. The completed test result from shall be submitted to the client for approval.
- On completion of an electric installation a certificate shall be furnished by the contractor, countersigned by the certified supervisor under whose direct supervision the installation was carried out. This certificate shall be in a prescribed form as required by the local electric supply authority.

12.0. LIGHT FIXTURES

12.1 SCOPE

- The scope of work shall cover the supply, assembling and testing of various types of LED light fixtures as per specification and latest standards.

12.2 STANDARDS

12.2.1 The following standards and rules shall be applicable :

- i.) IS 3646 - 1960 Code of practice for interior illuminator.
- ii.) IS 1913 - 1969 General and Safety requirements for Electric lighting fittings.
- iii.) Indian Electricity Act and Rules issued there under.

12.2.2 All codes and standards mean the latest. Where not specified otherwise the installation shall generally follow the Indian Standard Code of Practice or the relevant British Standard Code of Practice in the absence of Indian Standard.

12.3 GENERAL REQUIREMENTS

- 12.3.1 All fixtures shall be latest, energy efficient, complete with ballast igniter, starter, capacitor, LED accessories and fixings necessary for installation whether so detailed under fixture description or not.
- 12.3.2 Fixture housing, frame or canopy shall provide a suitable cover for the fixture outlet box or fixture opening.
- 12.3.3 Fixture shall be completely wired with FRLS wires and constructed to comply with the regulations and standards for Electric Lighting Fixtures, unless otherwise specified.



Fixtures shall bear manufacturer's name and the factory inspection label unless otherwise approved.

12.3.4 Wiring within the fixture and for connection to the branch circuit wiring and shall not be not less than 1.5 sq. mm. copper for 250 Volt application. Wire insulation shall suit the temperature conditions inside the fixture and wires bypassing the choke shall be heat protected with a heat resistant sleeve.

12.3.5 Metal used in lighting fixtures shall be not less than 22 SWG or heavier if so required to comply with specifications or standards. Sheet steel reflectors shall have a thickness of not less than 20 SWG. The metal parts of the fixtures shall be completely free from burrs and tool marks. Solder shall not be used as mechanical fastening device on any parts of the fixture.

12.3.6 Non-reflecting surfaces such as fixture frames and trim shall be Aluminum die cast.

12.3.7 All the fixtures are as per the IP – 2X / 4X protections for indoor application where as IP – 6X protections for outdoor application.

12.3.8 Lighting fixtures shall be designed for minimum glare and for continuous operation under specified atmospheric condition.

12.3.9 All fixtures shall be complete with accessories like power factor improvement capacitors, low loss ballast; long range igniter maximum distance between igniter and fixture shall be 30 mtr. etc.

12.3.10 LED fixture shall be of sheet steel casing with corrosion resistance finish. It shall be provided with separate wiring channel with cover plate and an earth terminal. All screw shall be chromium plated only. Lamp and starter holders shall be of tough moulded plastic with spring loaded rotor type connector. Capacitors shall be low loss paper impregnated hermetically sealed. Internal wiring shall be neatly clipped and where by passing the ballast, a suitable heat resistance barrier or sleeve shall be provided.

12.3.11 Industrial low bay / medium bay / high bay fitting shall be of die cast Aluminium housing, high purity Al. Reflector, acrylic cover and wire guard.

12.4 REFLECTOR

- Light reflecting surface shall be mirror finished having the reflection factor of not less than 90%. All parts of reflector shall be completely covered by finish and free from irregularities. It shall be capable of withstanding a 6 mm. radius bend without showing sign of cracking, peeling or loosening from the base metal. Finish shall be capable of withstanding 72 hours exposure to ultra violet sun lamp placed 10 cm. from the surface without discoloration, hardening or warping and retain the same



reflection factor after exposure. Test report shall be furnished for each lot of fixtures.

- Lighting fixture reflectors shall generally be manufactured from aluminium sheet of not less than 20 SWG. They shall be readily removable from the housing for cleaning and maintenance without disturbing the lamps and without the use of tools. They shall be security mounted to the housing by means of positive fastening devices of a captive type.
- Polystyrene egg-box type louvers shall be provided whenever specified. Appropriate captive type fixing devices shall be incorporated for securing these.

12.5 CAPACITORS

12.5.1 Lighting fixture capacitors shall have a constant value of capacitors and shall be connected across the supply of individual lamp circuits.

12.5.2 Each capacitor shall be suitable for operation at 240 volts \pm 5% single phase 50 Hz with a suitable value of capacitance so as to correct the power factor of lists corresponding lamp circuit to the extent of 0.98 lag.

12.5.3 The capacitors shall be hermetically sealed preferably in metal container to prevent seepage of impregnating material and ingress of moisture.

12.5.4 All light fixture shall have THD less than 3% and power factor greater than 0.98.

12.6 TEST

The following routine tests shall be conducted as per the relevant Indian Standards.

12.6.1 Each fixture shall be tested at 1500 volts r.m.s. 50 Hz for one minute and no flashover of Break down shall occur between current carrying parts and ground.

12.6.2 Insulation resistance of each fixture shall be tested at 500 V.D.C. and the insulation resistances so measured shall not be less than 2 mega ohms between all current carrying parts and ground.

12.6.3 Each fixture shall be examined visually to ensure that it is complete in all respects and satisfactorily finished.

12.6.4 Type and routine test certificates shall be submitted for tests conducted as per relevant IS/BS for the fixture and accessories.

12.7 DRAWINGS AND DATA

As per of the proposal the bidder furnish relevant descriptive and illustrative literature on lighting fixtures and accessories and following drawings/ data for the respective lighting fixtures.



- 12.7.1 Dimensional Drawings.
- 12.7.2 Mounting details cable entry facilities and weights.
- 12.7.3 Light distribution diagrams.
- 12.7.4 Light absorption and utilization factors.
- 12.7.5 LED output V/S temp. Curves.

13.0 INSTALLATION, TESTING & COMMISSIONING – ELECTRICAL EQUIPMENT:

GENERAL:

- 13.1 In accordance with the specific installation instructions, as shown in Contractor's drawings or as directed by the Engineer In Charge the Contractor shall unload, erect, install, wire, test and place into commercial use of all electrical & instrumentation equipment included in the contract. Equipment shall be installed in a neat manner so that it is level, plumb, and properly aligned and oriented.
- 13.2 The Contractor shall furnish all supervision, labour, tools, equipment, rigging materials and incidental materials such as bolts, wedges, anchors, concrete inserts etc. required to completely install, test and adjust the equipment.
- 13.3 Drawings, instructions and recommendations shall be correctly followed in handling, settling, testing and commissioning of all equipment and care shall be exercised in handling to avoid distortion to stationary structures, the marring of finish, or damaging of delicate instruments or other electrical parts.
- 13.4 The Contractor shall erect and commission the equipment as per the instructions of the Purchaser/ Engineer In Charge and shall extend all co-operations to him. All the guidelines of original equipment manufacturer shall also be followed for erection, testing and commissioning
- 13.5 In case of any doubt/ misunderstanding as to correct interpretation of drawings or instructions, necessary clarification shall be obtained from the Engineer's Representative. The Contractor shall be held responsible for any damage to the equipment consequent to not following instructions correctly.
- 13.6 The Contractor shall move all equipment into the respective buildings through regular doors or floor openings provided specifically for the equipment. The Contractor shall make his own arrangement for lifting of equipment.



- 13.7 Where assemblies are supplied in more than one section, the Contractor shall make all necessary mechanical and electrical connections between sections including the connections between busbars /wires. The Contractor shall also carry out the adjustments/alignments necessary for proper operation of the circuit breakers. All insulators and bushings shall be protected against damage during installation. Insulators or bushings chipped, cracked or damaged due to negligence or carelessness shall be replaced by the Contractor at his own expenses.
- 13.8 The Contractor shall take utmost care in handling instruments, relays and other delicate mechanisms. Wherever the instruments or relays are supplied separately, they shall be mounted only after the associated control panels have been erected and aligned. The blocking material/mechanism employed for the safe transit of the instruments and relays shall be removed after ensuring that the panels have been completely installed and no further movement of the same would be necessary. Any damage to relays and instruments shall be immediately reported to the Engineer In charge.
- 13.9 Equipment furnished with finished coats of paint shall be touched up by the Contractor if their surface is spoiled or marred while handling.
- 13.10 Foundation work and grouting of fixing bolts or channels for all transformers, switchgear, motors, and control panels shall be carried out by the Contractor.

13.11 POWER/ DISTRIBUTION TRANSFORMERS:

Inspection, storage, installation, testing and commissioning of transformers shall be in accordance with the latest Indian Standards Code of Practice IS: 10028. All commissioning tests as applicable, vide Appendix B of IS: 10028 (Part II) shall be carried out. Fire Wall of 4 Hr fire rating shall be provided between two transformers.

13.12 HV/ LV SWITCHGEAR CONTROL PANELS:

- a. Switchgear control panels shall be installed in accordance with the latest Indian Standard Code of Practice 10118. The switchgear panels shall be installed on finished surface or concrete or steel sills. The Contractor shall be required to install and align any channel sills which form part of the foundations. Tape or compound shall be applied where called for. The base of outdoor type units shall be sealed in an approved manner to prevent ingress of moisture.
- b. Following minimum clearances shall be observed while finalizing the HV/ LV panel layouts-
 - i. Minimum clearance of 1.0 meter shall be maintained from the rear of the panel to the nearest wall /structure.
 - ii. Minimum clearance of 2.0 meter between panels facing opposite to each other.



- iii. Side clearance for LV panels shall be either $\leq 200\text{mm}$ or $\geq 800\text{ mm}$.
- iv. For HT metal enclosed, indoor panels, Minimum 1 meter clearance from all sides & 2.0 meter in the front.
- v. Emergency Exit doors shall be provided for electrical room, complying with the requirements of NBC 2005 latest edition.

13.13 After installation of all power and control wiring, the Contractor shall perform operating tests on all switchgear and panels to verify the proper operation of switchgear/panels and the correctness of the interconnections between various items of equipment. This shall be done by applying normal a-c or d-c voltage to the circuits and operating the equipment. Megger tests for insulation, polarity checks on the instrument transformers, operation tests on equipment, and installation tests shall be carried out by the Contractor who shall also make all necessary arrangements for proper functioning of the equipment.

13.14 The Contractor shall install copper/ steel conductors, braids, etc., required for the system and individual equipment earthing. All work such as cutting, bending, supporting, painting/coating, drilling, brazing/soldering/welding, clamping, bolting and connecting onto structures, equipment frames, terminals, rails or other devices 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.

13.15 The quantities, sizes, material of earthing conductors and electrodes to be installed as per requirement. Routes of the conductors and locations of electrodes shall be shown in the earthing layout drawings, which are to be prepared by Contractor & approved by Purchaser's representative.

13.16 The work of embedment of earthing conductor in RCC floors/walls along with provision of earth plate inserts/pads/earth risers shall be done by the Contractor when the floors are cast or during construction of walls. Contractor's scope of installation shall also include, laying the conductors in position with 60 mm concrete cover, making welded connections to inserts/pads/risers above the floor near the equipments. The embedded conductors shall be connected to reinforcing rods wherever necessary.

13.17 If the tap connections (earthing leads) from the floor embedded main earthing grid to the equipment are more than 500 mm long then the same shall be embedded in floor by the Contractor where required, together with associated civil work such as excavation/chasing, concreting and surfacing. The concrete cover over the conductor shall not be less than 60 mm.



- 13.18 Installation of earth conductors in outdoor areas, buried in ground, shall include excavation of earth up to 600 mm deep 450 mm wide, laying of conductors at 600 mm depth, brazing/welding as required, of main grid conductor joints as well as risers of length 500 mm above ground at required locations and then backfilling material to be placed over buried conductor shall be free from stones and other harmful mixtures. Backfill shall be placed in layers of 150 mm, uniformly spread along the ditch, and tampered utilizing pneumatic tampers or other approved means. If the excavated soil is found unsuitable for backfilling, the Contractor shall arrange for suitable material from outside.
- 13.19 Installation of earth connection leads to equipment and risers on steel structures/walls shall include laying the conductors, welding/cleaning at specified intervals, welding/brazing to the main earth grids risers, bolting at equipment terminals and coating welded/brazed joints by bituminous paint. Galvanized conductors shall be touched up with zinc rich paint where holes are drilled at site for bolting to equipment/ structure.
- 13.20 Electrodes shall be installed in constructed earth pits, and connected to main buried earth grid, The scope of work shall include excavation, construction of the earth pits including all materials required for construction of earth pits, placing the rod and fixing test links on those pipe/rod/plate electrodes in test pits and connecting to main earth conductors.
- 13.21 Installation of lightning conductors on the roofs of buildings shall include laying, anchoring, fastening and cleaning of horizontal conductors, grouting of vertical rods wherever necessary, laying fastening/ cleaning/ welding of the down comers on the walls/columns of the building and connection to the test links to be provided above ground level.
- 13.22 Installation of the test links shall include mounting of the same at specified height on wall/column by suitable brackets and connections of the test link to the earth electrode.
- Whenever main earthing conductor crosses cable trenches, they shall be buried below the trench floor.
- 13.23 Suitable earth risers shall be provided above finished floor/ ground level. If the equipment is not available at time of laying of the main earth conductors, the minimum length of such riser inside the building shall be 200 mm and outdoors shall be 500 mm above ground level. The risers to be provided shall be marked in project drawings.
- 13.24 Earth leads and risers between equipment earthing terminals and the earthing grid shall follow as direct and short a path as possible.



13.25 An earthing mat shall be provided under each operating handle of the isolator and operating mechanism of HV breakers. Operating handle of the isolator and supporting structure shall be bonded together by a flexible connection and connected to the earthing grid.

13.26 A separate earth electrode bed shall be provided adjacent to structure supporting lightning arrestors. Each connection shall be as short and as straight as practicable. For arrestors mounted near transformers, earth conductors shall be located clear off the tank and coolers.

13.27 Wherever earthing conductors passes through walls, galvanized iron/PVC sleeves shall be provided for the passage of earthing conductor. The pipe ends shall be sealed by the Contractor by suitable water proof compound.

13.28 Earthing Connections:

- All connections in the main earth conductors buried in earth/concrete and connection between main earthing conductor and earth leads shall be of welded type.
- Connection between earth leads and earthing terminal provided on the equipment shall be bolted type.
- All bimetallic connections shall be treated with suitable compound to prevent moisture ingress.
- Metallic conduits and pipes shall be connected to the earthing system.
- Lightning protection system down conductors shall not be connected to other earthing conductors above ground level. Also no intermediate earthing connection shall be made to lightning arrester and transformer earthing leads which shall be directly connected to pipe electrode.

13.29 Earth Electrodes:

- 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 work such as excavation and connection to main earth grid.
- Earth pits shall be treated with salt and charcoal. In case found necessary, then with the approval of Purchaser's representative, Back fill compound of suitable composition may be used. Back fill material shall not be water soluble & shall retain moisture & enhance conduction around electrode. Back fill compound shall be low resistance & non corrosive earth enhancement compound which shall provide safe discharge path to fault current & lightening current.
- Ohmic value shall be within safe limits & it shall be stable & not fluctuating.



- 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.

13.30 INSTALLATION OF CABLE RACKS AND CABLE TRAY

- Lines and grade for trays may be measured from building steel and finished floor elevations. Change in line or grade, or the addition of offsets by means of cutting standard tray sections and inserting additional tray fittings to match with the existing arrangement shall be considered as a normal part of the work.
- Where embedded steel inserts in concrete floors/ walls for welding the supports for cable racks/ trays are not available, Contractor shall provide suitable anchor fasteners at no extra cost.
- Cable shall be clamped to the cable trays at every 750 mm distance.
- Flexible metallic conduits shall be used for termination of connection to equipment such as motors, limit switches and other apparatus.

13.31 Cable Trays:

All the cable tray shall be hot dipped galvanized with minimum galvanization thickness as per mentioned in these specifications.

- Cable tray shall be of perforated sheet steel with formed flanges and of minimum thickness not less than 1.25 mm for trays up to 100 mm width, not less than 1.5 mm for trays from 100 mm to 150 mm width and not less than 2.0 mm for trays from 150 mm to 300 mm width.
- All the cable trays above 300 mm width shall be of ladder type with minimum thickness of 2.5 mm.
- Cable tray for use in areas where chlorine gas may be present shall be constructed from U-PVC or GRP. Cable tray supports shall be of a compatible finish with the associated cable tray.
- All cable trays tees, intersection units, bends, turns and sets shall be prefabricated (made by the manufacturer) and shall be of a matching design to the main section of cable tray.
- Tray shall only be joined by couplers supplied by the manufacturers. The joint shall be secured in accordance with the manufacturer's instructions.
- Cable tray supports supplied by a manufacturer or made up on Site shall have adequate strength to maintain rigid support to the fully laden cable tray along its entire length and shall ensure that the deflection of any one section does not exceed 15 mm at mid span.
- Wherever possible, cable trays shall be installed in full lengths without cutting. Should it be necessary to cut or drill a length of tray, the bared ends or damaged section of the tray shall immediately be given a coat of zinc rich cold galvanized paint. All site manufactured accessories, supports and metal fittings required to ensure correct installation of the cable trays shall be similarly treated.

- All cables shall be firmly secured to the tray using purpose made saddles, as approved by the Purchaser's Representative, together with proprietary nylon fasteners and/or cable cleats. Following installation of cables, the tray shall remain rigidly supported and the deflection of any section shall not exceed 15 mm at mid span. All brackets and tray work shall be suitable for withstanding a temporary weight of 125 kgs.
- Cable trays shall not be cut to allow the passage of cables through the surfaces of the tray
- The sizing of the cable tray shall provide a minimum of 20% spare capacity.
- The tray shall be run at least 300 mm clear of plumbing and mechanical services.
- Bends in the installation shall take account of the minimum bending radii of cables to be installed.
- All the cable trays shall be supplied with cable tray supports (of adequate size) at no more than 1.2 meter interval.
- Other cable tray details & cabling system shall be as per typical drawings attached with the specifications.

13.32 Cable Trunking – Metal:

- Cable trunking shall be manufactured from mild steel of not less than 1.25 mm and shall be hot dipped galvanized. The Contractor shall ensure that the size of the trunking is adequate for the number of cables to be installed together with 50% spare capacity and shall in any case be 50 mm x 50 mm minimum size.
- Segregation of cables shall be carried out if required using continuous sheet steel barriers with the bottom edge welded to the trunking.
- The trunking shall have two return flanges for rigidity. Where necessary, additional strengthening straps shall be fitted internally. The cover shall overlap the trunking and be made of the same gauge. Fixing screws for covers shall be recessed and be of the self retaining 'quick fix' type. All bends, tees and intersections shall be of the gusset type and shall, wherever possible, be purpose made by the manufacturer and of a matching design to the main trunking.
- Cables shall be retained in the trunking when the cover is removed by means of straps. Internal connecting sleeves shall be fitted across joints in the trunking and earth continuity ensured by bonding each section of trunking to a continuous earth wire.
- Non-flammable fire barriers shall be inserted where the trunking passes through walls or floors. Conduit connections to trunking shall be made by flanged couplings and male bushes.
- Trunking shall be supported at intervals not greater than 2 meter horizontally or 2.5 meter vertically.
- Crossings over expansion joints shall be made in flexible conduit.
- Should it be necessary to cut or drill a section of trunking or a trunking fitting the bared ends shall immediately be given a coat of zinc rich cold galvanizing paint.
- Cable and conduit/ trunking runs shall be determined by the Contractor and agreed by the Purchaser's Representative before any work is started. The run shall be at least 300 mm clear of plumbing and mechanical services.



- Conduit/ trunking systems erected outside a building shall be weatherproof.

13.33 CABLE INSTALLATION:

- Cable installation shall be in accordance with IS 1255: 2001- latest edition.
- Cables shall be installed in such a way that the minimum bending radii are not reduced when installed or during installation. Cables shall not be installed in ambient temperatures below that recommended by the cable manufacturer.
- Cables grouped together shall have insulation capable of withstanding the highest voltage present in the group.
- Cables of different categories shall be installed so as to maintain satisfactory clearances for safety and in order to reduce the possibility of electrical interference. The following Table details the distances in mm that shall be maintained between the different categories of cable.

Table of Separation Distances in mm between different Categories of Cable

Cable Category	HV Power	LV Power	C&I/ Protection	Tele-communication
HV Power	N/A	300	500	500
LV Power	300	N/A	300	300
C&I/ Protection	500	300	N/A	100
Tele-communication	500	300	100	N/A

- These separations are minimum and special circumstances such as the presence of high current flows, or harmonic content may necessitate larger separation distances.
- A distance of minimum 300mm shall be maintained between the cables to be laid on trays/ conduits carrying low voltage AC and DC signals and a distance of minimum 600 mm shall be maintained between cables carrying HT and LT signals.
- In order to make economic use of the cable support system, cables shall be arranged in groups having diameters in the close proximity. These groups shall be securely tied to the cable support system at intervals not exceeding 900 mm for horizontal runs and 300 mm intervals on vertical runs.
- In order to make the most economic use of cable tray and duct capacity, multicore cabling shall be utilized in order to connect instrumentation groups by using suitably located sub-distribution junction boxes. The junction boxes shall be suitable for the area in which they are to be installed and for the type of circuit. They shall be readily accessible for maintenance and clearly labeled junction boxes shall be constructed of die cast Aluminium and provide degree of protection IP 65.
- Instrumentation cables shall be continuous without any joints. Separate cables shall be used for digital and analogue signals at all times. Digital and analogue signals shall be segregated within junction boxes.



- Cables shall be laid in a manner such that any electrical interference between cables shall not have a detrimental effect on the life and operation of Plant.
- Where practical a separate cable support system shall be provided for power and non-power cables. Where this is not practical a separation as per indicated in above table shall be maintained between power and non-power cables when run on the same support system.
- Heavy duty galvanized iron cable tray and ladder racking shall be used for cable support systems. FRP/ GRP cable support systems shall be used in areas used for the storage and handling of chlorine. These systems shall be used to route cables around walls and within cable trenches. Cables shall be securely fixed to the support systems. Bundling of cables shall be permitted where allowance for this practice has been made in sizing the cables.

13.34 Laying of Cables:

- Each instrumentation and power supply cable shall be terminated to individual panel/ terminal box.
- Identification of each cable shall be by proper ferrules at each junction as per cable schedule to be prepared by Contractor.
- Cables shall be laid in accordance with layout drawings and cable schedule which shall be prepared by Contractor and submitted for approval.
- 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 1.0 meter shall be left near each field instrument before terminating the cable.
- Cables shall be complete uncut lengths from one termination to the other.
- Separate cables shall be used for digital and analog signals.
- All cables shall be identified close to their termination point by cable numbers as per cable interconnection schedules.
- Identification tags shall be securely fastened to the cables at both the ends.
- Cable shall be rigidly supported on structural steel and masonry, using individually cast or malleable iron galvanized clips, multiple cable supports or cable trays.
- The Contractor shall take the actual measurement of the cables and the associated accessories such as cable trays, conduits etc required at site, prior to the placement of order on the cables.

13.35 Cables Laid Direct in Ground:

- Buried cable up to 1.1 kV shall have a laid at a minimum depth of 750 mm measured from FGL to the top of the highest cable. On crossing roadways the cable shall be run through a PVC-U duct of minimum diameter 100 mm with a minimum of 1000 mm cover and encased on all sides by 150 mm of concrete.



- Cables of greater than 1.1kV shall be buried at a minimum depth of 1 meter.
- The bottom of the cable trench shall be freed of sharp stones and such like and 75 mm of sieved sand laid below the cable. After cable laying 75 mm of sieved sand shall be laid above the cable. For HT cables sand bedding shall be of 150 mm & cables shall be covered with half round Hume pipes of twice the diameter of cable.
- Interlocking cable protective covers, minimum 1 m long x 300 mm wide, marked 'Danger-Electric Cable' in English and the vernacular shall be laid on top of the sieved sand. Covers shall extend the whole length of the cable trench and shall overlap cables by a minimum of 50 mm.
- Warning tape shall be laid a minimum of 200 mm above the protective covers.
- Cables are to be installed without tees or through joints unless otherwise approved by the Purchaser's Representative. Single core cables shall be run in trefoil formation.

13.36 Cables Laid in Underground Ducts:

- Underground ducts shall be constructed of impact resistant PVC-U and laid at a minimum depth of 750 mm, ducts shall be surrounded by at least 75 mm of sieved sand except at road crossings where it shall be 1 meter deep and encased on all sides by 150 mm of concrete.
- The Contractor shall ensure that sufficient draw-in points have been provided and that adequate room has been allowed for installation of cables. Drawstrings shall be provided in all ducts to enable additional cables to be installed when required.
- Where cables pass in or out of any duct entries into or within buildings such entries, together with any spare ducts shall be sealed against the ingress of moisture by means of duct stoppers and bituminous compounds or by any other method approved by the Purchaser's Representative. The stopper shall have a fire resistance of at least 30 minutes. Single core cables in trefoil formation shall pass through the same duct and shall not be separated. However, for two different trefoil formations, they shall be laid in separate ducts.

13.37 Cables installed in Conduit:

- Conduits shall be galvanized heavy gauge solid drawn or welded screwed steel type and be in accordance with IS 9537, Part 2 or BS 4568. Accessories shall either be malleable cast iron screwed type or pressed steel and galvanized.
- A space factor of 40% shall not be exceeded, but in any case conduit of less than 20 mm diameter shall not be permitted. The tubing shall be perfectly smooth inside and out and free from flaws and imperfections of any kind. Both ends of every length of tubing shall be properly reamed with all sharp edges removed before erection.
- Where a number of conduits converge, malleable cast iron or heavy gauge sheet steel adaptable boxes shall be employed in order to avoid crossings. Conduits shall be connected by means of male brass bushes and couplings.



- Where conduits are greater than 25 mm, straight through joint boxes shall be of the trough type. Where conduit and/ or fittings are attached to equipment casings, the material or case of the casing shall be tapped for a depth of not less than 10 mm or male bushes and flanged couplings shall be used.
- Heavy hexagonal lock nuts shall be used at all positions where running joints are required and care shall be taken to ensure that they seat firmly and evenly on to the mating faces of coupling or other adjacent accessories. All junction boxes, draw-in boxes, and inspection fittings, shall be so placed that the cables can be inspected and, if necessary, withdrawn and re-wired throughout the life of the installation.
- Generally not more than two bends or offsets or one coupling will be permitted without a suitable inspection accessory. Fish wires shall not be left in conduits after erection. The whole of the installation shall be arranged for a loop-in type of system with joints being carried out at switches, isolators, etc. Intermediate joints in the cable will only be allowed by arrangement with the Purchaser/ Purchaser's Representative.
- Ends of conduits which are liable to be left open for any length of time during building operations shall be plugged to prevent the ingress of dirt, cement, etc. and covers, either temporary or permanent, shall be fitted on all boxes.
- Generally, conduits shall not cross expansion joints of buildings, but where they cannot be installed in any other manner then a flexible conduit shall be used across the expansion joint. A total 150 mm movement shall be allowed.

13.38 Surface Installation:

- Surface conduits shall be secured and fixed by means of distance spacing saddles or approved purpose made clips at every 500mm, which allow the conduits to be taken directly into accessories without sets or bends. Conduits shall be run in a square and symmetrical manner. An efficient means shall be adopted to provide for the drainage of condensation and the runs shall be properly ventilated. All surface conduit runs shall be marked out for approval by the Purchaser's Representative before the installation is carried out. Where large multiple parallel conduit runs would occur, use may be made of galvanized cable trunking. Conduits installed on structural steelwork shall be secured at spacing not exceeding those for surface conduit by girder clips, otherwise fixing shall be as for surface conduits on walls, drilled and tapped to the metalwork. Power driven fixings shall only be used with the express permission of the Purchaser's Representative. Any drilling or access which is required through any structural member of the building shall be agreed with the Purchaser/ Engineer in Charge before carrying out the work.
- Exposed threads and places where galvanizing has been damaged shall be cleaned and then painted with two coats of an approved metallic zinc based paint. This treatment shall be applied as the work proceeds.

13.39 Concealed Installation:



- Concealed conduits shall be securely fixed to prevent movement before laying of screeds, floating of plaster, casting of columns or other building operations necessary after the conduit installation. Crumpets or similar fixings shall be used for attaching the conduit to block work, etc. Building nails will not be accepted.
- At least 15 mm cover shall be allowed for finishes over the conduit. Where this cover cannot be maintained then expanded metal shall be fitted with the conduit. Conduit cast into reinforced concrete floors shall be fixed to the steel reinforcing with binding wire and the conduit boxes filled with expanded polystyrene or enclosed in a plastic bag to prevent the ingress of concrete when poured. Where possible, the conduit boxes shall be fixed to shuttering to give a flush finish. The conduit junction boxes shall be provided after every 30M straight line of conduit and at each bend.
- Conduit installed in voids, false ceilings, and other concealed routes shall be installed as specified for the surface conduits. Wiring shall be carried out after the false ceiling or permanent ducts have been completed. Conduit installed in floors shall be sealed against ingress of moisture.
- The conduit installation shall be inspected by the Purchaser's Representative before the building operation conceals the work.

13.40 Cable Installed in Flexible Conduit:

- Flexible conduit shall be of the waterproof galvanized type or PVC wire-wound type with cadmium plated mild steel couplings. Lengths of flexible conduits shall be sufficient to permit withdrawal, adjustment or movement of the equipment to which it is attached and shall have a minimum length of 300 mm. Flexible conduit shall not be used as a means of providing earth continuity. A single earth conductor of adequate size shall be installed external to the conduit complete with earth terminations.
- Where conversion from rigid conduit to flexible metallic conduit is to be made, the rigid conduit shall terminate in a through type box and the flexible conduit shall extend from this box to the equipment, the earth continuity cable shall be secured to the box and to the piece of equipment by properly designed earthing screws. The use of lid facing screws, etc., will not be permitted. Adapters shall incorporate a grub screw or a gland to prevent the flexible conduit becoming loose.

13.41 Cable Clipped Direct:

- All cable hangers, clips, cleats and saddles shall be of an approved type and appropriate to the type and size of cable installed. Their spacing shall be such as to ensure a neat appearance and prevent sagging of the cables at all times during their installed life.

13.42 Cable Installed in Internal Floor Trench:

- In shallow trenches (maximum depth 500 mm)



- In shallow trenches used for electrical services only, cables may be laid in a neat and orderly manner on the floor of the trench. One layer only shall be allowed. Additional cables shall be installed on the walls of the trench in an acceptable manner & such a way that, in no case the distance between two different types of cable shall not be less than the separation distance tabulated above.
- Where the trench is shared by other services, cables shall be installed on the walls of the trench in an acceptable manner & such a way that, minimum separation distance of 300mm shall be maintained.
- All other trenches including walk through service ducts
- Cable trenches & cable installation shall be in accordance with the attached typical cabling system drawings.
- Where other services are present the cables shall be segregated from them by separation distances as mentioned above and wherever possible kept above 'cold' wet services. Cables should not be run if at all possible above or in close proximity to 'hot' services.
- The cabling shall be installed in such a manner as to allow access to the other services for normal maintenance without disturbance of the electrical installation

13.43 Cable Terminations and Joints:

- Power Cable Terminations
 - i. Power cables shall be terminated in suitable boxes arranged for bolting to switchgear, motor starters and motors.
 - ii. Cores shall have either crimped lugs or sleeves to match either post terminals or bolted clamp terminals.
 - iii. Each cable entry into a terminating box shall be made through a suitable gland, which shall have provision for securing the armour where applicable. Where single core glands are required these shall be of the non-magnetic type and the associated box bottom plate, where the core passes through, shall not have a continuous magnetic path.
 - iv. Adequate provision shall be made to bond the cable armouring to the box and/or switchgear casing of a suitable size to withstand the prospective short circuit fault current of the system, glands shall be fitted with earth bonding tags where intimate screwed contact between gland and cable box is not possible.
 - v. Where cable glands are exposed to the weather these shall be protected by heat shrink plastic sleeve or purpose moulded sleeves covering the gland continuously from overall sheath to the gland neck.



- vi. Where terminations of multicore type have to be made on to items of Plant which have to be dismantled for maintenance, these shall be made off through glands into an adaptable box containing terminals and flexible single cores taken into the equipment via flexible waterproof plastic covered conduit, and a separate earth core linking the box to the equipment.
- vii. Where single core cables are glanded to or pass through cabling plates the gland plate or cabling plate shall be constructed of non-magnetic material.
- Power Cable Joints:
 - i. Through joints shall only be allowed with the approval of the Purchaser's Representative. Where such joints are necessary in thermoplastic and elastomeric cables, the cables shall be jointed with epoxy or acrylic resin cold setting compound, which has been premeasured and pre-packed ready for use. The boxes shall preferably be of split, moulded plastic type with filling vents for compound. Bonding straps shall be fitted with armour clamps across the joint and inspected by the Purchaser/ Purchaser's Representative prior to filling the box with compound. Wrapped pressure type joints will not be accepted.
- Multi-core or Control Cable Terminations:
 - i. A sufficient number of terminals shall be provided to terminate all cable cores. For control and auxiliary wiring an additional 20% of this number shall be provided as spares.
 - ii. Not more than one core of internal or external wiring shall be connected on any one terminal. Where duplication of terminal blocks is necessary, purpose-made solid links shall be incorporated in the design of the terminal blocks.
 - iii. Terminals which remain energized when the main equipment is isolated shall be suitably screened and labeled.
 - iv. Terminal blocks for different voltages or circuit type shall be segregated into groups and distinctively labeled.

13.44 Cable Fixings:

- i. Ties and strapping shall be suitable for securing cable and cable groups to cable tray or ladder. They shall be resistant to chemical and marine corrosion. Plastic coated metal ties used in order to obtain corrosion resistance shall not be acceptable. Nylon ties shall be resistant to the effects of ultra-violet light and shall be self-extinguishing.
- ii. Large single cables shall be secured with cable clamps or cable cleats.

13.45 Cable Identification:



- At each end of each cable, in a uniform and visible position a label shall be fixed on the cable in accordance with the cable schedule. Labels shall be made of PVC and shall be indelibly marked to the approval of the Purchaser's Representative. The label shall be retained using proprietary nylon strips passing through two fixing holes at either end of the label. If the cable gland is not normally visible, then the label shall be fixed inside the panel by means of screws.

13.46 Marking Locations of Underground Cables:

- i. The location of all underground cables shall be engraved on brass or other non-corrodible plates to be fixed to the exterior surface of all walls of buildings 300 mm above ground level and directly above the point where cables pass through the wall.
- ii. Cable route markers as per the attached drawing shall be installed at an interval not more than 15meter& at bending/ road crossings the interval shall be at every 10 meter.
- iii. The minimum depth for laying of underground cable route markers shall be as per indicated in the typical drawings attached with this tender.

13.47 Additional Requirements for Cable Installations:

- The Contractor shall install, test and commission the cables specified in the specification. Cables shall be laid directly buried in earth, on cable racks, in built up trenches, on cable trays and supports, in conduits and ducts or bare on walls, ceiling etc. as per drawings, which are to be prepared by Contractor & approved by Purchaser's representative. Contractor's scope of work includes unloading, laying, fixing, jointing, bending, and termination of the cables & all related accessories. The Contractor shall also supply the necessary materials and equipment required for jointing and termination or 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.
- 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. Identification tags shall be attached securely to each end of each cable with non-corrosive wire. The said wire must be non-ferrous material on single conductor power cable. Tags shall further be attached at 10 meter 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 bending and kinking of cables shall be avoided. The bending radius for various types of cables shall not be less than those specified below:
 - 11 kV, XLPE insulated, multicore : 15 times the overall dia of the cable armoured cables
 - 1.1 kV, XLPE insulated, multicore : 12 times the overall dia of the cable armoured cables
 - (If shorter radius appears necessary, no bend shall be made until clearance and instructions have been received from the Purchaser/ Engineer in charge)
- Power, control and instrumentation cables shall be laid in separate cable racks/trays.
- Where groups of HV, LV and control cables are to be laid along the same route, suitable barriers to segregate them physically shall be provided.
- Where cables cross roads and water, oil, gas or 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 no 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 is then gently filled up to a depth of about 100 mm above the top of uppermost cable to provide bedding for the protective cable covers which are 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 is then backfilled with the excavated soil and well rammed in successive layer of not more than 300 mm in depth, with the trenches being watered to improve consolidation wherever necessary. To allow for subsidence, it is advisable to allow a crown of earth not less than 75 mm in the centre and tapering towards the sides of the trench.
- 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, on cable trays and conduits shall be formed to avoid bearing against edges of trays, racks, conduits or their supports upon entering or leaving trays, racks or conduits. Cables shall be racked or laid directory into cantilevered cable trays where practicable, but in some cases it may be necessary that cables are pulled or threaded into trays. To facilitate visual tracing, cables in trays shall be laid only in single layers and unnecessary crossing of cables shall be avoided. Cables on trays shall finally be clamped in an approved manner.
- Cable splices will not be permitted except where permitted by the Purchaser/ Purchaser's Representative. Splices shall be made by Contractor for each type of wire or cable in accordance with the instructions issued by cable manufacturer's 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.



- Jointing of cables shall be in accordance with relevant Indian Standards Codes of Practice. 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.
- At cable terminal points where the conductor and cable insulation will be terminated, terminations shall be made in a neat, workmanlike and approved manner by men specialized in this class of work.
- Control cable termination shall be made in accordance with wiring diagrams, using colour codes established by the Purchaser's Representative for the various control circuit, by code marked wiring diagram.
- When control cables are to be fanned out and cabled 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 question as to the proper 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 through operating the equipment, 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 workmanlike manner.
- 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 by the Purchaser/ Purchaser'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.
- 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.

13.48 LIGHTING SYSTEM INSTALLATION:

This covers the requirements of installation of the following:

- Lighting fixtures complete with lamps and accessories
- Main Lighting distribution board
- Lighting panels
- Receptacles and lighting control switches
- Point wiring
- Street lighting poles and flood light towers
- Multi core cables for street and boundary lighting



- Maintaining equipment/ materials during storage and being responsible for the equipment/ material until they are handed over to Purchaser.
- Installation, testing and commissioning shall be carried out in accordance with the drawings and as stipulated in this specification.

Applicable Standards for lighting system installation

Electrical wiring installations : IS: 732

(System voltage exceeding 650 V)

Code for practice for interior illumination (Part-1) : IS: 3646/ BS: 8206

Code of practice for street lighting installation : IS: 1944

Code of practice for industrial lighting : IS: 6666

Code of practice for fire safety of building : IS: 1646

Boxes for enclosure of electrical accessories : IS: 5133(Part-1)

Guide for safety procedures and practices in : IS: 5216

electrical work

Ceiling roses : IS: 371

13.49 Lighting Fixtures:

- The installation of lighting fixtures shall be based on the mounting arrangement shown in the drawings. The rates quoted for installation shall include all materials required to mount the fixtures. Hooks in RC slabs for suspension of high bay fixtures shall be provided wherever not already provided. Cost of supply and installation of such hooks shall be included in the cost of installation of lighting fixtures. Rate for installation of lighting fixtures shall include cost of installation of control gear box wherever applicable.
- Installation of receptacles and switches shall be carried out suitably. Switch shall be mounted in flush with the front cover plate. Cost of supply and installation of necessary hardware shall be included in the lump sum rates quoted for installation of receptacles/ switches.
- Lighting distribution boards shall be installed at the suitable location. Installation shall include supply and installation of base channels, foundation bolts, etc.
- Outdoor lighting distribution boards shall be installed on a concrete plinth. The top of plinth shall be 1000 mm (min.) above the grade level. Cost of construction of concrete plinth shall be included in Contractor's scope. No cement and steel will be supplied by Purchaser. Installation cost of lighting distribution board shall include cost of installation of earthing conductor from LDB to the nearest earthing grid.



13.50 Point Wiring:

- Contractor has to prepare the detailed conduit layout drawing showing primary & secondary point wiring points. Point wiring also covers the wiring of the associated control switches of lighting fixtures/control switches of receptacle units.

i. Primary Point Wiring:

Primary point wiring covers the wiring between a circuit of the lighting panel to the junction box of the first lighting fixture/receptacle unit and between junction boxes of the subsequent lighting fixture connected to that circuit of the lighting panel. In some cases where there are junction boxes, the primary point covers the wiring between junction box and the first lighting fixture/receptacle unit in that circuit.

ii. Secondary Point Wiring:

Secondary point wiring covers the wiring of the remaining lighting fixtures/receptacle unit other than that covered under primary point of that circuit in the lighting panel. Secondary point wiring also covers the wiring of the associated control switches of lighting fixtures/control switches and control switches of receptacle units.

- Supply and Installation of Conduit Point Wiring:

- i. The point wiring shall include supply of necessary materials for the conduit wiring such as galvanized rigid steel conduit, galvanized M.S. fixing saddles with spacer plates, nylon/fiber fixing plugs, galvanized M.S. fixing screws, 12 SWG galvanized steel earthing wire, FRLS PVC insulated Copper conductor wires, control switches and pulling, termination of the earthing/ FRLS PVC insulated wires as required, installation of control switches, drilling holes in brick walls/RCC roof slabs for taking the wiring conduits and refinishing and any other works/material necessary for making point wiring complete in all respects.
- ii. Wires used for conduit point wiring of lighting fixtures/ceiling fans, 5A receptacles and receptacles above 15A shall be 1.1 kV grade, FRLS PVC insulated, single core, multistranded Copper conductor wires of sizes not less than 1.5 sq. mm and 2.5 sq. mm respectively. Wires shall conform to IS: 694 and shall bear the ISI mark.
- iii. Contractor shall take into consideration necessary galvanized MS fixing clamps when the wiring conduits are to be supported from steel roof truss/structural members.

- Supply & Installation of cabling for Street and Flood Lighting

- i. Work includes supply and installation of cables required between LDB and junction box mounted on street lighting pole/flood lighting tower and also between junction box mounted on flood light tower to metal enclosed control gear box located near flood light fixture, supply and installation of all the termination accessories such as crimping type cable lugs and double compression cable glands at each junction box and fixture, termination, testing and commissioning of cables. Contractor's scope of work also includes excavation, preparation of riddled soil bedding, supply and installation of protective covers over the cable, backfilling, ramming, supply and installation of route markers, supply and installation of HDPE / Hume pipes for road crossing, etc, supply and installation of necessary cleating arrangement for cabling on flood light tower, supply of labour, supervision, welding equipment, all tools and tackles and testing equipment as required.
 - ii. Contractor shall plan and cut the cables in such a way that there is no wastage and no cable jointing is required in any run. However, should any joint become necessary the same shall be provided by the Contractor and a joint marker shall also be provided at no extra cost. Earthing of street light pole/flood light tower, lighting fixtures, etc. are included under Contractor scope.
- Point wiring shall also include/hold good for the following :
 - i. Supply and installation of lighting control switches and switchboxes complete with fixing accessories.
 - ii. Drilling holes in brick/RCC wall and roof for taking cable or conduit, sealing and refinishing with cement plaster.
 - iii. Testing, commissioning and handing over the lighting system in commercial working condition.
 - iv. Marginal shifting of any fixture/accessory from the location indicated in the lighting layout drawings.

13.51 Outdoor Lighting (Street and Flood Lighting): The following shall be deemed included as part of the installation work for outdoor lighting point wiring.

- i. Installation of multicore/ single core cables between LDB and junction box mounted on street light pole/flood lighting tower, from junction box to metal enclosed control gear box.
- ii. Supply and installation of crimping type cable lugs, double compression type cable glands at each junction box and fixture, termination, testing and commissioning of cables.



- iii. Contractor's scope shall also include excavation and preparation for buried cables. Supply and installation of route markers, supply and installation of HDPE/Hume pipes for road crossing shall also be included in the scope of installation of point wiring.
- iv. Supply and installation of necessary cleating arrangement for cabling on flood light poles.
- v. Contractor shall provide necessary foundation for erecting street light pole/flood light tower and install the same. Contractor shall prepare foundation drawings with necessary details & Purchaser Representative's approval shall be obtained.
- vi. Contractor shall plan and cut the cables in such a way that there is no wastage and no cable jointing is required in any run. However, should any joint become necessary, the same shall be provided by the Contractor and joint marker shall also be provided at no extra cost.
- vii. Earthing of street light pole/flood light tower, lighting fixtures, control gear boxes, junction boxes, etc. are also included in the scope of installation of point wiring. Contractor shall earth street light pole/flood light poles and junction box with 25x3 mm G.S. flat tap off from the 25x3 mm M.S. flat earthing grid along the street lighting included in scope. The Contractor shall interconnect earthing grid to plant main earthing grid at first and last pole of each feeder circuit and at one intermediate poles.
- viii. Installation of lighting Poles and Towers for Outdoor Lighting (Street and Flood Lighting)-
 - i. Work includes supply and installation of street light poles and flood light towers including associated junction boxes with fuses, links and terminals for junction boxes and junction boxes near each flood light fixtures.
 - ii. All street light poles and towers shall be painted with one shop coat of red oxide oil primer followed by two coats of aluminium alkyd paint.

13.52 Installation of Lighting Distribution Board, Lighting Panels (AC & DC), 230 V, AC 1-Ph Distribution Boards.

- Installation of above items shall include necessary foundation channels, bolts/ nuts, etc. for grouting lighting distribution boards, iron brackets/ grouting brackets, bolts/nuts for wall/ column mounted panels and associated civil works.



13.53 Details of work requirements are covered in lighting installation notes and details and typical drawings which form the part of specification. Any changes, if necessary due to site conditions/requirements shall be carried out after obtaining approval of Purchaser/ Purchaser's Representative. The changes carried out shall be marked clearly in the layout drawings by Contractor and 'AS BUILT DRAWING' shall be prepared by the 'Contractor' and this shall be forwarded to Purchaser's site / design office.

a) Wiring

- i. Wiring shall be carried out strictly as per project drawings and technical specification. All exposed conduit wiring shall have provision for easy inspection. Where cable wiring is specified cable shall be cleated on to the wall as close to the ceiling as possible. In all types of wiring due consideration shall be given for neatness and appearance.
- ii. Wherever DC emergency lighting is provided, emergency lighting wires shall run in a separate conduit. Colour of the wires used shall be as follows; white for positive, black for negative.
- iii. Wherever lighting system has three phase distribution, separate conduits shall be used for different phases. For easy identification of phases and neutral wires the following colour wires shall be used.

R - Phase - Red

Y - Phase - Yellow

B - Phase - Blue

N - Neutral - Black

- b) There shall be a circuit breaker on each live conductor of supply mains at the point of entry.
- c) Conductors not arranged for connection to the same system or supply different phases of the same supply, shall be kept apart throughout their entire run.
- d) Receptacles and lighting fittings in general shall be fed from different Circuits. Five amps receptacles for toilet or small rooms can be fed from the lighting circuit with proper isolating arrangement.
- e) Each final sub-circuit from a lighting panel shall be controlled by a single pole switch connected to the live conductor.
- f) For long conduit wiring runs, inspection/ pull boxes shall be provided at intervals not exceeding 10 meter. Such facilities shall also be provided at conduit bends.

13.54 General Practices for lighting:



- a) All receptacles and switches to be installed in offices and control rooms shall be flush mounted within the wall and those in other areas shall be wall or column mounted.
- b) Ceiling roses shall not embody fuse terminals as an integral part. For voltages exceeding 250 volts, a ceiling rose or any similar attachment shall not be used.
- c) All exposed metal parts of the plug, when the plug is in complete engagement with the socket outlet, shall be in effective electrical connection with the earthing pin.

13.55 Earthing for lighting:

- Conduits and fittings shall be earthed by 12 SWG GI wires run along the length of the conduit and secured by means of suitable clamps efficiently fastened to conduit tip. To achieve perfect electrical continuity, the conduits shall be bonded effectively on either end of a coupling and other joints.
- a) Conduits shall be earthed at the ends adjacent to switch boards at which they originate or otherwise at the earth clip, clamp or gland, in effective electrical contact with the conduit.
 - b) For outdoor lighting poles & mast 8 SWG GI earth wire shall be run buried in ground at a depth of 600 mm along-with lighting cables and shall be terminated up to the junction box on the pole and 12 SWG wire shall be taken up to the pole fitting. In case of lighting poles where the main earth grid is far away from the pole, local pits shall be provided for pole earthing.

14.0 SOLAR SYSTEM

14.1 SCOPE OF WORK

- The scope includes Supply, Installation, Testing and Commissioning of On- Grid PV power plants (Roof-top/Ground Mounted)
- All the necessary approvals from MGVCL / Local Electricity Board / Electrical Inspectorate, feasibility study, necessary civil work, Mounting of Module Structures, PV Module Installation, Inverter Installation, DC/AC Cabling and interconnections, Installation of Lightning Arresters and Earthing System as per the standards, Net Metering, Arranging all the necessary inspections from MGVCL / Local Electricity Board / Electrical Inspectorate as part of work.

14.2 DEFINITION



- Solar PV power plant system comprises of Topcon Monocrystalline silicon Solar PV modules with intelligent Inverter having MPPT technology and Anti-Islanding feature and associated power electronics, which feeds generated AC power to the Grid. Other than PV Modules and Inverter/Inverters, the system consists of Module Mounting Structures, appropriate DC and AC Cables, Array Junction Boxes (AJB) / String Combiner Boxes (SCB), AC and DC Distribution Box, Lightning Arrester, Earthing Systems, Net meter, etc.
- The system should be capable for exporting the generated AC power to the Grid, whenever the Grid is available with all System Protection facilities.
- Components and parts used in the Solar PV power plants including the PV modules, metallic structures, cables, junction box, switches, PCUs etc., should confirm to the BIS or IEC or international specifications, wherever such specifications are available and applicable.

14.3 SOLAR PV MODULE

- The EPC Company/ Contractor shall use only the PV modules that are empanelled to the ANERT OEM empanelment.
- The PV modules should be made in India. The PV modules used must qualify to the latest edition of IEC / BIS standards, PV module design qualification & Type approval shall be confirm IEC 61215 / IS 14286. In addition, the modules must confirm to IEC 61730 Part-1 -requirements for construction & Part 2 -requirements for testing, for safety qualification or equivalent IS.
- The Total Solar PV array capacity shall be as per site space availability / Engineer In charge approval and shall be assembled with minimum 610 Wp or higher. PV modules shall be Topcon Glass to Glass or higher efficient, Front & back sheet having encapsulant POE to POE material as per MNRE or ALMM approved. The modules should be tested and certified by a Govt. of India authorized test centers or should confirm to relevant IEC standard as per MNRE guidelines. Offered module shall have a power output warranty of min 90% or higher of the rated power for 10 years. The rated output power and Efficiency of each supplied & installed module shall not be less than the specified power rating and Efficiency of the modules, in any case. Every module should have suitable by-pass diode at its terminal box.
- The PV modules must be PID compliant, salt, mist & ammonia resistant and should withstand weather conditions for the project life cycle.
- The maximum allowed water vapor transmission rate shall be 4-6 g/ m²/day.
- The front glass shall meet the following specifications:
 - a) The facing glass must be Tempered, PV grade with Low iron and high transmission.
 - b) The transmission shall be > 94 %
 - c) Thickness shall be min 2.0 mm
 - d) Textured to trap more light



- e) The glass shall have an Anti-reflective coating for the better transmission and light absorption.
- f) Tempered glass to meet the external load conditions like wind and snow load.
- The Back glass shall meet the following specifications:
 - a) The back glass must be Tempered & Textured along with white color grid to achieve Bifacial gain.
 - b) The transmission shall be $> 93 \%$
 - c) Thickness shall be min 2.0 mm
 - d) Textured to trap more light
 - e) Tempered glass to meet the external load conditions like wind load.
- The encapsulant used for the PV modules should be UV resistant in nature. No yellowing of the encapsulant with prolonged exposure shall occur. The sealant used for edge sealing of PV modules shall have excellent moisture ingress Protection with good electrical insulation and with good adhesion strength. Edge tapes for sealing are not allowed.
- Anodized Aluminium module frames of sufficient thickness (min. 1.5mm thick) shall be used which are electrically & chemically compatible with the structural material used for mounting the modules having provision for earthing.
- UV resistant junction boxes with minimum three numbers of bypass diodes and two numbers of MC4 connectors or equivalent with appropriate length of 4 sq.mm Cu cable shall be provided. IP67 / IP68 degree of protection shall be used to avoid degradation during Life.
- Shading correction/ bypass diode for optimizing PV out to be incorporated in each solar module or panel level.
- Each PV module used in any solar power project must use a RF identification tag (RFID), which must contain the following information. The RFID can be inside or outside the module laminate but must be able to withstand harsh environmental conditions.
- Name of the manufacturer of PV Module.
 - a) Name of the manufacturer of Solar cells.
 - b) Month and year of the manufacture (separately for solar cells and module).
 - c) Country of origin (separately for solar cell and module).
 - d) I-V curve for the module.
 - e) Peak Wattage, IM, VM and FF for the module.
 - f) Unique Serial No. and Model No. of the module.
 - g) Date and year of obtaining IEC PV module qualification certificate.



- h) Name of the test lab issuing IEC certificate.
- i) Other relevant information on traceability of solar cells and module as per ISO 9001 series.

The following details should be provided on the module

- a) Name of the manufacturer (Should be Made in India)
 - b) Month and year of manufacture.
 - c) Rated Power at STC.
 - d) VMP, IMP, VOC, Isc.
- The PV modules must qualify (enclose Test Reports/Certificates from IEC/NABL accredited laboratory) as per relevant IEC standard. The Performance of PV Modules at STC conditions must be tested and approved by one of the IEC/NABL Accredited Testing Laboratories.
 - PV modules used in solar power plant/ systems must be warranted (Product Warranty) for 12 years for their material & manufacturing defects. The output peak watt capacity (Performance Warranty) which should not be less than 94.5 % at the end of 12 years and not less than 87% at the end of 30 years.
 - Original Equipment Manufacturers (OEM) Warrantee of the PV Modules shall be submitted by the successful bidder when the materials delivered at site.
 - The PV modules shall conform to the following standards:
 - IS 14286: Crystalline silicon terrestrial photovoltaic (PV) modules — design qualification and type approval.
 - IEC 61215 / IEC 61646: c-Si (IEC 61215): Crystalline silicon terrestrial photovoltaic (PV) modules – Design qualification and type approval Thin Film (IEC 61646): Design, Qualification & Type Approval
 - IEC 61730-1: Photovoltaic Module safety qualification- Part 1: Requirements for construction
 - IEC 61730-2 : Photovoltaic Module safety qualification- Part 2: Requirements for testing
 - IEC 61701 : Salt mist corrosion testing of photovoltaic modules
 - IEC 62716 : Test Sequences useful to determine the resistance of PV Modules to Ammonia (NH₃)

14.4 INVERTER / POWER CONDITIONING UNIT (PCU)

- The Power Conditioning Unit shall be String Inverter with power exporting facility to the Grid. The List of Inverters under On-Grid category is attached as Annexure II-F. However the specifications for the ON-Grid Inverters are detailed below:

- As SPV array produce direct current electricity, it is necessary to convert this direct current into alternating current and adjust the voltage levels to match the grid voltage. Conversion shall be achieved using an electronic Inverter and the associated control and protection devices. All these components of the system are termed the “Power Conditioning Unit (PCU)”. Typical technical features of the inverter shall be as follows:
- General Specifications:
- All the Inverters should contain the following clear and indelible Marking Label & Warning Label as per IS16221 Part II, clause 5. The equipment shall, as a minimum, be permanently marked with:
 - a) The name or trademark of the manufacturer or supplier.
 - b) A model number, name or other means to identify the equipment.
 - c) A serial number, code or other markings allowing identification of manufacturing location and the manufacturing batch or date within a three-month time period.
 - d) Input voltage, type of voltage (A.C. or D.C.), frequency, and maximum continuous current for each input.
 - e) Output voltage, type of voltage (A.C. or D.C.), frequency, maximum continuous current, and for A.C. outputs, either the power or power factor for each output.
 - f) The Ingress Protection (IP) rating
 - g) The inverter output shall be 415 VAC, 50 Hz, 3 phase or 230 VAC, 50 Hz, 1 phase.
 - h) The inverter shall include appropriate self-protective and self-diagnostic feature to protect itself and the PV array from damage in the event of inverter component failure or from parameters beyond the inverter’s safe operating range due to internal or external causes.
- The Technical Specification of On-Grid Inverters are summarized below:

Specifications of Inverters	
Parameters	Detailed specification
Nominal voltage	230V/415V
Voltage Band	Between 80% and 110% of V nominal
Nominal Frequency	50 Hz
Operating Frequency Range	47.5 to 50.5 Hz
Waveform	Sine wave
Harmonics	AC side total harmonic current distortion < 3%
Ripple	DC Voltage ripple content shall be not more than 1%
Efficiency	Efficiency shall be >97%



Casing protection levels	Degree of protection: Minimum IP-54 for internal units and IP-65 for outdoor units
Operating ambient Temp range	-10 to + 60 degree Celsius
Operation	Completely automatic including wakeup, synchronization (phase locking) and shut down
MPPT	MPPT range must be suitable to individual array voltages
Protections	Over voltage: both input and output Over current: both input and output Over / Under grid frequency Over temperatureShort circuit Lightning Surge voltage induced at output due to external source Islanding
Ingress Protection	IP 65 for Outdoor / IP 54 for Indoor
Recommended LED Indication	ON Grid ON Under/ Over voltageOverload Over temperature
Recommended LCD Display on front Panel	DC input voltageDC current AC Voltage (all 3 phases) AC current (all 3 phases) Frequency Ambient Temperature Instantaneous power Cumulative output energy Cumulative hours of operationDaily DC energy produced
Communication Interface	RS485/ RS232/Wi-Fi (with or without USB)

The IEC Certifications of On-Grid Inverters are summarized below:

Standard	Description
IEC 61683	Photovoltaic systems - Power conditioners - Procedure for measuring efficiency
IEC 61727	Photovoltaic (PV) systems- Characteristics of the utility interface
IEC/EN 62109-1	Safety of power converters for use in photovoltaic power systems - Part 1: General requirements
IEC/EN 62109-2	Safety of power converters for use in photovoltaic power systems - Part 2: Particular requirements for inverters

IEC/EN 61000-3-3/3-11/ 3-5	Electromagnetic compatibility (EMC) - Part 3-11; Limits; Limitation of Voltage Change, Voltage Fluctuations and Flicker in Public Low- Voltage Supply Systems; Rated Current <16A/ >16A and <75A/>75A per Phase respectively
*IEC/EN 61000-6-1 / 6-2	Electromagnetic compatibility (EMC) - Part 6-2: Generic standards - Immunity standard for residential and commercial /industrial environments
*IEC/EN 61000-6-3 / 6-4	Electromagnetic compatibility (EMC) - Part 6-4: Generic standards - Emission standard for residential and commercial / industrial environments
IEC 62116	Utility-interconnected photovoltaic inverters - Test procedure of islanding prevention measures
IEC 60068-2-1	Environmental testing - Part 2-1: Tests - Test A: Cold
IEC 60068-2-2	Environmental testing - Part 2-2: Tests - Test B: Dry heat
IEC 60068-2-14	Environmental testing - Part 2-14: Tests - Test N: Change of temperature
IEC 60068-2-30	Environmental testing - Part 2-30: Tests - Test Db; Dampheat, cyclic (12 h + 12 h cycle)

- a) Three phase PCU/ inverter shall be used with each power plant system (10kW and/or above) but in case of less than 10kW single phase inverter can be used.
- b) PCU/inverter shall be capable of complete automatic operation including wake-up, synchronization & shutdown.
- c) The output of power factor of PCU inverter is suitable for all voltage ranges or sink of reactive power; inverter should have internal protection arrangement against any sustainable fault in feeder line and against the lightning on feeder.
- d) Built-in meter and data logger to monitor plant performance through external computer shall be provided.
- e) Anti-islanding (Protection against Islanding of grid): The PCU shall have anti islanding protection in conformity to IEEE 1547/UL 1741/ IEC 62116 or equivalent BIS standard.
- f) In PCU/Inverter, there shall be a direct current isolation provided at the output by means of a suitable isolating transformer. If Isolation Transformer is not incorporated with PCU/Inverter, there shall be a separate Isolation Transformer of suitable rating provided at the output side of PCU/PCU units for capacity more than 100 kW.
- g) The PCU/ inverter generated harmonics, flicker, DC injection limits, Voltage Range, Frequency Range and Anti-Islanding measures at the point of connection to The Utility services should follow the latest CEA (Technical Standards for Connectivity Distribution Generation Resources) Guidelines.



- h) The power conditioning units / inverters should comply with applicable IEC/ equivalent BIS standard for efficiency measurements and environmental tests as per Standard codes IEC 61683/IS 61683 and IEC 60068-2(1,2,14,30)/Equivalent BIS Standard.
- i) The MPPT units environmental testing should qualify IEC 60068-2 (1, 2, 14,30)/ Equivalent BIS STD. The junction boxes/ enclosures should be IP 65 (for outdoor)/ IP 54 (indoor) and as per IEC 529 specifications.
- j) The PCU/ inverters should be tested from the MNRE approved test centers/ NABL/ BIS/IEC accredited testing- calibration laboratories. In case of imported power conditioning units, these should be approved by international test houses.

14.5 MODULE MOUNTING STRUCTURE

- Photovoltaic arrays must be mounted on a stable, durable structure that can support the array and withstand wind, rain, and other adverse conditions. The modules will be fixed on structures with fixed arrangement.
- The module mounting structures shall have adequate strength and appropriate design suitable to the locations, which can withstand the load and high wind velocities. Stationary structures shall support PV modules at a given orientation, absorb and transfer the mechanical loads to the surface properly.
- Foundation: The PCC foundation shall have to be designed on the basis of the weight of the structure with module and maximum wind speed of the site, i.e. 150 Km/hour. Normally each MMS should be with four legs grouted on pedestals of proper size.
- Each structure with fixed tilt should have a tilt angle as per the site conditions to take maximum insolation which will be approximately equal to the latitude of the location facing true South with a North - South orientation. The tilt angle can vary from 9 degree to 12 degree based on the location's latitude in Baroda.
- The PV module mounting structure shall have a capacity to withstand a wind velocity of 150 km/hr unless specified for dedicated requirements.
- Suitable fastening arrangement such as grouting and calming should be provided to secure the installation against the specific wind speed. The PV array structure design shall be appropriate with a factor of safety of min 1.5
- The materials used for structures shall be Hot dip Galvanized Mild Steel conformed to IS 2062:1992 or aluminium of suitable grade minimum alloy 6063 or better.
- The minimum thickness of galvanization for hot dip Galvanized Mild Steel should be at least 80 microns as per IS 4759.
- The Bolts, Nuts, fasteners, and clamps used for panel mounting shall be of Stainless Steel SS 304.
- No Welding is allowed on the mounting structure.



- Aluminum structures used shall be protected against rusting either by coating or anodization.
- Aluminum frames should be avoided for installations in coastal areas.
- The structure shall be designed to withstand operating environmental conditions for a period of minimum 25 years. And shall be free from corrosion while installation.
- Screw fasteners shall use existing mounting holes provided by module manufacturer. No additional holes shall be drilled on module frames
- The total load of the structure (when installed with PV modules) on the terrace should be less than 60 kg/m².
- Minimum distance between the lower level of PV Module and the ground shall be 0.6m from the ground level.
- The PV Panel area shall be accessible for cleaning and for any repair work.
- Sufficient gap need to be provided between the rows to avoid falling of shadow of one row on the next row. Seismic factors for the site will be considered while making the design of the foundation.
- Adequate spacing shall be provided between any two modules secured on PV panel for improved wind resistance.
- Installation of structure for solar PV mounting should not tamper with the water proofing of the roofs.
- The above drawing is specific for RCC flat roofs and may vary for slope roofs. However the drawings shall be approved by concerned Engineer Incharge / Technical Consultant before installing the plant.

14.6 SOLAR METER AND NETMETER

Solar Meter:

- A separate Energy Meter called Solar Meter shall be provided at the output of PCU to record the energy generation from the Solar System. (This energy meter should not be integrated with PCU). Solar energy meter means a unidirectional meter to be installed at the delivery point of the solar energy system to measure the solar electricity generated. This Energy Meter should be tested along with the Net Meter (Import-Export Meter).

Netmeter:

- As per Gujarat State Electricity Regulatory Commission (Renewable Energy and Net Metering) Regulations 2020, net metering system is to be provided to the solar consumer. Net meter means the bidirectional energy meter to be installed at the interconnection point of the consumer with the network of distribution licensee.



- Energy meters shall be installed and maintained in accordance with the provisions of The Central Electricity Authority (Installation and Operation of Meters) Regulations, 2006 as amended from time to time. The Contractor shall maintain the Metering System as per metering code and CEA guidelines. The defective meter shall be immediately tested and rectified/ replaced.
- The solar energy meter and net energy meter shall be of accuracy as given and CT and PT shall be utilized according to CEA metering regulations 2006 and its amendment.
- Display parameters : LCD test, kWh import, kWh export, MD in kW export, MD in kW import, Date & Time, AC current and voltages and power factor (Cumulative kWh will be indicated continuously by default & other parameters through push-button). The solar energy meters and net energy meters should be DLMS compliant and AMR compatible with RS 485 communication port for measurement of specified electrical parameters.

14.7 EARTHING

- The Solar PV Plant should have a dedicated earthing system. The Earthing for array and LT power shall be made as per the provisions of IS:3043-2018 “Code of practice for earthing (Second Revision),” that governs the earthing practices of a PV system and IS 732:2019 “Code of practice for electrical wiring installations (Fourth Revision)
- Earthing System shall connect all non –current carrying metal receptacles, electrical boxes, appliance frames, chassis and PV module mounting structures in one long run. The earth strips should not be bolted. Earthing GI strips shall be interconnected by proper welding.
- The earthing conductor should be rated for 1.56 times the maximum short circuit current of the PV array. The factor 1.56 considers 25 percent as a safety factor and 25 percent as albedo factor to protect from any unaccounted external reflection onto the PV modules increasing its current.
- In any case, the cross-section area or the earthing conductor for PV equipment should not be less than 6 mm² if copper, 10 mm² if aluminium or 70 mm² if hot-dipped galvanized iron. For the earthing of lightning arrestor, cross-section of the earthing conductor should not be less than 16 mm² of copper or 70 mm² if hot-dipped galvanized iron. The complete Earthing system shall be mechanically & electrically connected to provide independent return to earth.
- Masonry enclosure with the earth pit of size not less than 400mm X 400 mm(depth) complete with cemented brick work (1:6) of minimum 150mm width duly plastered with cement mortar (inside)shall be provided. Hinged inspection covers of size not less than 300mm X 300mm with locking arrangement shall be provided . Suitable handle shall be provided on the cover by means of welding a rod on top of the cover for future maintenance.



- Minimum four (04) numbers of interconnected earth pit needs to be provided in each location. Minimum required gap shall be provided in between earth pits as per relevant standard. Body earthing shall be provided in inverter, each panel frame, module mounting structure, kiosk and in any other item as required.
- Earth pit shall be constructed as per IS: 3043-2018. Electrodes shall be embedded below permanent moisture level.. Earth pits shall be treated with salt and charcoal if average resistance of soil is more than 20 ohm meter.
- Earth resistance shall not be more than 5 ohms. Earthing system must be interconnected through GI strip to arrive equipotential bonding. The size of the GI earth strip must be minimum 25mm X 6mm.
- The equipment grounding wire shall be connected to earth strip by proper fixing arrangement. Each strip shall be continued up to at least 500mm from the equipment. Necessary provisions shall be made for bolted isolating joints of each earthing pit for periodic checking of earth resistance.

14.8 LIGHTNING PROTECTION

- The SPV power plant should be provided with lightning and over voltage protection. The source of over voltage can be lightning or other atmospheric disturbance. The lightning conductors shall be made as per applicable Indian Standards in order to protect the entire array yard from lightning stroke.
- The design and specification shall conform to IS/IEC 62305, "Protection against lightning" govern all lightning protection-related practices of a PV system.
- The entire space occupying SPV array shall be suitably protected against lightning by deploying required number of lightning arresters. Lightning protection should be provided as per IS/ IEC 62305.
- Lightning system shall comprise of air terminations, down conductors, test links, earth electrode etc. as per approved drawings.
- The protection against induced high voltages shall be provided by the use of surge protection devices (SPDs) and the earthing terminal of the SPD shall be connected to the earth through the earthing system.
- The EPC Contractor / Company shall submit the drawings and detailed specifications of the PV array lightning protection equipment to Employer for approval before installation of system.

14.9 AC DISTRIBUTION BOARD

- AC Distribution Board (ACDB) shall control the AC power from inverter and should have necessary surge arrestors.
- An ACDB panel shall be provided in between PCU and Utility grid. It shall have MCB/MCCB/ACB or circuit breaker of suitable rating for connection and disconnection of PCU from grid.



- The connection between ACDB and Utility grid shall be of standard cable/ Conductor with suitable termination. It shall have provision to measure grid voltage, current and power.
- The incomer shall be selected at required rating. The ACDB enclosure shall be of good protection and suitable for mounting on the trenches / on wall.
- All the 415 V AC or 230 V AC devices/equipment like bus support insulators, circuit breakers, SFU isolators (if applicable), SPD, etc. mounted inside the switch gear shall be suitable for continuous operation.
- Switches/ circuit breakers/ connectors meeting general requirements and safety measurements as per IS 60947 Part I, II, III and IEC 60947 part I, II and III.
- Junction boxes, enclosures, panels for inverters/ Controllers shall meet IP 54 (for outdoor)/ IP 65 (for indoor) as per IEC 529.

14.10 AC / DC CABLING :

- Cabling is required for wiring from AC output of inverter/PCU to the Grid Interconnection point. It includes the DC cabling from Solar Array to AJB and from AJB to inverter input.
- All cables of appropriate size to be used in the system shall have the following characteristic:
- Shall conform to IEC 60227 / IS 694 & IEC 60502 / IS 1554 standards.
- Temperature Range: -10 degree Celsius to +80 degree Celsius
- Voltage rating: 660/1000V
- Excellent resistance to heat, cold, water, oil, abrasion, UV radiation
- Flexible Sizes of cables between any array interconnections, array to junction boxes, junction boxes to inverter etc. shall be so selected to keep the voltage drop (power loss) of the entire solar system to the minimum (2%).
- The length of exceeding 25m of AC cable from Inverter to ACDB and to the Grid connection point shall be borne by the customer.
- For the DC cabling, XLPE insulated and sheathed, UV stabilized single core flexible copper cables shall be used; Multi-core cables shall not be used.
- For the AC cabling, PVC or XLPE insulated and PVC sheathed single or, multi-core flexible copper cables shall be used. However, for above 25kWp systems, XLPE insulated Aluminium cable of suitable area of cross section can be used in the AC side subject to a minimum area of cross section of 10 sq.mm. Outdoor AC cables shall have a UV -stabilized outer sheath IS/IEC 69947.
- All LT XLPE cables shall conform to IS:7098 part I&II.
- The total voltage drop on the cable segments from the solar PV modules to the solar grid inverter shall not exceed 2.0%



- The total voltage drop on the cable segments from the solar grid inverter to the building distribution board shall not exceed 2.0%
- The DC cables from the SPV module array shall run through a UV-stabilized PVC conduit pipe of adequate diameter with a minimum wall thickness of 1.5mm.
- Cables and wires used for the interconnection of solar PV modules shall be provided with solar PV connectors (MC4) and couplers.
- All cables and conduit pipes shall be clamped to the rooftop, walls and ceilings with thermo-plastic clamps at intervals not exceeding 50cm; the minimum DC cables size shall be 4.0mm² copper, the minimum AC cable size shall be 4.0mm² copper. In three phase systems, the size of the neutral wire size shall be equal to the size of the phase wires.
- Cable Marking: All cable/wires are to be marked in proper manner by good quality ferule or by other means so that the cable can be easily identified. The following color code shall be used for cable wires
 - a) DC positive: red (the outer PVC sheath can be black with a red line marking)
 - b) DC negative: black
 - c) AC single phase: Phase: red; Neutral: black
 - d) AC three phase: phases: red, yellow, blue; neutral: black
 - e) Earth wires: green
- Cables and conduits that have to pass through walls or ceilings shall be taken through PVC pipe sleeve.
- Cable conductors shall be terminated with tinned copper end ferrules to prevent fraying and breaking of individual wire strands. The termination of the DC and AC cables at the Solar Grid Inverter shall be done as per instructions of the manufacturer, which in most cases will include the use of special connectors.
- All cables and connectors used for installation of solar field must be of solar grade which can withstand harsh environment conditions including high temperatures, UV radiation, rain, humidity, dirt, salt, burial and attack by moss and microbes' for 25 years and voltages as per latest IEC standards. DC cables used from solar modules to array junction box shall solar grade copper (Cu) with XLPE insulation and rated for 1.1 kV as per relevant standards only.
- Bending radius for cables shall be as per manufactures recommendations and IS: 1255. For laying/termination of cables latest BIS/IEC Codes/ standards shall be followed.

14.11 CIVIL WORK

- Existing shade-free roof-top space shall be used to install Solar PV array. While installing solar power plants on rooftops, the physical condition of the rooftop, chances of shading, chances water level rise in the rooftop during raining due improper drainage in the roof-top should be taken in to consideration.



- PV array shall be installed in the terrace space free from any obstruction and/or shadow and to minimize effects of shadows due to adjacent PV panel rows. PV array shall be oriented in the south direction in order to maximize annual energy yield of the plant.
- The solar PV array must be installed on the rooftop in such a way that there is sufficient space on the rooftop for maintenance etc.
- There should not be any damage what so ever to the rooftop due to setting up of the solar power plant so that on a later day there is leakage of rainwater, etc. from the rooftop.
- Ample clearance shall be provided in the layout of the inverter and DC/AC distribution boxes for adequate cooling and ease of maintenance.
- While cabling the array, care must be taken such that no loose cables lie on the rooftops. The roof top should look clean and tidy after installation of the array. Neatness, tidiness and aesthetics must be observed while installing the systems.
- RCC Works - All RCC works shall be as per IS 456 and the materials used viz. Cement reinforcement, steel etc. shall be as per relevant IS standards. Reinforcement shall be high strength TMT Fe 415 or Fe 500 conforming to IS: 1786-1985. Brick Works (If any) - All brick works shall be using 1st class bricks of approved quality as per IS 3102. Plastering - Plastering in cement mortar 1:5, 1:6 and 1:3 shall be applied to all.
- Display of mandatory items- Single Line Diagram and layout diagram of modules and interconnection at installation site shall be provided near the inverter for greater than 10 kWp systems
- For painting on concrete, masonry and plastered surface IS:2395 shall be followed. For distempering IS 427 shall be followed referred. For synthetic enamel painting IS 428 shall be followed. For cement painting IS 5410 shall be followed.
- All Civil works required for the installation of the PV Plant and other civil and electrical work in evacuation infrastructure, wherever necessary, shall be within the scope of the bidder / contractor.
- The layout of Inverter accommodation shall be designed to enable adequate heat dissipation and availability. Mount within the existing infrastructure available in consultation with the Site in charge. String Inverters may be installed with Canopy type structure over it to protect it from frequent monsoon and weather changes.

14.12 DRAWING AND DOCUMENTS

- Contractor must submit drawings/documents required by statutory authorities and obtain the approval before the installation.



- a) Schematic drawing showing the PV panels, Power conditioning Unit(s)/Inverter, Array Junction Boxes (AJBs)/String Combiner Boxes (SJB), AC and DC Distribution Box, Net meters etc.
- b) Layout of Solar PV array.
- c) Single Line Diagram (SLD) with specification of all components.
- d) Design documents for Module Mounting Structure (MMS) including certificate showing wind speed withstanding capacity of the structure
- e) Module Mounting Structure along with foundation details for the structure.
- f) Sizes and specification of cables for PV module interconnections, PV array to array Junction boxes, Array Junction Boxes to Inverter, Inverter to ACDB / Grid connection point etc. shall be furnished.
- Contractor shall submit a PV system report for PV power plants from 25KWp and above. All PV plant design should contain the following details which should be approved by the concerned Engineer In Charge / Technical Consultant before installation.
 - a) Design of strings including the number of PV modules in series and number of strings.
 - b) Ac Protection (Circuit Breaker, Switches, Fuses, SPD)
 - c) DC Protection (Switches, Fuses, SPD)
 - d) AJB / SCB Details
 - e) DC Cable Size and length from point to point
 - f) AC Cable Size and length from point to point
 - g) Earthing system details and number of pits
 - h) Lightning protection details / specification
 - i) PV system Simulation Report for above 25Kwp

15.0 HV TWO/ FOUR POLE STRUCTURE:

- The design, material, construction, manufacture and testing of HV two/ four pole structures shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed. The equipment shall also conform to the latest applicable standards.
- Two/ four pole structures shall conform to the latest applicable standards specified as under. In case of conflict between the standards and this specification, this specification shall govern.
- Two/ four pole structures shall be erected in switchyard to receive HV power supply from power supply authority.
- Each two/ four pole structure shall be inclusive of items listed below.

15.1 STRUCTURE :

- A two/ four pole structure shall be of a rolled steel joist of minimum ISMB 150 (150mm x 75mm) for 6 meter pole/ ISMB 175 (175 mm x 90 mm) for 9/ 11meter pole with 400



- mm x 400 mm x 8 mm thick base plate welded at bottom end of all the poles of structure.
- Mild steel cross members of minimum ISMC 100 mm x 50 mm x 6 mm size channels of 3.5 mtr in length, 8 Nos. shall be provided with cross bracing angles of minimum ISA 50 mm x 50 mm x 6 mm size of 4.5 meter in length.
 - Side clamps, stay clamps, cleats etc. shall be fabricated from minimum 50 mm x 6 mm size MS flats as per actual requirements. All bolts, nuts, washers, etc. shall be of minimum 15 mm size.
 - All the members of two/ four pole structure should be galvanized.
 - Excavation of pits even in hard soil shall be done up to a depth of about 1/ 6 the length of pole and refilling the same after erection of structure and concreting work. Compacting the bottom of pits, providing cement concrete to suit at bottom and side of poles up to at-least 150 mm above FGL curing and making it hard as per requirement.
 - Erection of RSJ poles and fixing of all structural members as per requirement shall be in line, level and properly facing the incoming and outgoing lines. Cross members shall be firmly tightened.
 - All members shall be fabricated to suit mounting/ fixing of Gang Operated Disconnectors/ Isolators, Lightning Arrestors, Pin/ Post insulators, cable end termination Kit/ Box etc.
 - All MS parts shall be painted with two coats of red oxide and two coats of aluminum paints.
 - Earthing terminals shall be provided by welding 15 mm size bolts or cleats of 50 mm x 6 mm size MS flat shall be welded in each joist with a hole of 15 mm size and galvanized nuts, bolts, washers shall be provided as earthing terminals.
 - Necessary hardware including stay wire and its accessories as required for completeness shall be supplied and erected.
 - All drawings/ documents such as GA drawing of two/ four pole structure showing all equipment mounted on the structure, technical particulars & Bill of Material etc shall be prepared and submitted to Purchaser/ Purchaser's representative for approval. Obtaining the approval from CEIG/ IMPD (GOG) and getting power released from supply authority are also included in the scope of work.

15.2 Gang operated offload disconnectors (GOD) with earth switch:

- The double break type isolator (GOD) shall be manually operated and suitable for the specified site conditions and shall be able to-
- Carry rated current without excessive temperature rise.
- Withstand the short circuit forces developed during fault.
- Carry the inrush current of the transformer.
- Interrupt small inductive and capacitive currents.
- The operating rod shall be extended up to the operating level and shall have a handle with 'lock and key' arrangement. The operating handle shall be at a level of 1.0 meter from finished ground level.
- The operating handles shall be mounted on the base of supporting structure. Guide bearings shall be provided if necessary at appropriate height above ground level. Necessary accessories viz. brackets, angles, guides, guide bearings for attaching the

operating mechanism and operating handles to the structure and part of the isolator, rust proof pins, ball or roller type bearings shall be provided and installed. All bearings shall be protected by means of covers and grease retainers. Bearings pressure shall be kept low to ensure long life and ease of operation.

- The operating mechanism design shall be such that, as soon as the moving blades reach the sparking distance during operation of isolator, springs shall take over to give a quick snap action closing so that the isolator closing is independent of manual effort. Similarly the springs must assist during opening operation to give quick breaking feature.
- All copper parts shall be Silver or Tin plated. All ferrous parts shall be hot dip galvanized to assure long protection against tropicalized weather.
- The contacts shall be of silver faced copper ensuring sufficient contact pressure. The male and female contacts shall be of self-aligning type to ensure trouble free operation during opening and closing of isolator. Mild steel arcing horn capable of breaking the magnetizing current shall be provided. Earth mesh below GOD to be provided.
- Isolator Interlock
- Electrical interlock arrangement shall be provided among double break isolator (GOD) and respective 11 KV indoor type breakers.
- Interlocking arrangement shall be robust, heavy-duty type and sturdy in construction.
- Mechanical interlock between isolator & Earth switch shall be provided.

15.3 Insulators :

- Insulator shall be properly glazed with smooth surface without cracks etc. and dielectric property shall be properly co-ordinated with isolator voltage class. Porcelain used for the manufacturer of insulator shall be uniform, brown color, free from blisters, burns and other similar defects. Insulators of the same rating and type shall be interchangeable.
- Porcelain and metal parts shall be assembled in such a manner that any thermal expansion differential between the metal and porcelain parts throughout the range of the temperature variation shall not loosen the parts or create undue internal stresses which may affect the electrical or mechanical strength and rigidity. Each cap and base shall be of high grade cast steel or malleable steel casting and they shall be machine faced and smoothly galvanized. The cap and base of the insulators shall be interchangeable with each other.

15.4 ACSR Conductor:

- Aluminum conductor steel reinforced shall be hard drawn from 99.5% pure electrolytic aluminum rods. The Contractor shall specify the conductivity.
- Chemical composition of the material shall comply with the requirements of relevant standards.
- The surface of conductor shall be clean and dry and free from any excess grease that may be used in its fabrication. The surface strands shall be smooth and free from burrs and other projections which may be a cause for increasing corona losses.
- The Contractor shall provide necessary treatment for the bus conductor to make it free from corrosion.
- The steel wire strand of conductor and steel conductor shall be hot dip galvanized. Zinc coating shall be evenly and uniformly for heavily coated wires.

- The steel core and inner layer of aluminum wires where more than one aluminum layer exist shall be protected with special grease in order to provide additional protection against corrosion due to salinity. The grease shall fill the whole space between wires within circumscribed cylinder at inner aluminum layer or at steel core if the conductor has only one aluminum layer.
- The grease shall be chemically neutral with respect to aluminum, zinc and steel. It shall withstand weather conditions given elsewhere and temperature of 85 degree centigrade without alternation of its properties.
- Bare conductor shall be covered in Alkathene pipes of suitable insulation to avoid accidental contact.

15.5 Drop Out (DO) Fuse Unit :

- Drop Out Fuse shall be of approved make suitable for 11 kV supply and shall be mounted on two pole structure complete with 3 fuse elements of required ampere suitable for continuous current rating and shall offer protection against fault level of suitable ampere at 11 kV.
- The fuse link shall consists of iron channel base to stack insulators per phase, fuse carrier Bakelite tube, heavy duty non-ferrous metal parts and spring loaded phosphor bronze contacts.
- The insulator shall comply with impulse voltage in accordance with relevant IS.

15.6 Station Class Lightning Arrestors:

- The design, material, construction, manufacture, inspection and testing of lightning arresters shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed.
- In case of conflict between the standards and this specification, this specification shall govern.
- The equipment covered in this specification shall conform to the latest edition of the following standards.

IS: 3070 (Part-3) ::	Lightning arresters for AC system – Specification (Metal Oxide Lightning Arrester without Gaps)
IEC: 60099-4 ::	Metal Oxide surge arresters without gaps for AC system

a) Constructional Features:

- Lightning arrester shall be station class heavy duty and non-- linear resistance type. The elements shall be in hollow cylindrical form, stacked together. Lightning arrestor shall be of class II, having non – linear voltage – current characteristic and having high discharge capability.
- The entire arrester unit shall be housed in a porcelain insulating casing of high strength, made from brown glazed wet process porcelain, with metallic cover plates and terminal assemblies. The end castings shall be hermetically sealed and leak tested to protect the unit from moisture or breathing.
- Pressure relief diaphragm, vent pipe, etc. shall be provided on the LA for the escape of

gases formed. In the event of failure of L.A., the pressure relief directional aperture should be directed away from adjacent apparatus to prevent damage, due to arc transfer.

- All hardware such as clamps, screws, bolts, nuts, washers etc. shall be electro galvanized.

b) Insulators:

- The porcelain insulators used shall be made from wet process, and shall be homogenous, free from lamination, cavities and other flaws, which may impair its mechanical or dielectric strength. They shall be thoroughly vitrified, tough and impervious to moisture.
- The glazing of porcelain shall be uniform brown colour, free from blisters, burns, cracks and other defects. The glazing shall cover all the porcelain part of the insulators except that area which serves as support during glazing or are unglazed for the purpose of assembly.
- The minimum creep age distance shall be as stipulated in data sheets. The petticoats shall be spaced for natural cleaning action by wind and rain and avoid concentrated hot spots where local stress can precipitate flashover.
- All live metallic parts shall be suitably painted. All joints shall be fluid – tight and air tight. The design of insulators shall be such, as to produce uniform compression pressure joints.
- All insulators of identical rating shall be interchangeable.
- Each bushing shall be provided with aluminium/ bimetallic terminal connectors suitable for inter – connection with aluminium tubular Bus bars or ACSR conductor as specified in data sheet.

c) Accessories:

Each lightning arrester shall be furnished complete with the accessories as listed below:

- Anti – contamination and pressure relief diaphragm complete with vent pipe.
- Two (2) grounding pads.
- Base plate suitable for mounting on G.I. / steel structure or concrete structure.
- Line side terminal suitable for specified conductor.
- Other standard accessories which are not specifically mentioned but are usually provided with lightning arrester of similar type and rating for efficient and trouble free operation.
- Name plates fixed on lightning arresters giving full technical details.
- The clamps and connectors on arrester terminals for connection to Purchaser's line conductor and the connection between incoming transmission line and LA will be in the Contractors scope.

d) Drawings/ documents to be furnished for Purchaser's approval:

- i. Technical Particulars
- ii. GA drawing of LA indicating weight and overall dimensions
- iii. GA drawing of insulating base, discharge counter, terminal assembly
- iv. Bill of Material
- v. Mounting arrangement (base plate details) on the structure



vi. QAP for Lightning Arrester

15.7 Chain Link Fencing and Gravel Filling :

- The work of erecting chain link fencing includes excavation, brick wall construction, erection of angle/ channel supports, providing chain link mesh on angle/ pipe frame barbed wire fencing at the top, concreting of support members, painting the complete structure and white washing the walls. All materials, hard wares, labours etc. are in the scope of contractor.
- Fencing height shall be minimum 2.0 meter & shall be complying with CEA guide lines requirements.
- Gate for entry in the fenced compound shall be fabricated from pipes of heavy duty class. Design of gate shall be got approved from the engineer in charge before starting the fabrication work. All necessary hard wares, fittings, stoppers, locking arrangements with brass pad locks of 100 mm size are in the scope of gate works. Gates shall be self-supporting type.

16.0 SPECIFICATIONS FOR MATERIAL HANDLING SYSTEMS (CRANE / HOIST / CHAIN PULLEY BLOCKS)

General

- Appropriate and suitable material handling arrangements shall be provided for all equipment included in Contractor's scope to transfer the equipment to maintenance area within the building and/or to transfer the equipment outside the building up to ground level for further transportation by the Employer. For this purpose contractor shall provide monorails and hoist blocks with cross travel facility or cranes with 3D movement (vertical i.e. hoisting motion, longitudinal i.e. long travel motion LT, Cross travel motion CT) where specified.

Codes and Standards

- The design, manufacture, inspection and testing of monorails and hoists shall comply with all the currently applicable statutes, regulations and safety codes in the locality where the equipment is to be installed. The monorails and hoists shall conform to the latest edition of the following standards and codes. Other internationally acceptable standards/codes, which ensure equal or higher performance than those specified, are also acceptable. Nothing in this specification shall be construed to relieve the contractor of the required statutory responsibility. In case of any conflict in the standard and this specification, the decision of the Employer shall be final and binding.

IS: 807 : Design, Erection and Testing of Cranes and Hoists IS: 3177 : Electric Overhead Travelling Cranes

IS: 3938 : Specification for Electric Wire Rope Hoists IS: 3832: Chain Pulley Blocks

IS 2429 : Round Steel Short Link Hand Chain

IS: 6216 : Short Link Load Chain Grade 80 Alloy Steel IS: 2266 : Steel Wire Ropes

IS: 15560 : Points Hooks with Shank and Safety Latch IS: 210 : Cast Iron Castings

Design Requirements

- If not specified elsewhere in specific requirement of tender specifications/BOQ, then



generally for the hoists with more than 1.0 metric ton lifting capacity or more than 06 meters lift, motor operated hoist blocks for both long travel and lift shall be provided where rest other hoist blocks shall be of manually operated type for both, longitudinal travel and lift. Minimum 1.5 to 3 meter length of cantilever from edge of building/cladding shall be provided in monorails coming out of the building to lower the equipment to ground level clearing the building sidewalls/cladding and any other facilities beneath the floor up to ground level.

- The exact lift/travel and capacity of the hoisting mechanisms and the mode of lifting equipment shall be as per approved GA drawings of building/concerned civil unit.
- Clear height shall be maintained when handling one equipment over other, in such case dismantling of any equipment shall not be permitted. The center line of monorail shall not deviate by more than 500 mm from the center of gravity of any equipment that is to be lifted.
- Monorails shall be extended outside the building to handle the equipment to ground level. For monorail/hoist routed inside the buildings, suitable machinery well and removable handrail and grating shall be provided on various floors of buildings, as necessary to handle the equipment.

ELECRIC OVERHEAD TRAVELLING (EOT) CRANES

- The crane shall be electrically operated, box/standard "I" beam type single/double girder complete with all accessories including down shop conductor, crane rails and fixtures, starter panel, cable up to starter and shall conform to IS: 3177, IS: 807, IS: 3938 and other relevant approved standards. Crane having 10 MT or higher capacity shall be double girder type only and shall be provided as per the relevant IS and other applicable standards.
- The crane bridge shall consist of single bridge girders on which a wheeled trolley is to run. The bridge trucks and trolley frames shall be fabricated from structural steel. Access walkway with safe hand railing as required along the full span length of the bridge girder shall be provided for double girder crane and for single girder crane a center platform and two platforms at drive end shall be provided for ease of maintenance/access to crane drive. Steel shall be tested for quality conforming to IS: 2062, plates more than 20mm thick shall conform to IS: 2062/BS 4360 or relevant internationally approved standards.
- The bridge shall be designed to carry safely the loads specified in IS: 807/BS 2573 or relevant internationally approved standards. All anti-friction bearings for bridge and trolley track wheels, gear boxes and bottom sheaves on hook shall be lubricated manually by hand operated grease pump through respective grease nipples.
- Wheel base and structural frame of the wheel mounting of the end carriages shall be designed so as to ensure that the crane remains square and prevent skew ness. Bridge and trolley track wheels shall be of forged steel and shall be double flanged type. The wheel diameter and rail sizes shall be suitable for the wheel loads confirming to relevant standards.
- The crane rails/square bars shall be of MS polish as per IS: 2062 or better grade of material. Mountings of the wheels shall be designed to facilitate easy removal for maintenance.



- Walkways shall be of at least 500 mm clear inside width with 6mm thick non-skid steel plate surface. Steel rail stops to prevent rails from creeping and trolley from running off the bridge shall be abutted against ends of rails and welded to the girders. Bridge and trolley stops to match the wheel radius shall be provided before the buffer stops.
- All exposed couplings, shafts, gear, wheels, pinions and chain drives etc. shall be safely encased and guarded completely to prevent any hazard to persons working around. All bearings and gears shall have a design life of 10,000 hours. Electro-magnetic or hydraulic thruster brake shall be provided for the main hoist. One electro-magnetic brake shall be provided for each of the cross travel and long travel motions.
- Hoist mechanism shall consist of motor, brake, gear box, rope drum and bottom block.
- Rope drums shall be grooved and shall be made of seamless pipe as per ASTM 106 Gr. A or B, cast iron of minimum Grade 25 or cast steel, rolled steel of welded construction and in case of welded drum this should be stress relieved and conforming to IS: 3177/BS 466 or relevant internationally approved standards. Rope sheaves are to be made from CI running on drum with provision of adequate guards to prevent the rope from leaving the sheaves.
- Hoist rope shall be extra flexible, improved plough galvanised/FMC plough steel rope with well lubricated hemp core and having six strands of 36 wires per strand with minimum ultimate tensile strength of $1.6/1.75 \times 106 \text{ kN/m}^2$ of right hand ordinary (RHO) lay construction. The ropes shall have a 6:1 safety factor on the specified safe working load, and shall conform to IS: 2266.
- Hook shall be solid forged, heat treated alloy or carbon steel suitable for the duty service. They shall have swivels and operate on ball thrust bearings with hardened races. The lifting hooks shall comply with the requirements of IS: 15560 or relevant internationally approved standards and shall have a safety latch to prevent rope coming off the hook.
- Gears shall be cut from solid cast or forged steel blanks or shall be stress relieved welded steel construction. Pinions shall be of forged carbon or heat treated alloy steel. Strength, quality of steel, heat treatment, face, pitch of teeth and design shall conform to BS 436/IS: 4460 or BS 721 or relevant internationally approved standards.
- A SWL plate not less than 150mm in height showing year of manufacture and rated capacity of hoist in figures shall be placed on each side of the crane girder.
- The maximum deflection under full load shall not exceed $1/900$ of the span.
- All accessory and auxiliary electrical equipment including drive motors, electrically operated brakes, controllers, braking resistors, conductors, insulators, current collectors, pendant push button station, protective devices, operating devices, cables, conduits etc. necessary for the safe and satisfactory operation of the crane shall be provided.
- Power to the crane shall be provided by down shop conductors manufactured from high conductivity hard drawn copper, GI shrouded type. Conductors shall be completely shrouded such that they have no exposed current carrying surfaces. Pendant type push button station shall be sheet steel enclosed and shall comprise the following push buttons and indicating lamps.

‘Start’ and ‘Stop’



Long Travel - 'Right' and 'Left'

Cross Travel - 'To' and 'From'

Hook - 'Hoist' and 'Lower' and micro hoist and lower Red indicating lamp for supply 'ON' indication

- Pendant type push button shall be supported independently of the electrical cable and shall be earthed separately, independent of the suspension. Automatic reset type of limit switches shall be provided to prevent over travel for each of the following:
For 'UP' and 'Down' motions of the hook
Long travel motion
Cross travel motion
- Crane structures, motor frames and metal cases of all electrical equipment including metal conduit and cable guards shall be earthed. All motors, brakes, limit switches, panels, drum controllers, resistor unit sets shall be provided with two studs for earthing.
- Drive motors shall be suitable for crane duty (S4) application and generally conforming to latest IS: 12615/IEC 600342-1 standards as applicable. Motor shall be designed for frequent reversal, braking, inching and acceleration. Pullout torque shall be 2.15 times the rated torque. Pendant control switch, controllers and resistors, controls, electrical protective devices, cables and conductors, earthing guards etc. shall be as per IS: 3938/IS: 3177. Limit switches shall be provided for over hoisting and over- lowering and of two extreme ends of trolley travel i.e. cross as well as long travels. Make of Crane Duty (S4) Motors for EOT Crane / electric hoist as per manufacturer standards shall be acceptable.
- Drive for hoist drive (up and down motion) shall be provided with VFD. VFD shall be as per vendor selection to suit the application and reliable operation. For this application being intermittent operation, de-rating as specified in tender / electrical specifications, conformal coating, and other specific requirements like provision FA fuse, etc. not required.

Tests and test Certificates

- Overload tests at 125% of the rated load shall be carried out and test certificates shall be furnished for hook, wire rope, brake and complete crane.
- Following accessories shall be provided with crane.
 - a) Mechanical stoppers for long travel and cross travel shall be provided.
 - b) Pendant push button station shall be located at maximum 1.0meter from operating floor elevation.
 - c) Earthing terminals shall be provided.
 - d) Limit switches for over hoist, over lower, over cross travel and over long travel shall be provided.
 - e) Flexible trailing cable system shall be provided with sufficient number of loops for specified cross travel.
 - f) The control panel shall be provided. Panel shall be with isolation breaker/switch to receive the power from electrical panel.
 - g) MS ladder shall be provided by the contractor for maintenance.



Painting

- Refer painting requirement / specifications provided separately below.

HAND OPERATED OVERHEAD CRANES

- Cranes shall be designed and manufactured in accordance with BS 2573/IS: 3177/IS: 3832 and shall comply with the requirements of BS 466/IS: 3177/IS: 3832 class II medium duty.
- The crane details and ancillary equipment provided shall conform with applicable parts of the general requirements specified above for electrically operated over-head cranes, except that the crane shall be manually operated in all motions by conveniently mounted endless chains, arranged for operation by one man.

ELECTRIC CHAIN HOIST AND TRAVELLING TROLLEY

- The design, manufacture, inspection and testing of monorail, electric chain hoist and electrically operated traveling trolley shall comply with all the currently applicable statutes, regulations and safety codes in the locality where the equipment is to be installed. Electrically operated chain hoist shall conform to IS: 6547 (1972) and shall be designed for duty service Class II. Other internationally acceptable standards/codes, which ensure equal or higher performance than those specified, are also acceptable.

IS: 6547 (1972) :Electric Chain Hoist

IS: 2429 :Round Steel Short Hand Link Chain

IS: 6216 :Short Link Load Chain Grade 80, Alloy Steel IS: 15560: Points Hooks with Shank and Safety Latch IS: 808 : Indian Standard Medium Weight Beam

IS: 210 :Cast Iron Castings

- Electrically operated chain pulley hoist shall consist of following major components.
 - (a) Electrically operated chain hoist, motor with motor cable, hoisting block and hooks complete.
 - (b) Limit switch to prevent over hoisting and over lowering.
 - (c) Erection hardware.
 - (d) Pendant control station suspended from hoist.
 - (e) Control panel mounted on wall or crane/hoist as applicable.
- Load chain shall be Grade 80 alloy steel chain as per IS: 6216 (1982). Chain wheel shall be made from malleable/SG iron cast confirming to IS: 1865, accurately shaped pockets ensuring smooth operation of load chain.
- Chain hoist shall be suitable to fix with supporting/monorail girder at fixed location at the top/bottom flange of beam (for fixed installation) and bottom hook shall be so designed that it shall be free to swivel in the loaded conditions without twisting the load chain. Hook shall be forged as per IS: 15560 or its latest amendment.
- All running shafts and wheels running on fixed axles/pins shall be fitted with antifriction bearings. Necessary provision shall be made for lubrication of all moving parts and bearings. All exposed bearings shall be suitably sealed or shielded.



- Electric chain hoist shall be with limit switch, pendant push button control switch and over load relay.
- Drive motors shall be suitable for crane duty (S4) application and generally conforming to latest IS: 12615/IEC 60034-1 standards as applicable. Make of Crane Duty (S4) Motors for EOT Crane / electric hoist as per manufacturer standards shall be acceptable.
- Hoist shall be designed into two separate independent units, i.e. motor and hoist for easy maintenance.
- The load hook shall be swiveling type forged circular shank section and shall be as per IS: 15560 with antifriction/thrust bearing.
- Further, suitable local brake shall be provided as per IS to arrest and sustain loads in all working positions.
- The velocity rates, effort on chain required to raise the safe working load and travel and speed shall be within the limit as per IS. Proof load test shall be carried out as per IS: 6547.
- Cast iron parts, wherever used, shall be of minimum grade 30, IS: 210.
- Trolley for manual/electric cross travel shall be designed to accommodate a wide range of "I" beams and shall be capable of traveling on straight as well as curved monorails with the design being such to maintain uniform distribution of pressure on the flanges.
- All gears and pinions shall be case hardened and tempered steel with machine cut teeth in metric modules and shall conform to relevant Indian standard. Surface hardening of steel is not acceptable.
- All running shafts and wheels shall be fitted with ball/roller bearings with a rated life not less than 20 years based on equivalent running time as per IS: 3938.
- Monorail 'I' beam shall be medium weight beams (ISMB) as per IS: 808 (1989) (Reaffirmed 1999) for steel beam in case of providing the same.
- Clear height of the monorail shall be maintained to handle one equipment over other.
- Monorails shall be extended outside the building to handle the equipment to ground level. For monorail/hoist routed inside the buildings, suitable machinery well and removable handrail and grating shall be provided on various floors of buildings as necessary to handle the equipment.

MANUALLY OPERATED CHAIN PULLEY BLOCK AND PUSH-PULL GEARED TROLLEY

General

- Hoist shall be designed, manufactured including overload testing with all accessories and shall be as per IS: 3832 and other relevant standards.
- Complete unit shall be comprising mainly i) geared trolley with hand chain, ii) hand operated hoist block with hand chain and load chain, iii) gears, load brake and cover parts, iv) load blocks complete with sheaves and lifting hook and v) ratchet and pawl type load brakes.
- All chain pulley blocks shall be designed for class II service as per IS: 3832. Materials of construction shall be as per IS: 3832.
- Proof load testing must be carried out at 1.5 times the rated load as per relevant IS.



- All hoists/chain pulley blocks shall be selected to have minimum headroom and shall be selected to lift heaviest piece of equipment. Further, it shall be possible to handle any equipment without disturbing other equipment.
- All gears and bearings shall be lubricated by grease. All lubricating points shall be grouped together in easily accessible position. All parts requiring replacement/inspection/lubrication shall be accessible without need for dismantling of other parts/structures.
- All components of hoist of identical capacity and duty shall be interchangeable.
- Hoist shall have permanent inscription in English on each side readily recognizable from floor level stating safe working load.

Trolley

- Trolley may be push pull geared type and of specified capacity as mentioned in BOQ or as per specific requirements.
- It shall be designed to move the load along the “I” beam axis. It shall be rigid and robust in construction with side plates but shall also facilitate easy assembly / disassembly. The material of construction of trolley shall be as per IS 2062.
- The steel plates shall extend beyond the trolley wheels on either side so as to act as bumper, protecting the wheels from damage by collision.
- Trolley wheels shall be of single flange type in the taper/straight treads and accurately machined and shall be easily removable for repairs/replacement. They shall be compatible with and mounted on roller bearings to minimize frictional load, and parallel to the flanges of the “I” beam. Load shall be evenly distributed on all wheels. Wheel bearings shall be conforming to IS: 2513 or equivalent and shall be of standard make.

Hoist Blocks

- The hoist frame shall be made of steel as per IS: 2062 and gear train shall be enclosed in housing. The hoist mechanism shall consist of a grooved rope drum operated through gears. Each end of the rope shall be anchored to the drum in such a way as the anchorage is readily available for maintenance. Each rope shall have two full turns of the drum when the hook is at its lowest position and one spare groove when the hook is at its highest position.
- The leading rope taken by the drum should not slope sideways when slack and it should not caught between the gear wheel.
- Rope drum, gear box, block etc. should be fabricated out of weld-able quality steel and as per IS: 3177/IS: 4460/IS: 3938.
- All gears shall be of high grade heat treated alloy steel conforming to AGMA standards. Gears shall be forged and accurately machined and shall not be of split type.
- All pulley blocks shall be provided with automatic mechanical load brakes which will prevent self- lowering of the load and sustain rated load in all working positions. Brakes shall be ratchet and pawl type/shoe and friction disc type and self-actuating at any load position.
- The chain pulley block shall be fixed with the trolley with removable type pin(s)/



bolt(s) directly without having upper hook.

Load Chain

- The material of construction shall be case hardened alloy steel as per grade 80 of IS: 6216. It shall be of size 8mm to 12mm or higher as required to suit load requirement.
- The hand chain wheels shall be of cast steel/SG cast iron/sheet metal, the wheels shall be with flanges and designed to ensure effective operation of hand chain. Further, suitable local brake shall be provided as per IS: 3832 to arrest and sustain loads in all working positions.

Hand Chain

- The hand chain shall be of grade 30 of IS: 2429. It shall be properly pitched and polished.

Bottom Block and Load Hook

- The bottom block shall be of enclosed type and shall have guard against rope jamming in normal use. It shall have standard forged swivel shank hook fitted on antifriction thrust bearing. It also shall have lock to prevent hook from rotation and locking arrangement to prevent accidental unlocking. Pulley of the bottom block shall be provided with antifriction bearings.
- The load hook shall be swiveling type forged circular shank section and shall confirm to IS: 15560. It shall be proof load tested at twice its rated load and with antifriction bearing.

17.0 SPECIFICATIONS FOR METALLIC EXPANSION BELLOWS

- Expansion bellow shall be fabricated in accordance with the EJMA/ASME standard.
- The bellows shall be metallic corrugated design of MOC as specified and shall have flanged ends on both sides with liner/internal sleeve. The fatigue life expectancy considered for EB shall be minimum 3000 cycles. The drilling standard of EB flange shall be matched on piping side to ensure proper alignment and bellows is not subjected to torsional forces due to misalignment. It shall be single bellow design and suitable for axial movement of up to total 30mm (20mm axial compression and 10mm axial extension). Further it shall be suitable accommodate angular misalignment of piping for up to minimum 5mm/3 degrees for installation. The overall length of expansion joint for up to 300mm dia. size shall be 250mm, for above 300mm and up to 1000mm it shall be 300mm and for above 1000mm the same shall be 350mm. The austenitic stainless steel shall be welded using the TIG welding method. The shipping bracket of bellows shall be removed only after installation of the bellows at site.
- To achieve maximum flexibility coupled with required resistance to pressure, bellows shall be formed with single or multiple walls using a number of concentric cylinders (multi-ply construction) of specified MOC, each longitudinally welded. However for the blower application the bellows shall be of multi-ply construction only.
- Generally the expansion joint is provided of single bellow design as a dismantling/disassembly joint in piping near valve or pump or flow meter or such device or equipment for ease of removal and jointing. Tie rods/threaded draw bars attached to expansion joint assembly shall be provided for this application.

- In case of bellows used for air piping application/in air blower discharge piping or such application witnessing vibration and temperature variations the expansion joint shall be single bellow with or without limit rods as recommended by manufacturer suitable to absorb axial movement and to suit this requirement. In case of bellows used for diaphragm type dosing pump or such pulsating service the expansion joint shall be single bellow with or without limit rods as recommended by manufacturer suitable to absorb axial movement and to suit this requirement.
- The weld end pipe shall be suitable for design pressure (Minimum PN 10 or higher as per design) and for CS/MS weld end pipe shall be with minimum corrosion allowance of 3mm for water/waste water application. However for blower application the bellows shall be designed for a working pressure of minimum 1 Bar or higher as per design and for a temperature of minimum 115°C or higher as per design and for velocity of minimum 25 m/sec or higher as per design and the liner thickness shall be suitable for the same.
- During installation the bellows as a practice shall always to be placed between two fixed points. Thrust block or saddle welded to pipe to make it fixed must be provided on both sides of EB.
- The shipping bracket of bellows shall be removed only after installation of the bellows at site.
- For blower application generally after the bellow the first support (saddle or suitable) shall be provided at 4D distance and second support 14D distance from bellows to dampen the vibrations.

Materials of Construction

Component Description	Water / Sewage / Sec. Treated Indl. Effluent / Air Application	Indl. Effluent / Bio-Gas / Chemicals or Corrosive Application
Bellows	SS 304 (ASTM A 240 Tp. 304)	SS 316 (ASTM A 240 Tp. 316)
Internal Sleeves / Liners	SS 304 (ASTM A 240 Tp. 304)	SS 316 (ASTM A 240 Tp. 316)
Weld End Pipe	CS / MS	SS 316L
Flanges	IS:2062 with drilling as per IS:1538, PN10	IS:2062 with drilling as per IS:1538, PN10 with SS lining (all wetted portion with SS lining)
Tie / Limit Rods	Carbon Steel (CS) as per IS 1367	SS 316
Nut, Bolt , Hardware	CS as per IS 1367	SS 316

Note: For Chemical (Alum, polyelectrolyte, etc.) or Corrosive application the above specified MOC are minimum and higher / better / suitable MOC shall be provided as per the nature

18.0 CIVIL SPECIFICATION



Buildings and Structures

All the building and structure works shall generally comply with the following EMPLOYER's requirements unless otherwise specified elsewhere.

1. All building works shall be of reinforced concrete framework.
2. All external walls shall be in 230 mm thick brick masonry built cement mortar in 1:4. Transoms and mullions of 115 mm x 230 mm size 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.
3. All internal partition walls except for toilets and Residential units shall be in 230 mm thick brick masonry built in cement mortar 1:4 with transoms and mullions as in (2) 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 in (2) above and shall form panels not exceeding 1200 mm x 1200 mm in size.
 - (a) Finishes to concrete liquid retaining structures (for details, refer clause 3.16 of this volume) shall be :
 - F1 - External surfaces, buried
 - F2 - External surfaces exposed and up to 300 mm below ground level F2 - Internal surfaces
 - (b) Finishes to other concrete structures (for details, refer clause 3.16 of this volume) shall be :
 - F1 - Buried
 - F1 - Exposed, where plastering is specified F2 - Exposed
4. All internal masonry surfaces finish shall have 15 mm thick plain faced cement plaster in cement mortar (1:4) with neat lime or neeru finish on top. Over this, one coat of primer and two coats of plastic emulsion paint of approved quality and shade shall be provided.
5. All external masonry surfaces shall have 20 mm thick sand faced cement plaster in cement mortar (1:3) in two coats. Waterproofing compound of approved make and quality shall be added to the cement mortar in proportions as specified by the manufacturer.
6. All external surfaces above ground level shall have one coat of primer and two coats of weatherproof exterior emulsion paint on wall surface to give an required shape even shade including priming coat after thoroughly brushing the surface to remove all dirt and remains of loose materials.
7. Toilet areas, walls and ceilings, shall have one coat of primer and two coats of plastic emulsion paint.
8. Toilet floor slab shall be filled with brick bat coba (broken bricks in lime) and provided with waterproofing as per the specifications of an approved specialist waterproofing company.
9. The finished floor level in toilet areas shall be 25 mm below general finished floor level elsewhere in the building.
10. Vitrified Tiles (24" x 24") (Double charge) with skirting for office room, conference room and Polished Kota stone with skirting for placed in cement mortar or lime



mortar to give overall thickness of 50 mm. Half tile skirting shall also be provided in these areas. For workshop and tool room shall have rough kota stone flooring.

11. Toilet areas shall have Anti skid Glazed Tiles placed in cement mortar or lime mortar to give an overall thickness of 50 mm. 2200 mm high ceramic tile (size 200 mm x 200 mm x 6 mm thick) dado placed in cement mortar shall also be provided in these areas. In
 - W.C. areas, the flooring and 2200 mm high dado shall be provided with 200 mm x 200 mm x 6 mm thick coloured ceramic tiles
12. All staircases shall have 25 mm thick chequered mosaic tiles for treads and 25 mm thick plain mosaic tiles of approved shade for risers set in cement mortar or lime mortar to give an overall thickness of 50 mm. Staircases in building shall have granite flooring.
 - Stairways shall be provided to permit access between different levels within buildings. All roof tops and 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 to access areas not frequently visited.
- 13 All floor cut-outs and cable ducts, etc. shall be covered with precast concrete covers in outdoor areas and mild steel chequered plates of adequate thickness in indoor areas. All uncovered openings shall be protected with GI hand railing of 40 NB (M).
 - All staircases shall be provided with GI pipe hand railing for protection.
 - All staircases, RCC platforms, walkways shall be provided with 40 mm NB GI medium duty pipe hand railing for protection.
 - Hand railing and vertical posts shall be made from GI pipes & fittings. The height of the top of railing shall be 1000 mm above finished floor level unless otherwise shown. There shall be total 3 horizontal rows. Vertical posts shall be made of 40 mm dia. & center to center distance between vertical post shall be min. 1.5 m
14. The reinforced concrete roofs shall be made waterproof by application of an approved china mosaic water proofing. The finished roof surface shall have adequate slope to drain quickly the rain water to R.W downtake inlet points.
15. For roofing drainage, cast iron rainwater downtakes with C.I./PVC bell mouth and C.I./PVC grating at top shall be provided. For roof areas up to 100 sq.m minimum two nos. 100 mm diameter downtake pipes shall be provided. For every additional area of 100 sq.m or part thereof, at least one no. 100 mm dia. downtake pipe shall be provided.
16. 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 rain water. Chajjas, canopies and roof projections shall have drip moulds.
17. Building plinth shall be minimum 600 mm above average finished ground level around building.
18. All doors, windows, rolling shutters shall have lintels above. Chajja protection to lintels on external walls shall be such as to prevent the rain water splashing into the building.



19. All windows and ventilators shall have 25 mm thick marble stone sills bedded in cement mortar (1:3)
20. All concrete channels and ducts used for conveying liquid shall have inside finish of type F2. The width of concrete channels shall not be less than 500 mm. All open channels shall be provided with handrailings.
21. Kerbs to be provided below the hand railing on the catwalks/pathways should be as per relevant sections of Factory Act.
22. All rooms in the buildings shall be provided with appropriate sign boards indicating the function of the rooms involved.
23. Wherever equipment and machinery are to be moved for inspection, servicing, replacement etc., suitable movable gantry in the form of EOT / HOT crane shall be provided. Minimum capacity of 2 tonnes or more as required shall be provided for monorail.
24. The design of buildings shall be suitable for the climatic conditions existing on site. Buildings shall as far as is possible permit the entry of natural light.
25. Emergency exit doorways with Signboards 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.
26. The side walls of buildings shall, comprise at least 15% ventilated brickwork or louvers. Ventilated brickwork or louvers shall not be used where the ingress of driven rain could affect equipment or stored materials.

Cable and Pipework Trenches

- Cable and pipework trenches shall generally be constructed in reinforced concrete. However, 500 mm x 500 mm size or smaller trenches, not on fill may be constructed in 350 mm thick brick masonry (1:4). The trenches will be plastered internally with cement mortar (1:4) and externally in cement mortar (1:3).
- Trenches within the buildings or Plant areas shall be covered with M.S chequered plates, suitably painted and those outside the buildings shall be covered with M20 precast R.C.C covers. The trenches shall be suitably sloped to drain rain water.
- Layout of trenches outside the buildings shall allow space for construction of future trenches where necessary with due consideration for planning for future developments. This aspect shall be brought to the notice of EMPLOYER while planning the works.

Valve Chambers

- All valve chambers are to be of an adequate size to facilitate maintenance and operation. The base slab of valve chambers shall slope towards a sump pit from which water can be pumped to keep the chamber dry. All valve chambers shall be constructed in M20 grade reinforced concrete/ 14 mm thk MS Plate cover. Chambers shall have removable reinforced concrete covers, as appropriate, approach ladders and valve supports.

1. BUILDING DETAILS

1.1 Applicable Codes and Specifications



- The following codes and standards are included in this section, as part of these specifications. However, respective IS codes for the works not mentioned here shall also be applicable for those particular items of work.

IS:110 - Ready mixed paint, brushing, grey filler, for enamels for use over primers
IS:269 - Specification for 33 grade ordinary portland cement
IS:280 - Specification for mild steel wire for general engineering purposes
IS:287 - Recommendations for maximum permissible moisture content of timber used for different purposes
IS:304 - High Tensile Brass Ingots and Castings.
IS:337 - Varnish, finishing interior
IS:348 - French polish
IS:383 - Specification for coarse and fine aggregates from natural sources for concrete
IS:412 - Expanded metal steel sheets for general purposes
IS:419 - Specification for putty for use on window frames
IS:428 - Distemper, oil emulsion, colour as required
IS:459 - Specification for unreinforced corrugated and semi-corrugated asbestos cement sheets
IS:702 - Specification for industrial bitumen
IS:710 - Specification for marine plywood
IS:712 - Specification for building limes
IS:730 - Specification for hook bolts for corrugated sheet roofing
IS:733 - Wrought aluminium and aluminium alloys, bars, rods and sections for general engineering purposes
IS:777 - Specification for glazed earthenware tiles
IS:1003 - Specification for timber panelled and glazed shutters (Parts 1 & 2)
IS:1038 - Specification for steel doors, windows and ventilators
IS:1077 - Specification for common burnt clay building bricks
IS:1081 - Code of practice for fixing and glazing of metal (steel & aluminium) doors, windows and ventilators
IS:1124 - Method of test for determination of water absorption, apparent specific gravity and porosity of natural building stones
IS:1237 - Specification for cement concrete flooring tiles
IS:1322 - Bitumen felts for water proofing and damp proofing
IS:1346 - Code of practice for water proofing of roofs with bitumen felts
IS:1361 - Specification for steel windows for industrial buildings
IS:1397 - Specification for kraft paper
IS:1443 - Code of practice for laying and finishing of cement concrete flooring tiles
IS:1477 - Code of practice for painting of ferrous metals in buildings (Parts 1 & 2)
IS:1542 - Specification for sand for plaster
IS:1580 - Specification for bituminous compounds for water-proofing and caulking purposes



IS:1597 - Code of practice for construction of stone masonry : Part 1 Rubble stone masonry

IS:1659 - Specification for block boards

IS:1661 - Code of practice for application of cement and cement-lime plaster finishes

IS:1834 - Specification for hot applied sealing compound for joint in concrete

IS:1838 - Specification for preformed fillers for expansion joint in concrete pavements and structures (non extruding and resilient type) : Part 1 Bitumen impregnated fibre

IS:1948 - Specification for aluminium doors, windows and ventilators

IS:1949 - Specification for aluminium windows for industrial buildings

IS:2074 - Ready mixed paint, air drying, red oxide- zinc chrome, priming

IS:2098 - Asbestos cement building boards

IS:2114 - Code of practice for laying in-situ terrazzo floor finish

IS:2116 - Specification for sand for masonry mortars

IS:2185 - Specification for concrete masonry units (Parts 1,2 & 3)

IS:2202 - Specification for wooden flush door shutters (Solid core type) : Parts 1 & 2

IS:2212 - Code of practice for brickwork

IS:2250 - Code of practice for preparation and use of masonry mortars

IS:2338 - Code of practice for finishing of wood and wood based materials (Parts 1 & 2)

IS:2339 - Aluminium paint for general purposes, in dual container

IS:2395 - Code of practice for painting concrete, masonry and plaster surfaces (Parts 1 & 2)

IS:2402 - Code of practice for external rendered finishes

IS:2571 - Code of practice for laying in-situ cement concrete flooring

IS:2572 - Code of practice for construction of hollow concrete block masonry

IS:2645 - Specification of integral cement waterproofing compounds

IS:2690 - Specification for burnt clay flat terracing tiles : Part 1 Machine made

IS:2691 - Specification for burnt clay facing bricks

IS:2750 - Specification for steel scaffoldings

IS:2835 - Flat transparent sheet glass

IS:2932 - Specification for enamel, synthetic, exterior type (a) undercoating, (b) finishing

IS:3007 - Code of practice for laying of asbestos cement sheets - corrugated and (Part 1 & 2) semi-corrugated sheets

IS:3036 - Code of practice for laying lime concrete for a water-proofed roof finish

IS:3067 - Code of practice of general design details and preparatory work for damp-proofing and water- proofing of buildings

IS:3068 - Specification for broken brick (burnt clay) coarse aggregates for use in lime concrete

IS:3384 - Specification for bitumen primer for use in water-proofing and damp-proofing

IS:3461 - Specification for PVC-asbestos floor tiles



- IS:3462 - Specification for unbacked flexible PVC flooring
- IS:3495 - Method of test for burnt clay building bricks: Part 1 to 4
- IS:3536 - Specification for ready mixed paint, brushing, wood primer, pink
- IS:3564 - Specification for door closures (hydraulically regulated)
- IS:3614 - Specification for fire checks doors : Part –I Plate metal covered and (Part - 1) rolling type
- IS:3614 - Specification for metallic and non-metallic fire check doors : Part-2 (Part – 2) Resistance test and performance criteria
- IS:3696 - Safety code of scaffolds and ladders (Parts 1 & 2)
- IS:4020 - Methods of test for wooden flush door : Type test
- IS:4021 - Specification for timber door, window and ventilator frames
- IS:4351 - Specification for steel door frames
- IS:4443 - Code of practice for use of resin type chemical resistant mortars
- IS:4457 - Specification for ceramic unglazed vitreous acid resisting tile
- IS:4631 - Code of practice for laying epoxy resin floor toppings
- IS:4832 - Specification for chemical resistant mortars (Part II)
- IS:4860 - Specification for acid resistant bricks
- IS:4948 - Specification for welded steel wire fabric for general use
- IS:5318 - Code of practice for laying of flexible PVC sheet and tile flooring
- IS:5410 - Cement paint, colour as required
- IS:5411 - Specification for plastic emulsion paint (Parts 1 & 2)
- IS:5437 - Wired and figured glass
- IS:5491 - Code of practice for laying of in-situ granolithic concrete floor topping
- IS:6041 - Code of practice construction of autoclaved cellular concrete block masonry
- IS:6042 - Code of practice for construction of light weight concrete block masonry
- IS:6248 - Specification for metal rolling shutters and rolling grilles
- IS:7193 - Specification for glass fibre base coal tar pitch and bitumen felts
- IS:7452 - Specification for hot rolled steel sections for doors, windows and ventilators
- IS:8042 - Specification for white portland cement
- IS:8543 - Methods of testing plastics
- IS:8869 - Specification for washers for corrugated sheet roofing
- IS:9197 - Specification for epoxy resin, hardeners and epoxy resin composites for floor topping
- IS:9862 - Specification for ready mixed paint, brushing, bituminous, black, lead-free, acid, alkali, water and chlorine resisting
- IS:12200- Code of practice for provision of waterstops at transverse contraction joints in masonry and concrete dams
- BS : 476 - Methods for determination of the fire resistance of elements of (Part – 20)construction (General Principles)
- BS : 476 - Methods for determination of the fire resistance of load bearing (Part – 21)elements of construction
- BS : 476 - Methods for determination of the fire resistance of non-load (Part –



22) bearing elements of construction

Part – IV - National Building code of India Fire Protection

1.2 Brickwork

1.2.1 Materials

- 1.2.1.1 Bricks used in the works shall conform to the requirements laid down in IS: 1077. The class of the bricks shall be as specifically indicated in the respective items of work prepared by the Contractor.
- 1.2.1.2 The nominal size of the modular brick shall be 200mmx100mmx100mm with the permissible tolerances over the actual size of 190mmx90mmx90mm as per IS: 1077. The nominal thickness of one brick and half brick walls using modular bricks shall be considered as 200 mm and 100 mm respectively. In the event of use of traditional bricks of nominal size 230 mmx115mmx75mm with tolerance upto 3 mm in each dimension, one brick and half brick walls shall be considered as 230 mm and 115 mm respectively.
- 1.2.1.3 Bricks shall be sound, hard, homogenous in texture, well burnt in kiln without being vitrified, hand/machine moulded, deep red, cherry or copper coloured, of regular shape and size & shall have sharp and square edges with smooth rectangular faces. The bricks shall be free from pores, cracks, flaws and nodules of free lime. Hand moulded bricks shall be moulded with a frog and those made by extrusion process may not be provided with a frog. Bricks shall give a clear ringing sound when struck and shall have a minimum crushing strength of 5N/sq.mm unless otherwise specified in the Items of work prepared by the Contractor.
- 1.2.1.4 The average water absorption shall not be more than 20 percent by weight upto class 12.5 and 15 percent by weight for higher classes. Bricks which do not conform to this requirement shall be rejected. Over or under burnt bricks are not acceptable for use in the works.
- 1.2.1.5 Sample bricks shall be submitted to the EMPLOYER for approval and bricks supplied shall conform to approved samples. If demanded by EMPLOYER, brick samples shall be got tested as per IS: 3495 by Contractor. Bricks rejected by EMPLOYER shall be removed from the site of works within 24 hours.
- 1.2.1.6 Mortar for brick masonry shall consist of cement and sand and shall be prepared as per IS: 2250. Mix shall be in the proportion of 1:5 for brickwork of thickness one brick or above and 1:4 for brickwork of thickness half brick or below, unless otherwise specified in the respective items of work prepared by the Contractor. Sand for masonry mortar shall conform to IS:218. The sand shall be free from clay, shale, loam, alkali and organic matter and shall be of sound, hard, clean and durable particles. Sand shall be approved by EMPLOYER. If so directed by the EMPLOYER, sand shall be screened and washed till it satisfies the limits of deleterious materials.
- 1.2.1.7 For preparing cement mortar, the ingredients shall first be mixed thoroughly



in dry condition. Water shall then be added and mixing continued to give a uniform mix of required consistency. Mixing shall be done thoroughly in a mechanical mixer, unless hand mixing is specifically permitted by the EMPLOYER. The mortar thus mixed shall be used as soon as possible, preferably within 30 minutes from the time water is added to cement. In case, the mortar has stiffened due to evaporation of water, this may be re-tempered by adding water as required to restore consistency, but this will be permitted only upto 30 minutes from the time of initial mixing of water to cement. Any mortar which is partially set shall be rejected and shall be removed forthwith from the site. Droppings of mortar shall not be re-used under any circumstances. The Contractor shall arrange for test on mortar samples if so directed by the EMPLOYER.

1.2.2 Workmanship

- 1.2.2.1 Workmanship of brick work shall conform to IS: 2212. All bricks shall be thoroughly soaked in clean water for at least one hour immediately before being laid. The cement mortar for brick masonry work shall be as specified in the respective item of work prepared by the Contractor. Brick work 200mm/230mm thick and over shall be laid in English Bond unless otherwise specified. 100mm/115mm thick brickwork shall be laid with stretchers. For laying bricks, a layer of mortar shall be spread over the full width of suitable length of the lower course. Each brick shall be slightly pressed into the mortar and shoved into final position so as to embed the brick fully in mortar. Only full size bricks shall be used for the works and cut bricks utilised only as closers to make up required wall length or for bonding. Bricks shall be laid with frogs on top.
- 1.2.2.2 All brickwork shall be plumb, square and true to dimensions shown. Vertical joints in alternate courses shall come directly one over the other and be in line. Horizontal courses shall be levelled. The thickness of brick courses shall be kept uniform. In case of one brick thick or half brick thick wall, at least one face should be kept smooth and plane, even if the other is slightly rough due to variation in size of bricks. For walls of thickness greater than one brick both faces shall be kept smooth and plane. All interconnected brickwork shall be carried out at nearly one level so that there is uniform distribution of pressure on the supporting structure and no portion of the work shall be left more than one course lower than the adjacent work. Where this is not possible, the work shall be raked back according to bond (and not saw toothed) at an angle not exceeding 45 deg. But in no case the level difference between adjoining walls shall exceed one metre. Brick work shall not be raised more than one metre per day.
- 1.2.2.3 Bricks shall be so laid that all joints are well filled with mortar. The thickness of joints shall not be less than 6 mm and not more than 10 mm. The face joints shall be raked to a minimum depth of 10mm/15mm by raking tools during the progress of work when the mortar is still green, so as to provide a proper key for the plastering/ pointing respectively to be done later. When



plastering or pointing is not required to be done, the joints shall be uniform in thickness and be struck flush and finished at the time of laying. The face of brickwork shall be cleaned daily and all mortar droppings removed. The surface of each course shall be thoroughly cleaned of all dirt before another course is laid on top.

- 1.2.2.4 During inclement weather conditions, newly built brick masonry works shall be protected by tarpaulin or other suitable covering to prevent mortar being washed away by rain.
- 1.2.2.5 Brickwork shall be kept constantly moist on all the faces for at least seven days after 24 hrs of laying. The arrangement for curing shall be got approved from the EMPLOYER.
- 1.2.2.6 Double scaffolding having two sets of vertical supports shall be provided to facilitate execution of the masonry works. The scaffolding shall be designed adequately considering all the dead, live and possible impact loads to ensure safety of the workmen, in accordance with the requirements stipulated in IS:2750 and IS:3696 (Part I). Scaffolding shall be properly maintained during the entire period of construction. Single scaffolding shall not be used on important works and will be permitted only in certain cases as decided by the EMPLOYER. Where single scaffolding is adopted, only minimum number of holes, by omitting a header shall be left in the masonry for supporting horizontal scaffolding poles. All holes in the masonry shall be carefully made good before plastering/pointing.
- 1.2.2.7 In the event of usage of traditional bricks of size 230 mm x115mm x75mm, the courses at the top of the plinth and sills as well as at the top of the wall just below the roof/floor slabs and at the top of the parapet shall be laid with bricks on edge.
- 1.2.2.8 All brickwork shall be built tightly against columns, floor slabs or other structural members.
- 1.2.2.9 To overcome the possibility of development of cracks in the brick masonry following measures shall be adopted.
- 1.2.2.10 For resting RCC slabs, the bearing surface of masonry wall shall be finished on top with 12 mm thick cement mortar 1:3 and provided with 2 layers of Kraft paper Grade 1 as per IS:1397 or 2 layers of 50 micron thick polyethylene sheets.
- 1.2.2.11 RCC/ steel beams resting on masonry wall shall be provided with reinforced concrete bed blocks of 50 mm thickness, projecting 50mm on either sides of the beam, duly finished on top with 2 layers of Kraft paper Grade 1 as per IS:1397 or 2 layers of 50 micron thick polyethylene sheets.
- 1.2.2.12 Steel wire fabric shall be provided at the junction of brick masonry and concrete before taking up plastering work.
- 1.2.2.13 Bricks for partition walls shall be stacked adjacent to the structural member to pre-deflect the structural member before the wall is taken up for execution. Further, the top most course of half or full brick walls abutting against either a deshuttered slab or beam shall be built only after any proposed masonry wall above the structural member is executed to cater for

the deflection of the structural element.

- 1.2.2.14 Reinforced cement concrete transomes and mullions of dimensions as indicated in the construction Drawings to be prepared by the Contractor are generally required to be provided in the half brick partition walls.
- 1.2.2.15 Where the drawings prepared by the Contractor indicate that structural steel sections are to be encased in brickwork, the brickwork masonry shall be built closely against the steel section, ensuring a minimum of 20mm thick cement-sand mortar 1:4 over all the steel surfaces. Steel sections partly embedded in brickwork shall be provided with bituminous protective coating to the surfaces at the point of entry into the brick masonry.
- 1.2.2.15 Facing bricks of the type specified conforming to IS:2691 shall be laid in the positions indicated on the Drawings prepared by the Contractor and all facing brickwork shall be well bonded to the backing bricks/RCC surfaces. The level of execution of the facing brick work shall at any time be lower by at least 600 mm below the level of the backing brickwork.
- 1.2.2.16 Facing bricks shall be laid over 10 mm thick backing of cement mortar. The mortar mix, thickness of joint and the type of pointing to be carried out shall be as specified in the item of works prepared by the Contractor. The pattern of laying the bricks shall be as specifically indicated in the Drawings prepared by the Contractor. For facing brickwork, double scaffolding shall be used. Faced works shall be kept clean and free from damage, discoloration etc., at all times.

1.3 Deleted

1.4 Deleted

1.5 Concrete Block Masonry

1.5.1 Materials

- 1.5.1.1 Masonry units of hollow and solid concrete blocks shall conform to the requirements of IS : 2185 (Part I).
- 1.5.1.2 Masonry units of hollow and solid light-weight concrete blocks shall conform to the requirements of IS : 2185 (Part 3).
- 1.5.1.3 Masonry units of autoclaved cellular concrete blocks shall conform to the requirements of IS:2185 (Part 3).
- 1.5.1.4 The height of the concrete masonry units shall not exceed either its length or six times its width.
- 1.5.1.5 The nominal dimensions of concrete block shall be as under.
 - a) Length 400, 500 or 600 mm
 - b) Height 100 or 200 mm
 - c) Width 100 to 300 mm in 50 mm increments
- 1.5.1.6 Half blocks shall be in lengths of 200, 250 or 300mm to correspond to the full length blocks.
- 1.5.1.7 Actual dimensions shall be 10mm short of the nominal dimensions.
- 1.5.1.8 The maximum variation in the length of the units shall not be more than ± 5

mm and maximum variation in height or width of the units shall not be more than ± 3 mm.

- 1.5.1.9 Concrete blocks shall be either hollow blocks with open or closed cavities or solid blocks.
- 1.5.1.10 Concrete blocks shall be sound, free of cracks, chipping or other defects which impair the strength or performance of the construction. Surface texture shall as specified. The faces of the units shall be flat and rectangular, opposite faces shall be parallel and all arises shall be square.
- 1.5.1.11 The bedding surfaces shall be at right angles to the faces of the block.
- 1.5.1.12 The concrete mix for the hollow and solid concrete blocks/light weight concrete blocks shall not be richer than one part of cement to six parts of combined aggregates by volume.
- 1.5.1.13 Concrete blocks shall be of approved manufacture, which satisfy the limitations in the values of water absorption, drying shrinkage and moisture movement, as specified for the type of block as per relevant IS code. Contractor shall furnish the test certificates and also supply the samples for the approval of EMPLOYER.

1.5.2 Workmanship

- 1.5.2.1 The type of the concrete block, thickness and grade based on the compressive strength for use in load bearing and/or non-load bearing walls shall be as specified. The minimum nominal thickness of non-load bearing internal walls shall be 100mm. The minimum nominal thickness of external panel walls in framed construction shall be 200 mm.
- 1.5.2.2 The workmanship shall generally conform to the requirements of IS:2572 for concrete block masonry, IS:6042 for light weight concrete block masonry and IS:6041 for autoclaved cellular concrete block masonry works.
- 1.5.2.3 From considerations of durability, generally concrete block masonry shall be used in superstructure works above the damp-proof course level.
- 1.5.2.4 Concrete blocks shall be embedded with a mortar which is relatively weaker than the mix of the blocks in order to avoid the formation of cracks. Cement mortar of proportion 1:6 shall be used for the works. Preparation of mortar shall be as specified in clause 1.2.1.
- 1.5.2.5 The thickness of both horizontal and vertical joints shall be 10mm. The first course shall be laid with greater care, ensuring that it is properly aligned, levelled and plumb since this will facilitate in laying succeeding courses to obtain a straight and truly vertical wall. For the horizontal (bedding) joint, mortar shall be spread over the entire top surface of the block including front and rear shells as well as the webs to a uniform layer of 10mm. For vertical joints, the mortar shall be applied on the vertical edges of the front and rear shells of the blocks. The mortar may be applied either to the unit already placed on the wall or on the edges of the succeeding unit when it is standing vertically and then placing it horizontally, well pressed against the previously laid unit to produce a compacted vertical joint. In case of two cell blocks with slight depression on the vertical sides these shall also be filled

up with mortar to secure greater lateral rigidity. To assure satisfactory bond, mortar shall not be spread too far ahead of actual laying of the block as the mortar will stiffen and lose its plasticity. Mortar while hardening shrinks slightly and thus pulls away from the edges of the block. The mortar shall be pressed against the units with a jointing tool after it has stiffened to effect intimate contact between the mortar and the unit to obtain a weather tight joint. The mortar shall be raked to a depth of 10mm as each course is laid to ensure good bond for the plaster.

- 1.5.2.6 Dimensional stability of hollow concrete blocks is greatly affected by variations of moisture content in the units. Only well dried blocks should be used for the construction. Blocks with moisture content more than 25% of maximum water absorption permissible shall not be used. The blocks should not be wetted before or during laying in the walls. Blocks should be laid dry except slightly moistening their surfaces on which mortar is to be applied to obviate absorption of water from the mortar.
- 1.5.2.7 As per the design requirements and to effectively control cracks in the masonry, RCC bound beams/studs, joint reinforcement shall be provided at suitable locations. Joint reinforcement shall be fabricated either from mild steel wires conforming to IS:280 or welded wire fabric/high strength deformed basis.
- 1.5.2.8 For jambs of doors, windows and openings, should concrete blocks shall be provided. If hollow units are used, the hollows shall be filled with concrete of mix 1:3:6. Hold fasts of doors/windows should be arranged so that they occur at block course level.
- 1.5.2.9 At intersection of walls, the courses shall laid up at the same time with a true masonry bond between atleast 50% of the concrete blocks. The sequence for construction of partition walls and treatment at the top of load bearing walls for the RCC slab shall be as detailed under clause 1.2 for the brick work.
- 1.5.2.10 Curing of the mortar joints shall be carried out for atleast 7 days. The walls should only be lightly moistened and shall not be allowed to become excessively wet.
- 1.5.2.11 Double scaffolding as per clause 1.2.2 shall be adopted for execution of block masonry work. 1.5.2.12 Cutting of the units shall be restricted to a minimum. All horizontal and vertical dimensions shall be in respectively, adopting modular co-ordination for walls, opening locations for doors, windows etc.
- 1.5.2.13 Concrete blocks shall be stored at site suitably to avoid any contact with moisture from the ground and covered to protect against wetting.

1.6 Damp - Proof Course

1.6.1 Materials and Workmanship

- 1.6.1.1 Where Specified, all the walls in a building shall be provided with damp-proof course cover plinth to prevent water from rising up the wall. The damp-proof course shall run without a break throughout the length of the wall, even under the door or other openings. Damp-proof course shall



consist of 50 mm thick cement concrete of 1:2:4 nominal mix with approved water-proofing compound admixture conforming to IS: 2645 in proportion as directed by the manufacturer. Concrete shall be with 10 mm down graded coarse aggregates.

- 1.6.1.2 The surface of brick work/stone masonry work shall be levelled and prepared before laying the cement concrete. Side shuttering shall be properly fixed to ensure that slurry does not leak through and is also not disturbed during compaction. The upper and side surface shall be made rough to afford key to the masonry above and to the plaster.
- 1.6.1.3 Damp-proof course shall be cured properly for atleast seven days after which it shall be allowed to dry for taking up further work.

1.7 Miscellaneous Inserts, Bolts etc.

- 1.7.1 All the miscellaneous inserts such as bolts, pipes, plate embedments etc., shall be accurately installed in the building works at the correct location and levels, all as detailed in the construction Drawings to be prepared by the Contractor prepared by the Contractor. Contractor shall prepare and use templates for this purpose, if so directed by the EMPLOYER. In the event, of any of the inserts are improperly installed, Contractor shall make necessary arrangements to remove and reinstall at the correct locations/levels, all as directed by the EMPLOYER.

1.8 Wood Work for Doors, Windows, Ventilators & Partitions

1.8.1 Materials

- 1.8.1.1 Timber To be used shall be first class Teak wood as per IS:4021. Timber shall be of the best quality and well seasoned by a suitable process before being planed to the required sizes. The maximum permissible moisture content shall be from 10 to 16 percent for timber 50mm and above in thickness and 8 to 14 percent of timber less than 50mm in thickness for different regions of the country as stipulated in IS:287. Timber shall be close grained, of uniform colour and free from decay, fungal growth, boxed heart, pitch pockets or streaks on the exposed edges, borer holes, splits and cracks
- 1.8.1.2 Flush door shutters of the solid core type with plywood face panels shall conform to IS:2202 (Part 1) and with particle board/hard board face panels shall conform to IS:2202 (Part 2).
- 1.8.1.3 Transparent sheet glass shall conform to the requirements of IS:2835. Wired and figured glass shall be as per IS:5437.
- 1.8.1.4 Builder's hardware for fittings and fixtures shall be of the best quality from approved manufacturers.

1.8.2 Workmanship

- 1.8.2.1 The workmanship and finish of wood work in doors, windows, ventilators and partitions shall be of a very high order. Contractor shall ensure that work is executed in a professional manner by skilled carpenters for good appearance, efficient and smooth operation of the shutters.



- 1.8.2.2 All works shall be executed as per the detailed Drawings prepared by the Contractor and/or as directed by the EMPLOYER.
- 1.8.2.3 All members of the door, window, and ventilator shall be straight without any warp or bow and shall have smooth well planed faces. The right angle shall be checked from the inside surfaces of the respective members of the frame. Frames shall have mortice and tenon joints which shall be treated with an approved adhesive and provided with metal or wood pins. The vertical members of the door frame shall project 50 mm below the finished floor level. The finished dimension of frames shall be rebated on the solid for keying with the plaster and for receiving the shutters. The depth of rebate for housing the shutter shall be 15 mm. The size of the frames shall be as specified in the respective items of work prepared by the Contractor. The workmanship shall generally conform to the requirements specified in IS:4021.
- 1.8.2.4 The face of the frames abutting the masonry or concrete shall be provided with a coat of coal tar.
- 1.8.2.5 Three hold fasts using 25 mm x 6 mm mild steel flats 225 mm long with split ends shall be fixed on each side of door and window frames, one at the centre and the other two at 300 mm from the top and bottom of the frame. For window and ventilator frames less than 1 m in height, two hold fasts on each side shall be fixed at quarter points.
- 1.8.2.6 Timber panelled shutters for doors, windows and ventilators shall be constructed in the form of framework of stiles and rails with panel insertion. The panels shall be fixed by either providing grooves in the stiles and rails or by beading. Glazing bars shall be as detailed in the Drawings prepared by the Contractor. The stiles and rails shall be joined by mortice and tenon joints at right angles. All members of the shutter shall be straight without any warp or bow and shall have smooth, well planed faces at right angles to each other. The right angle for the shutter shall be checked by measuring the diagonals and the difference shall not be more than 3 mm. Timber panels made from more than one piece shall be jointed with a continuous tongued and grooved joint, glued together and reinforced with metal dowels. The workmanship shall generally conform to the requirements specified in IS:1003 (Parts 1 & 2). The thickness of the shutter, width/thickness of the stiles/rails/panel type shall be as specified. Marine plywood panels conforming to IS:710 shall be used for doors where specified.
- 1.8.2.7 Details of the wooden flush door shutters, solid core type with specific requirement of the thickness, core, face panels, viewing glazed panel, venetian louvre opening, teak wood lipping etc. shall be as specified. Panels of shutter shall be of marine plywood conforming to IS:710. Flush door shutters shall be from reputed manufacturers and Contractor shall submit test results as per IS:4020, if so desired by the EMPLOYER.
- 1.8.2.8 Glazing of door, window, ventilator and partitions shall be with either flat transparent sheet glass, wired or figured glass. Transparent sheet glass shall be of 'B' quality as per IS:2835. The thickness and type of glazing to be



provided shall be as specified.

- 1.8.2.9 The material of the fittings and fixtures either of chromium plated steel, cast brass, copper oxidised or anodised aluminum shall be as specified. The number, size and type of the fittings and fixtures shall be as specified.
- 1.8.2.10 Woodwork shall not be provided with the finishes of painting/varnishing etc. unless it has been approved by the EMPLOYER. The type of finish and the number of coats shall be as stipulated in the respective items of work prepared by the Contractor. Preparation of the wood surfaces and application of the finishes shall be in accordance with clause 1.32.
- 1.8.2.11 Wooden hand railing and architrave's shall be of the size and shape with the fixing arrangement as indicated in the Drawings prepared by the Contractor.
- 1.8.2.12 The framework of the partitions with mullions and transoms shall be with the sections of dimensions as specified. Panels of double/single glazing/plywood shall be fixed as per details specified. Partitions shall be fixed rigidly between the floor and structural columns/beams including provision of necessary shims for wedging etc. Finished work shall be of rigid construction, erected truly plumb to the lines and levels, at locations as per the construction Drawings prepared by the Contractor.
- 1.8.2.13 Any carpentry work which show defects due to inadequate seasoning of the timber or bad workmanship shall be removed and replaced by Contractor with work as per Specifications.

1.9 Steel Doors, Windows and Ventilators

1.9.1 Materials

- 1.9.1.1 Hot rolled steel sections for the fabrication of steel doors, windows and ventilators shall conform to IS: 7452, which are suitable for, single glazing.
- 1.9.1.2 Pressed steel door frames for steel flush doors shall be out of 1.25mm thick mild steel sheets of profiles as per IS : 4351.
- 1.9.1.3 Transparent sheet glass shall conform to the requirements of IS : 2835. Wired and figured glass shall be as per IS : 5437.
- 1.9.1.4 Builder's hardware of fittings and fixtures shall be of the best quality from the approved manufacturers.

1.9.2 Workmanship

- 1.9.2.1 All steel doors, windows and ventilators shall be of the type as specified in the respective items of work prepared by the Contractor and of sizes as indicated in the Drawings prepared by the Contractor prepared by the Contractor. Steel doors, windows and ventilators shall conform to the requirements as stipulated in IS : 1038. Steel windows shall conform to IS : 1361, if so specified.
- 1.9.2.2 Doors, windows and ventilators shall be of an approved manufacture. Fabrication of the unit shall be with rolled section, cut to correct lengths and metered. Corners shall be welded to form a solid fused welded joint conforming to the requirements of IS : 1038. Tolerance in overall

dimensions shall be within $\pm 1.5\text{mm}$. The frames and shutters shall be free from warp or buckle and shall be square and truly plain. All welds shall be dressed flush on exposed and contact surfaces. Punching of holes, slots and other provisions to install fittings and fixtures later shall be made at the correct locations as per the requirements. Samples of the units shall be got approved by the EMPLOYER before further manufacture/purchase by the Contractor.

- 1.9.2.3 Type and details of shutters, hinges, glazing bar requirement, couplings, locking arrangement, fittings and fixtures shall be as described in the respective items of work and / or as shown in the Drawings prepared by the Contractor for single or composite units.
- 1.9.2.4 For windows with fly proof mesh as per the item of work prepared by the Contractor, rotor operator arrangement, for the operation of the glazed shutters from the inside shall be provided.
- 1.9.2.5 Pressed steel door frames shall be provided with fixing lugs at each jamb, hinges, lock-strike plate, mortar guards, angle threshold, shock-absorbers of rubber or similar material as per the requirements of IS : 4351. Pressed steel doorframes shall be fixed as 'built-in' as the masonry work proceeds. After placing it plumb at the specified location, masonry walls shall be built up solid on either side and each course grouted with mortar to ensure solid contact with the doorframe, without leaving any voids. Temporary struts across the width shall be fixed, during erection to prevent bow/sag of the frame.
- 1.9.2.6 Door shutters of flush welded construction shall be 45mm thick, fabricated with two outer skins of 1.25mm thick steel sheets, 1mm thick steel sheet stiffeners and steel channels on all four edges. Double shutters shall have meeting stile edge beveled or rebated. Provision of glazed viewing panel, louvers shall be made as per the items of works and/or Drawings prepared by the Contractor. Shutters shall be suitably reinforced for lock and other surface hardware and to prevent sagging/twisting. Single sheet steel door shutters shall be fabricated out of 1.25mm thick steel sheets, mild steel angles and stiffeners as per the Drawings prepared by the Contractor.
- 1.9.2.7 Doors, windows and ventilators shall be fixed into the prepared openings. They shall not be 'built-in' as the masonry work proceeds, to avoid distortion and damage of the units. The dimensions of the masonry opening shall have 10mm clearance around the overall dimensions of the frame for this purpose. Any support of scaffolding members on the frames/glazing bars is prohibited.
- 1.9.2.8 Glazing of the units shall be either with flat transparent glass or wired / figured glass of the thickness as specified in the items of works prepared by the Contractor. All glass panels shall have properly squared corner and straight edges. Glazing shall be provided on the outside of the frames.
- 1.9.2.9 Fixing of the glazing shall be either with spring glazing clips and putty conforming to IS:419 or with metal beads. Pre-formed PVC or rubber gaskets shall be provided for fixing the beads with the concealed screws. The



type of fixing the glazing shall be as indicated in the items of work and/or in Drawings prepared by the Contractor.

- 1.9.2.10 Steel doors, windows and ventilators shall be provided with finish of either painting as specified or shall be hot dip galvanised with thickness of the zinc coating as stipulated all as described in the respective items of works prepared by the Contractor.
- 1.9.2.11 The material of the Builders hardware of fittings and fixtures of chromium plated steel, cast brass, brass copper oxidised or anodised aluminium shall be as specified in the items of works prepared by the Contractor. The number , size and type of fittings and fixtures shall be as in the Drawings /items of works prepared by the Contractor.
- 1.9.2.12 Installation of the units with fixing lugs, screws, mastic caulking compound at the specified locations shall generally conform to the requirements of IS:1081. Necessary holes etc required for fixing shall be made by the Contractor and made good after installation. Workmanship expected is of a high order for efficient and smooth operation of the units.

1.10 Aluminum Doors, Windows, Ventilators & Partitions

1.10.1 Materials

- 1.10.1.1 Aluminum alloy used in the manufacture of extruded sections for the fabrication of doors, windows, ventilators shall conform to designation HE9-WP of IS:733.
- 1.10.1.2 Transparent sheet glass shall conform to the requirements of IS:2835. Wired and figured glass shall be as per IS:5437.
- 1.10.1.3 Builder's hardware of fittings & fixtures shall be of the best quality from approved manufacturers.

1.10.2 Workmanship

- 1.10.2.1 All aluminum doors, windows, ventilators and partitions shall be of the type and size as specified. The doors, windows, ventilators shall conform to the requirements of IS:1948. Aluminum windows, shall conform to IS:1949, if so specified.
- 1.10.2.2 All aluminum units shall be supplied with anodized finish. The minimum anodic film thickness shall be 0.015 mm.
- 1.10.2.3 Doors, windows and ventilators shall be of an approved manufacture. Fabrication of the units shall be with the extruded sections, cut to correct lengths, mitred and welded at the corners to a true right angle conforming to the requirements of IS:1948. Tolerance in overall dimensions shall be within $\pm 1.5\text{mm}$. The frames and shutters shall be free from warp or buckle and shall be square and truly plane. Punching of holes, slots and other provisions to install fittings or fixtures later shall be made at the correct locations, as per the requirements.
- 1.10.2.4 Aluminium swing type doors, aluminum sliding windows, partitions shall be as specified.



- 1.10.2.5 IS:1948 and IS:1949 referred to incorporates the sizes, shapes, thicknesses and weight per running metre of extruded sections for the various components of the units. However, new sizes, shapes, thicknesses with modifications to suit snap-fit glazing clips etc. are being continuously being added by various leading manufacturers of extruded sections, which are available in the market. As such, the sections of the various components of the unit proposed by the Contractor, will be reviewed by the EMPLOYER and will be accepted only if they are equal to or marginally more than that given in the codes/as specified.
- 1.10.2.6 The framework of the partitions with mullions and transomes shall be with anodised aluminium box sections. Anodised aluminium box sections shall be in-filled with timber of class 3 (silver oak or any other equivalent) as per IS:4021. Panels of double/single glazing/plywood shall be fixed as per details indicated in the Drawings to be prepared by the Contractor. Partitions shall be fixed rigidly between the floor and the structural columns/beams including provision of necessary shims for wedging etc. Finished work shall be of rigid construction, erected truly plumb to the lines and levels, at locations as per the construction Drawings to be prepared by the Contractor.
- 1.10.2.7 Specific provisions as stipulated for steel doors, windows, ventilators under clause 1.9.2 shall also be applicable for this item work. Glazing beads shall be of the snap-fit type suitable for the thickness of glazing proposed as indicated in the items of works prepared by the Contractor. A layer of clear transparent lacquer shall be applied on aluminium sections to protect them from damage during installation. This lacquer coating shall be removed after the installation is completed.

1.11 Steel Rolling Shutters

1.11.1 Materials and Workmanship

- 1.11.1.1 Rolling shutters shall be of an approved manufacture, conforming to the requirements specified in IS:6248.
- 1.11.1.2 The type of rolling shutter shall be self coiling type (manual) for clear areas upto 12 sq.m, gear operated type (mechanical) for clear areas upto 35 sq.m and electrically operated type for areas upto 50 sq.m. Mechanical type of rolling shutters shall be suitable for operation from both inside and outside with the crank handle or chain gear operating mechanism duly considering the size of wall/column. Electrical type of rolling shutter shall also be provided with a facility for emergency mechanical operation.
- 1.11.1.3 Rolling shutters shall be supplied duly considering the type, specified clear width/height of the opening and the location of fixing as indicated in the Drawings prepared by the Contractor.
- 1.11.1.4 Shutters shall be built up of interlocking laths 75 mm width between rolling centres formed from cold rolled steel strips. The thickness of the steel strip shall not be less than 0.90 mm for shutters upto 3.50 m width and not less



than 1.20 mm for shutters above 3.50 m width. Each lath section shall be continuous single piece without any welded joint.

- 1.11.1.5 The guide channels out of mild steel sheets of thickness not less than 3.15 mm shall be of either rolled, pressed or built up construction. The channel shall be of size as stipulated in IS:6248 for various clear widths of the shutters.
- 1.11.1.6 Hood covers shall be of mild steel sheets not less than 0.90 mm thick and of approved shape.
- 1.11.1.7 Rolling shutters shall be provided with a central hasp and staple safety device in addition to one pair of lever locks and sliding locks at the ends.
- 1.11.1.8 All component parts of the steel rolling shutter (excepting springs and insides of guide channels) shall be provided with one coat of zinc chrome primer conformity to IS:2074 at the shop before supply. These surfaces shall be given an additional coat of primer after erection at the site along with the number of coats and type of finish paint as specified in the respective items of works prepared by the Contractor. Painting shall be carried out as per clause 1.33.
- 1.11.1.9 In case of galvanised rolling shutter, the lath sections, guides, lock plate, bracket plates, suspension shaft and the hood cover shall be hot dip galvanised with a zinc coating containing not less than 97.5 percent pure zinc. The weight of the zinc coating shall be at least 610gms/sq.m.
- 1.11.1.10 Guide channels shall be installed truly plumb at the specified location. Bracket plate shall be rigidly fixed with necessary bolts and holdfasts. Workmanship of erection shall ensure strength and rigidity of rolling shutter for trouble free and smooth operation.

1.12 Rubble Sub-Base

1.12.1 Materials

- 1.12.1.1 Stones used for rubble packing under floors on grade, foundations etc., shall be clean, hard, durable rock free from veins, flaws, laminations, weathering and other defects. Stones shall generally conform to the requirements stipulated in IS: 1597 (Part I).
- 1.12.1.2 Stones shall be as regular as can be obtained from quarries. Stones shall be of height equal to the thickness of the packing proposed with a tolerance of ± 10 mm. Stones shall not have a base area less than 250 sq cm nor more than 500 sq.cm, and the smallest dimension of any stone shall not be less than half the largest dimension. The quality and size of stones shall be subject to the approval of the EMPLOYER.

1.12.2 Workmanship

- 1.12.2.1 Stones shall be hand packed carefully and laid with their largest base downwards resting flat on the prepared sub-grade and with their height equal to the thickness of the packing. Stones shall be laid breaking joints and in close contact with each other. All interstices between the stones shall be

wedged-in by small stones of suitable size, well driven in by crow bars and hammers to ensure tight packing and complete filling-in of the interstices. The wedging shall be carried out simultaneously with the placing in position of rubble packing and shall not lag behind. After this, any interstices between the smaller wedged stones shall be infilled with clean hard sand by brooming so as to fill the joints completely.

- 1.12.2.2 The laid rubble packing shall be sprinkled with water and compacted by using suitable rammers.

1.13 Base Concrete

- 1.13.1 The thickness and grade of concrete and reinforcement shall be as specified in items of works prepared by the contractor.
- 1.13.2 Before placing the blinding concrete, the sub-base of rubble packing shall be properly wetted and rammed. Concrete for the base shall then be deposited between the forms, thoroughly tamped and the surface finished level with the top edges of the forms. Two or three hours after the concrete has been laid in position, the surface shall be roughened using steel wire brush to remove any scum or laitance and swept clean so that the coarse aggregates are exposed. The surface of the base concrete shall be left rough to provide adequate bond for the floor finish to be provided later.

1.14 Terrazzo and Plain Cement Tiling Work

1.14.1 Materials

- 1.14.1.1 Terrazzo tiles and cement tiles shall generally conform in all respects to standards stipulated in IS:1237. Tiles shall be of the best quality manufactured adopting hydraulic pressure of not less than 14N/mm².
- 1.14.1.2 The type, quality, size, thickness, colour etc, of the tiles for flooring/dado/skirting shall be as specified.
- 1.14.1.3 The aggregates for terrazzo topping shall consist of marble chips which are hard, sound and dense. Cement to be used shall be either ordinary portland cement or white cement with or without colouring pigment. The binder mix shall be with 3 parts of cement to 1 part of marble powder by weight. The proportion of cement shall be inclusive of any pigments. For every one part of cement-marble powder binder mix, the proportion of aggregates shall be 1.75 parts by volume, if the chips are between 1mm to 6mm and 1.50 parts by volume if the chips are between 6mm to 25mm.
- 1.14.1.4 The minimum thickness of wearing layer of terrazzo tiles shall be 5mm for tiles with chips of size varying from 1mm upto 6mm or from 1mm upto 12mm. This shall be 6mm for tiles with chips varying from 1mm upto 25mm. The minimum thickness of wearing layer of cement/coloured cement tiles shall be 5mm. This shall be 6mm for heavy duty tiles. Pigment used in the wearing layer shall not exceed 10 percent of the weight of cement used in the mix.

1.14.2 Workmanship



- 1.14.2.1 Laying and finishing of tiles shall conform to the requirements of workmanship stipulated in IS:1443.
- 1.14.2.2 Tiling work shall be commenced only after the door and window frames are fixed and plastering of the walls/ ceiling is completed. Wall plastering shall not be carried out upto about 50mm above the level of proposed skirting/dado.
- 1.14.2.3 The base concrete shall be finished to a reasonably plane surface about 40 to 45mm below the level of finished floor. Before the tiling work is taken up, the base concrete or structural slab shall be cleaned of all loose materials, mortar droppings, dirt, laitance etc. using steel wire brush and well wetted without allowing any water pools on the surface.
- 1.14.2.4 A layer of 25mm average thickness of cement mortar consisting of one part of cement to 6 parts of sand shall be provided as bedding for the tiles over the base concrete. The thickness of bedding mortar shall not be less than 10mm at any place. The quantity of water to be added for the mortar shall be just adequate to obtain the workability for laying. Sand for the mortar shall conform to IS:2116 and shall have minimum fineness modulus of 1.5. The surface shall be left rough to provide a good bond for the tiles. The bedding shall be allowed to harden for a day before laying of the tiles.
- 1.14.2.5 Neat cement slurry using 4.4 kg of cement per sq.m of floor area shall be spread over the hardened mortar bedding over such an area at a time as would accommodate about 20 tiles. Tiles shall be fixed in this slurry one after the other, each tile being gently tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. The joints shall be in straight lines and shall normally be 1.5mm wide. On completion of laying of the tiles in a room, all the joints shall be cleaned and washed fairly deep with a stiff broom/wire brush to a minimum depth of 5mm. The day after the tiles have been laid, the joints shall be filled with cement grout of the same shade as the colour of the matrix of the tile. For this purpose white cement or grey cement with or without pigments shall be used. The flooring should be kept moist and left undisturbed for 7 days for the bedding/joints to set properly. Heavy traffic shall not be allowed on the floor for atleast 14 days after fixing of the tiles.
- 1.14.2.6 About a week after laying the tiles, each and every tile shall be lightly tapped with a small wooden mallet to find out if it gives a hollow sound; if it does, such tiles along with any other cracked or broken tiles shall be removed and replaced with new tiles to proper line and level. The same procedure shall be followed again after grinding the tiles and all damaged tiles replaced, properly jointed and finished to match. For the purpose of ensuring that such replaced tiles match with those laid earlier, it is necessary that the Contractor shall procure sufficient quantity of extra tiles to meet this contingency.
- 1.14.2.7 Wherever a full tile cannot be provided, tiles shall be cut to size and fixed. Floor tiles adjoining the wall shall go about 10mm under the plaster, skirting or dado.



- 1.14.2.8 Tile skirting and dado work shall be executed only after laying tiles on the floor. For dado and skirting work, the vertical wall surface shall be thoroughly cleaned and wetted. Thereafter it shall be evenly and uniformly covered with 10mm thick backing of 1:4 cement sand mortar. For this work the tiles as obtained from the factory shall be of the size required and practically full polished. The back of each tile to be fixed shall be covered with a thin layer of neat cement paste and the tile shall then be gently tapped against the wall with a wooden mallet. Fixing shall be done from the bottom of the wall upwards. The joints shall be in straight lines and shall normally be 1.5mm wide. Any difference in the thickness of the tiles shall be evened out in the backing mortar or cement paste so that the tile faces are in conformity & truly plumb. Tiles for use at the corners shall be suitably cut with bevelled edges to obtain a neat and true joint. After the work has set, hand polishing with carborundum stones shall be done so that the surface matches with the floor finish.
- 1.14.2.9 Wall plastering of the strip left out above the level of skirting/dado shall be taken up after the tiles are fixed.
- 1.14.2.10 Chequered terrazzo tiles for flooring and for stair treads shall be delivered to site after the first machine grinding.
- 1.14.2.11 Machine grinding and polishing shall be commenced only after a lapse of 14 days of laying. The sequence and three numbers of machine grinding operations, usage of the type of carborundum stones, filling up of pin holes, watering etc. shall be carried out all as specified in IS:1443.
- 1.14.2.12 Tiles shall be laid to the levels specified. Where large areas are to be tiled the level of the central portion shall be kept 10mm higher than that at the walls to overcome optical illusion of a depression in the central portion. Localised deviation of $\pm 3\text{mm}$ in any 3m length is acceptable in a nominally flat floor.

1.15 In-Situ Terrazzo Work

1.15.1 Materials

- 1.15.1.1 The requirements of marble aggregates for terrazzo topping shall be as per clause 1.14.1.
- 1.15.1.2 Cement shall first be mixed with the marble powder in dry state. The mix thus obtained shall be mixed with the aggregates in the specified proportions. Care shall be taken not to get the materials into a heap which results in the coarsest chips falling to the edges and cement working to the centre at the bottom. Materials shall be kept, as far as possible, in an even layer during mixing. After the materials have been thoroughly mixed in the dry state, water shall be added, just adequate to obtain plastic consistency for the desired workability for laying. The mix shall be used in the works within 30 minutes of the addition of water to the cement.

1.15.2 Workmanship



- 1.15.2.1 The thickness, type, quality, size and colour of chips etc. for the in-situ terrazzo finish for flooring/dado/ skirting shall be as specified in the respective items of works prepared by the Contractor. Laying and finishing of in-situ work shall conform to the requirements of workmanship stipulated in IS: 2114.
- 1.15.2.2 In-situ terrazzo finish shall be laid over hardened concrete base. The finish layer consists of an under layer and terrazzo topping. The underlayer shall be of cement concrete of mix 1:2:4 using 10mm down graded coarse aggregates. The combined thickness of under layer and topping shall not be less than 30 mm for flooring and 20mm for dado/skirting work.
- 1.15.2.3 The minimum thickness of topping shall be 6mm if chips used are between 1mm to 4mm, 9mm if chips are between 4mm to 7mm and 12mm if chips are between 7mm to 10mm. If chips larger than 10mm size are used, the minimum thickness shall be one and one third the maximum size of chips.
- 1.15.2.4 Both the underlayer and later the topping shall be divided into panels not exceeding 2 sq.m for laying so as to reduce the possibility of development of cracks. The longer dimension of any panel shall not exceed 2m. Dividing strips shall be used to separate the panels. When the dividing strips are not provided, the bays shall be laid alternately, allowing an interval of atleast 24 hours between laying adjacent bays.
- 1.15.2.5 Dividing strips shall be either of aluminium, brass or other material as indicated in the items of works prepared by the Contractor. Aluminum strips should have a protective coating of bitumen. The thickness of the strips shall be not less than 1.5mm and width not less than 25mm for flooring work.
- 1.15.2.6 Concrete base shall be finished to a reasonably plane surface to a level below the finished floor elevation equal to the specified thickness of terrazzo finish. Before spreading the underlayer, the base concrete surface shall be cleaned of all loose materials, mortar droppings, dirt, laitance etc. and well wetted without allowing any water pools on the surface. Dividing strips or screed strips, if dividing strips are not provided shall be fixed on the base and levelled to the correct height to suit the thickness of the finish. Just before spreading the under layer the surface shall be smeared with cement slurry at 2.75 Kg/sq.m. Over this slurry, the under layer shall be spread and levelled with a screeding board. The top surface shall be left rough to provide a good bond for the terrazzo topping.
- 1.15.2.7 Terrazzo topping shall be laid while the under layer is still plastic and normally between 18 to 24 hours after the under layer is laid. Cement slurry of the same colour as the topping shall be brushed on the surface immediately before laying is commenced. The terrazzo mix shall be laid to a uniform thickness and compacted thoroughly by tamping and with a minimum of troweling. Straight edge and steel floats shall be used to bring the surface true to the required level in such a manner that the maximum amount of marble chips come up and spread uniformly all over the surface.
- 1.15.2.8 The surface shall be left dry for air-curing for a period of 12 to 18 hours. Thereafter it shall be cured by allowing water to stand in pools for a period

of not less than 4 days.

- 1.15.2.9 Machine grinding and polishing shall be commenced only after a lapse of 7 days from the time of completion of laying. The sequence and four numbers of machine grinding operations, usage of the type of carborundum stones, filling up of pinholes, wet curing, watering etc shall be carried out all as specified in IS: 2114.

1.16 Shahabad / Tandur/ Kota Stone Slab work

1.16.1 Materials

- 1.16.1.1 The slabs shall be of approved selected quality, hard, sound, dense and homogenous in texture, free from cracks, decay, weathering and flaws. The percentage of water absorption shall not exceed 5 percent as per test conducted in accordance with IS : 1124.
- 1.16.1.2 The slabs shall be hand or machine cut to the required thickness. Tolerance in thickness for dimensions of tile more than 100mm shall be ± 5 mm. This shall be ± 2 mm on dimensions less than 100mm.
- 1.16.1.3 Slabs shall be supplied to the specified size with machine cut edges or fine chisel dressed to the full depth. All angles and edges of the slabs shall be true and square, free from any chipping giving a plane surface. Slabs shall have the top surface machine polished (first grinding) before being brought to site. The slabs shall be washed clean before laying.

1.16.2 Workmanship

- 1.16.2.1 The type, size, thickness and colour/shade etc. of the slabs for flooring/dado/skirting shall be as specified in the respective items of works prepared by the Contractor.
- 1.16.2.2 Preparation of the concrete base, laying and curing shall be as per clause 1.14.2.
- 1.16.2.3 Dado / skirting work shall be as per clause 1.14.2. The thickness of the slabs for dado/skirting work shall not be more than 25mm. Slabs shall be so placed that the back surface is at a distance of 12mm. If necessary, slabs shall be held in position temporarily by suitable method. After checking for verticality, the gap shall be filled and packed with cement sand mortar of proportion 1:3. After the mortar has acquired sufficient strength, the temporary arrangement holding the slab shall be removed.
- 1.16.2.4 Grinding and polishing shall be as per clause 1.14.2 except that first grinding with coarse grade carborundum shall not be done and cement slurry with or without pigment shall not applied before polishing.

1.17 Carborundum Tile Finish

1.17.1 Materials

- 1.17.1.1 Carborundum tiles shall generally conform in all respects to the standards stipulated in IS:1237 for heavy duty tiles. Tiles shall be of the best quality manufactured adopting hydraulic pressure of not less than 14 N/mm².



- 1.17.1.2 The topping shall be uniform and of thickness not less than 6mm. The quantity of carborundum grit shall be not less than 1.35 kg/sq.m used with cement with or without pigment. The carborundum grit shall pass through 1.18mm mesh and shall be retained on 0.60 mm mesh.

1.17.2 Workmanship

- 1.17.2.1 Requirements as detailed for terrazzo/cement tile finish under clause 7.14.2 shall be applicable for carborundum tile flooring.

1.18 Glazed Tile Finish

1.18.1 Materials

- 1.18.1.1 Glazed earthenware tiles shall conform to the requirements of IS: 777. Tiles shall be of the best quality from an approved manufacturer. The tiles shall be flat, true to shape and free from flaws such as crazing, blisters, pinholes, specks or welts. Edges and underside of the tiles shall be free from glaze and shall have ribs or indentations for a better anchorage with the bedding mortar. Dimensional tolerances shall be as specified in IS: 777.

1.18.2 Workmanship

- 1.18.2.1 The total thickness of glazed tile finish including the bedding mortar shall be 20 mm in flooring/dado/skirting. The minimum thickness of bedding mortar shall be 12mm for flooring and 10mm for dado/skirting work.
- 1.18.2.2 The bedding mortar shall consist of 1 part of cement to 3 parts of sand mixed with just sufficient water to obtain proper consistency for laying. Sand for the mortar shall conform to IS: 2116 and shall have minimum fineness modulus of 1.5.
- 1.18.2.3 Tiles shall be soaked in water for about 10 minutes just before laying. Where full size tiles cannot be fixed, tiles shall be cut to the required size using special cutting device and the edges rubbed smooth to ensure straight and true joints.
- 1.18.2.4 Coloured tiles with or without designs shall be uniform and shall be preferably procured from the same batch of manufacture to avoid any differences in the shade.
- 1.18.2.5 Tiles for the flooring shall be laid over hardened concrete base. The surface of the concrete base shall be cleaned of all loose materials, mortar droppings etc well wetted without allowing any water pools on the surface. The bedding mortar shall then be laid evenly over the surface, tamped to the desired level and allowed to harden for a day. The top surface shall be left rough to provide a good bond for the tiles. For skirting and dado work, the backing mortar shall be roughened using a wire brush.
- 1.18.2.6 Neat cement slurry using 3.3 kg cement per sq.m of floor area shall be spread over the hardened mortar bed over such an area as would accommodate about 20 tiles. Tiles shall be fixed in this slurry one after the other, each tile being gently tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. For skirting and dado work, the

back of the tiles shall be smeared with cement slurry for setting on the backing mortar. Fixing of tiles shall be done from the bottom of the wall upwards. The joints shall be in perfect straight lines and as thin as possible but shall not be more than 1mm wide. The surface shall be checked frequently to ensure correct level/required slope. Floor tiles near the walls shall enter skirting/dado to a minimum depth of 10mm. Tiles shall not sound hollow when tapped.

- 1.18.2.7 All the joints shall be cleaned of grey cement with wire brush to a depth of at least 3mm and all dust, loose mortar etc. shall be removed. White cement with or without pigment shall then be used for flush pointing the joints. Curing shall then be carried out for a minimum period of 7 days for the bedding and joints to set properly. The surface shall then be cleaned using a suitable detergent, fully washed and wiped dry.
- 1.18.2.8 Specials consisting of coves, internal and external angles, cornices, beads and their corner pieces shall be of thickness not less than the tiles with which they are used.

1.19 In-Situ Cement Concrete Floor Topping

1.19.1 Materials

- 1.19.1.1 The mix proportion for the in-situ concrete floor topping shall be 1:2.5:3.5 (one part cement : two and half parts sand : three and half parts coarse aggregates) by volume unless otherwise specified.
- 1.19.1.2 The aggregates shall conform for the requirements of IS:383.
- 1.19.1.3 Coarse aggregates shall have high hardness surface texture and shall consist of crushed rock of granite, basalt, trap or quartzite. The aggregate crushing value shall not exceed 30 percent. The grading of the aggregates of size 12.5mm and below shall be as per IS:2571.
- 1.19.1.4 Grading of the sand shall be within the limits indicated in IS:2571.

1.19.2 Workmanship

- 1.19.2.1 The thickness of the floor topping shall be as specified in the items of work prepared by the Contractor. The minimum thickness of the floor topping shall be 25mm.
- 1.19.2.2 Preparation of base concrete/structural slab before laying the topping shall be as per clause 1.13. The surface shall be rough to provide adequate bond for the topping.
- 1.19.2.3 Mixing of concrete shall be done thoroughly in a mechanical mixer unless hand mixing is specifically permitted by the EMPLOYER. The concrete shall be as stiff as possible and the amount of water added shall be the minimum necessary to give just sufficient plasticity for laying and compacting. The mix shall be used in the work within 30 minutes of the addition of water for its preparation.
- 1.19.2.4 Floor finish shall be laid in suitable panels to reduce the risk of cracking. No dimension of a panel shall exceed 2 meters and the length of a panel shall

not exceed one and a half times its breadth. Topping shall be laid in alternate panels, the intermediate panels being cast after a gap of at least one day. Construction joints shall be plain vertical butt joints.

- 1.19.2.5 Screed strips shall be fixed dividing the area into suitable panels. Immediately before depositing the concrete topping, neat cement slurry at 2.75 kg/sq.m of area shall be thoroughly brushed into the prepared surface. Topping shall then be laid, very thoroughly tamped, struck off level and floated with wooden float. The surface shall then be tested with a straight edge and mason's spirit level to detect any inequalities and these shall be made good immediately.
- 1.19.2.6 Finishing of the surface by troweling shall be spread over a period of one to six hours depending upon the temperature and atmospheric conditions. The surface shall be trowelled 3 times at intervals so as to produce a smooth uniform and hard surface. Immediately after laying, the first trowelling just sufficient to give a level surface shall be carried out avoiding excessive trowelling at this stage. The surface shall be re- trowelled after sometime to close any pores and to scrap off excess water or laitance, which shall not be trowelled back into the topping. Final trowelling shall be done well before the concrete has become too hard but at a time when considerable pressure is required to make any impression on the surface. Sprinkling of dry cement or cement-sand mixture for absorbing moisture shall not be permitted.
- 1.19.2.7 Immediately after the surface is finished, it shall be protected suitably from rapid drying due to wind/ sunlight. After the surface has hardened sufficiently to prevent any damage to it, the topping shall be kept continuously moist for a minimum period of 10 days.
- 1.19.2.8 It is preferable to lay the topping on hardened base concrete, as against being laid monolithically with a lesser thickness, since proper levels and slopes with close surface tolerances is achievable in practice, owing to its greater thickness. Further, as this would be laid after all other building operations are over, there will be no risk of any damages or discoloration to the floor finish which are difficult to repair satisfactorily.

1.20 In-Situ Granolithic Concrete Floor Topping

1.20.1 Materials and Workmanship

- 1.20.1.1 The Requirements of materials and workmanship shall be all as per clause 7.19 for in-situ cement concrete floor topping except that the mix proportion of the concrete shall be 1:1:2 (cement: sand : coarse aggregates) by volume.
- 1.20.1.2 The minimum thickness of granolithic floor topping on hardened concrete base shall be 40mm.

1.21 Floor Hardener Topping

1.21.1 Materials & Workmanship

- 1.21.1.1 Floor Hardener topping shall be provided either as integrally finished over the structural slab/grade slab or laid monolithically with the

concrete/granolithic floor finish on top of hardened concrete base.

- 1.21.1.2 Floor hardener of the metallic or non-metallic type suitable for the performance of normal / medium/ heavy duty function of the floor, the quantum of ingredients and the thickness of topping shall be as specified in the respective items of work prepared by the Contractor.
- 1.21.1.3 For monolithic application with the floor finish/slab the thickness of the layer shall be 15mm. The topping shall be laid within 2 to 3 hours after concrete is laid when it is still plastic but stiffened enough for the workmen to tread over it by placing planks. The surface of the concrete layer shall be kept rough for providing adequate bond for the topping. Laitance shall be removed before placing the topping. The topping shall be screeded and thoroughly compacted to the finished level. Trowelling to a smooth finish shall be carried out as per clause 1.19.2. After the surface has hardened sufficiently, it shall be kept continuously moist for at least 10 days.
- 1.21.1.4 The procedure for mixing the floor hardener topping shall be as per manufacturer's instructions.
- 1.21.1.5 Surface shall be prevented from any damages due to subsequent building operations by covering with 75 mm thick layer of sand.

1.22 PVC Sheet/Tile Flooring

1.22.1 Materials

- 1.22.1.1 PVC floor covering shall be of either unbacked homogeneous flexible type in the form of sheets/tiles conforming to IS:3462 or homogeneous PVC asbestos tiles conforming to IS:3461.
- 1.22.1.2 The surface of the sheets/tiles shall be free from any physical defects such as pores, blisters, cracks etc. which affects the appearance and serviceability. Tiles/ sheets shall meet with the tolerance limits in dimensions specified in the IS. Contractor shall submit the test certificates, if so desired by the EMPLOYER.
- 1.22.1.3 Each tile/sheet shall be legibly and indelibly marked with the name of the manufacturer or his trade mark, IS certificate mark, and batch number.
- 1.22.1.4 The adhesive to be used for laying the PVC flooring shall be rubber based and of the make as recommended and approved by the manufacturer of PVC sheets/tiles.
- 1.22.1.5 The type, size, colour, plain or mottled and the pattern shall be as specified in the respective items of work prepared by the Contractor.

1.22.2 Workmanship

- 1.22.2.1 PVC Floor covering shall be provided over an under bed of cement concrete floor finish over the base concrete or structural slab. It is essential that the sub-floor and the under bed are perfectly dry before laying the PVC flooring. This shall be ensured by methods of testing as stipulated in Appendix-A of IS:5318.
- 1.22.2.2 The surface of the under bed shall have trowelled finish without any

- irregularities, which creates poor adhesion. Surface shall be free of oil or grease and thoroughly cleaned of all dust, dirt and wiped with a dry cloth.
- 1.22.2.3 PVC sheets/tiles shall be brought to the temperature of the area in which they are to be laid by stacking in a suitable manner within or near the laying area for a period of about 24 hours. Where air-conditioning is installed, the flooring shall not be laid on the under bed until the A/C units have been in operation for at least 7 days. During this period, the temperature range shall be between 20deg.C and 30deg.C and this shall be maintained during the laying operations and also for 48 hours thereafter.
- 1.22.2.4 Layout of the PVC flooring shall be marked with guidelines on the under bed and PVC tiles/sheets shall be first laid for trial, without using the adhesive, according to the layout.
- 1.22.2.5 The adhesive shall be applied by using a notched trowel to the surface of the under bed and to the backside of PVC sheets/tiles. When the adhesive has set sufficiently for laying, it will be tacky to the touch, which generally takes about 30 minutes. The time period need be carefully monitored since a longer interval will affect the adhesive properties. Adhesive shall be uniformly spread over only as much surface area at one time which can be covered with PVC flooring within the stipulated time.
- 1.22.2.6 PVC sheet shall be carefully taken and placed in position from one end onwards slowly so that the air will be completely squeezed out between the sheet and the background surface and no air pockets are formed. It shall then be pressed with a suitable roller to develop proper contact. The next sheet shall be laid edge to edge with the sheet already laid, so that there is minimum gap between joints. The alignment shall be checked after each row of sheet is completed and trimmed if considered necessary.
- 1.22.2.7 Tiles shall be laid in the same manner as sheets and preferably, commencing from the centre of the area. Tiles should be lowered in position and pressed firmly on to the adhesive with minimum gap between the joints. Tiles shall not be slid on the surface. Tiles shall be rolled with a light wooden roller of about 5kg to ensure full contact with the underlay. Work should be constantly checked to ensure that all four edges of adjacent tiles meet accurately.
- 1.22.2.8 Any excess adhesive which may squeeze up between sheets/tiles shall be wiped off immediately with a wet cloth. Suitable solvents shall be used to remove hardened adhesive.
- 1.22.2.9 A minimum period of 24 hours shall be given after laying for the development of proper bond of the adhesive. When the flooring is thus completed, it shall be cleaned with a wet cloth soaked in warm soap solution.
- 1.22.2.10 Metallic edge strips shall be used to protect the edges of PVC sheets/tiles which are exposed as in doorways/ stair treads.
- 1.22.2.11 Hot sealing of joints between adjacent PVC sheet flooring to prevent creeping of water through the joints shall be carried out, using special equipment as per manufacturer's instructions.



1.23 Acid Resisting Brick/Tiling Work

1.23.1 Materials

- 1.23.1.1 The ceramic unglazed vitreous acid resisting tiles shall conform to the requirements of IS:4457. Acid resistant bricks shall conform to the requirements of IS:4860.
- 1.23.1.2 The finished tile/brick when fractured shall appear fine grained in texture, dense and homogeneous. Tile/brick shall be sound, true to shape, flat, free from flaws and any manufacturing defects affecting their utility. Tolerance in dimensions shall be within the limits specified in the respective IS.
- 1.23.1.3 The tiles/bricks shall be bedded and jointed using chemical resistant mortar of the resin type conforming to IS:4832 (Part II). Method of usage shall generally be as per the requirements of IS:4443.

1.23.2 Workmanship

- 1.23.2.1 The resin shall have viscosity for readily mixing with the filler by manual methods. The filler shall have graded particles which permit joint thickness of 1.5 mm.
- 1.23.2.2 The base concrete surface shall be free from dirt and thoroughly dried. The surface shall be applied with a coat of bitumen primer conforming to IS:3384. The primed surface shall then be applied with a uniform coat of bitumen conforming to IS:1580. Tiles or bricks shall be laid directly without the application of bitumen, if epoxy or polyester resin is used for the mortar.
- 1.23.2.3 Just adequate quantity of mortar which can be applied within the pot life as specified by the manufacturer shall be prepared at one time for bedding and jointing. Rigid PVC/Stainless steel/chromium plated tools shall be used for mixing and laying.
- 1.23.2.4 For laying the floor 6 to 8 mm thick mortar shall be spread on the back of the tile/brick. Two adjacent sides of the tile/brick shall be smeared with 4 to 6 mm thick mortar. Tile/brick shall be pressed into the bed and pushed against the floor and with the adjacent tile/ brick, until the joint in each case is 2 to 3 mm thick. Excess mortar shall then be trimmed off and allowed to harden fully. Similar procedure shall be adopted for the work on walls by pressing the tile/brick against the prepared wall surfaces and only one course shall be laid at a time until the initial setting period.
- 1.23.2.5 The mortar joints shall be cured for a minimum period of 72 hours with 20 to 25% hydrochloric acid or 30 to 40% sulphuric acid. After acid curing, the joints shall be washed with water and allowed to thoroughly dry. The joints shall then be filled with mortar to make them smooth and plane. Acid curing is not required to be carried out if epoxy or polyester resin is used for the mortar.
- 1.23.2.6 Resin mortars are normally self curing. The area tiled shall not be put to use before 48 hours in case epoxy, polyester and furane type of resin is used for the mortar. If phenolic or cashewnut shell liquid resin is used for the mortar,



the area tiled shall not be put to use for 7 to 28 days respectively, without heat treatment. This period shall be 2 to 6 days respectively, if heat treatment is given with infrared lamp.

1.24 Epoxy Lining Work

1.24.1 Materials

- 1.24.1.1 The epoxy resin and hardener formulation for laying of jointless lining work in floors and walls of concrete tanks/trenches etc shall be as per the requirements of IS:9197.
- 1.24.1.2 The epoxy composition shall have the chemical resistance to withstand the following conditions of exposure:
 - a) Hydrochloric acid upto 30% concentration
 - b) Sodium hydroxide upto 50% concentration
 - c) Liquid temperature upto 60deg.C
 - d) Ultraviolet radiation
 - e) Alternate wetting and drying
- 1.24.1.3 Sand shall conform to grading zone III or IV of IS:383.
- 1.24.1.4 The hardener shall be of the liquid type such as Aliphatic Amine or an Aliphatic/Aromatic Amine Adduct for the epoxy resin. The hardener shall react with epoxy resin at normal ambient temperature.
- 1.24.1.5 Contractor shall furnish test certificates for satisfying the requirements of the epoxy formulation if so directed by the EMPLOYER.

1.24.2 Workmanship

- 1.24.2.1 The minimum thickness of epoxy lining shall be 4 mm. It is essential that the concrete elements are adequately designed to ensure that water is excluded to permeate to the surface, over which the epoxy lining is proposed.
- 1.24.2.2 The epoxy lining shall be of the trowel type to facilitate execution of the required thickness for satisfactory performance.
- 1.24.2.3 The concrete surfaces over which epoxy lining is to be provided shall be thoroughly cleaned of oil or grease by suitable solvents, wire brushed to remove any dirt/dust and laitance. The surfaces shall then be washed with dilute hydrochloric acid and rinsed thoroughly with plenty of water or dilute ammonia solution. The surfaces shall then be allowed to dry. It is essential to ensure that the surfaces are perfectly dry before the commencement of epoxy application.
- 1.24.2.4 Just adequate quantity of epoxy resin which can be applied within the pot life as specified by the manufacturer shall be prepared at one time for laying and jointing.
- 1.24.2.5 Rigid PVC/stainless steel/chromium plated tools shall be used for laying. Trowelling shall be carried out to obtain uniformly the specified thickness of lining.
- 1.24.2.6 Lining shall be allowed to set without disturbance for a minimum period of 24 hours. The facility shall be put to use only after a minimum period of 7



days of laying of the lining.

1.25 Water-Proofing

1.25.1 General

- 1.25.1.1 The work shall include waterproofing for the building roofs, terraces, toilets, floor slabs, walls, planters, chajjas, sills and any other areas and at any other locations and situations as directed by the Employers Representative.
- 1.25.1.2 The waterproofing treatment shall be carried out on top of lime concrete (brick bat coba) laid to slope on roof surfaces. The brick bat coba shall be covered as specified below.
- 1.25.1.3 The work shall be carried out by an experienced specialist Sub-Contractor who shall be appointed only after prior approval of the EMPLOYER.

1.25.2 Modified Bituminous Membrane

- 1.25.2.1 Modified Bituminous Membrane shall be "SUPER THERMOLAY" 4 mm thick weighing 4 Kg/sqm, manufactured using APP Polymer modified bitumen with a central core of non-woven polyester reinforcement (200 gms/sqm) and with top and bottom layers of thermofusible film (top layer could also be sand finished) made by STP Limited in collaboration with Bitumat Company Limited. "PLYFLEX" of Bitumat Company Limited, Saudi Arabia supplied by STP Limited shall also be acceptable or other equivalent specification.

1.25.3 Waterproofing of Roofs with Lime Concrete

1.25.3.1 Materials

- a) Broken brick coarse aggregates prepared from well/over burnt bricks shall be well graded having a maximum size of 25mm and shall generally conform to IS:3068.
- b) Lime shall be class C lime (fat lime) or factory made hydrated lime conforming to IS:712.

1.25.3.2 Workmanship

- 1.25.3.2.1 Lime concrete shall be prepared by thoroughly mixing the brick aggregates inclusive of brick dust obtained during breaking with the slaked lime in the proportions of 2 1/2 (two and a half) parts of brick aggregates to 1 part of slaked lime by volume. Water shall be added just adequate to obtain the desired workability for laying. Washing soap and alum shall be dissolved in the water to be used. The quantity of these materials required per cum of lime concrete shall be 12kg of washing soap and 4kg of alum. Brick aggregates shall be soaked thoroughly in water for a period of not less than six hours before use in the concrete mix. Lime concrete shall be used in the works within 24 hours after mixing.
- 1.25.3.2.2 The roof surface over which the water-proof treatment is to be carried out shall be cleaned of all foreign matter by wire brushing, dusting and made thoroughly dry. Preparation of surfaces shall be as stipulated in IS:3067.



- 7.25.3.2.3 The slope of the finished waterproofing treatment shall be not less than 1 in 60 for efficient drainage. This shall be achieved either wholly in the lime concrete layer.
- 1.25.3.2.4 The average thickness of lime concrete, slope and the finish on top of machine made burnt clay flat terracing tiles conforming to IS:2690 (part I) shall be as specified in the items of work to be prepared by the Contractor. Cement concrete flooring tiles in lieu of clay terracing tiles shall be provided if so specified in the items of work prepared by the Contractor, duly considering the traffic the terrace will be subjected to.
- 1.25.3.2.5 The minimum compacted thickness of lime concrete layer shall be 75mm and average thickness shall not be less than 100mm. In case, the thickness is more than 100mm, it shall be laid in layers not exceeding 100mm to 125mm.
- 1.25.3.2.6 Laying of lime concrete shall be commenced from a corner of the roof and proceeded diagonally towards centre and other sides duly considering the slopes specified for effectively draining the rain-water towards the downturn points.
- 1.25.3.2.6 Lime concrete fillet for a minimum height of 150mm shall be provided all along the junction of the roof surface with the brick masonry wall/parapet/column projections. These shall then be finished on top with provision of clay terracing tiles/cement concrete tiles.
- 1.25.3.2.7 After the lime concrete is laid it shall be initially rammed with a rammer weighing not more than 2 Kg and the finish brought to the required evenness and slope. Alternatively, bamboo strips may be used for the initial ramming. Further consolidation shall be done using wooden THAPIES with rounded edges. The beating will normally have to be carried on for at least seven days until the THAPI makes no impression on the surface and rebounds readily from it when struck. Special care shall be taken to properly compact the lime concrete at its junction with parapet walls or column projections.
- 1.25.3.2.8 During compaction by hand-beating, the surface shall be sprinkled liberally with lime water (1 part of lime putty and 3 to 4 parts of water) and a small proportion of sugar solution for obtaining improved water-proofing quality of the lime concrete. On completion of beating, the mortar that comes on the top shall be smoothened with a trowel or float, if necessary, with the addition of sugar solution and lime putty. The sugar solution may be prepared in any one of the following ways as directed by the EMPLOYER.
- a) By mixing about 3 Kg of Jaggery and 1.5 Kg of BAEL fruit to 100 litres of water.
 - b) By mixing about 600 gm of KADUKAI (the dry nuts shall be broken to small pieces and allowed to soak in water), 200 gm of jaggery and 40 litres of water for 10sq.m of work. This solution shall be brewed for about 12 to 24 hours and the resulting liquor decanted and used for the work.
- 1.25.3.2.9 The lime concrete after compaction shall be cured for a minimum period of seven days or until it hardens by covering with a thin layer of straw or hessian which shall be kept wet continuously.



- 1.25.3.2.10 Machine made flat terracing tiles shall be of the size and thickness as specified. Tiles shall be soaked in water for at least one hour before laying. Bedding for the tiles shall be 12mm thick in cement mortar 1:3. Tiles shall be laid, open jointed with 4 to 6 mm wide joints, flat on the mortar and lightly pressed and set to plane surface true to slope, using a trowel and wooden straight edge. They shall be laid with their longitudinal lines of joints truly parallel and generally at right angles to the direction of run-off gradient. Transverse joints in alternate rows shall come directly in line with each other. Transverse joints in adjacent courses shall break joints by at least 50 mm. The joints shall be completely filled and flush pointed with cement mortar 1:2 mixed with water proofing compound as per manufacturer's instructions. Curing shall be carried out for a minimum period of seven days.
- 1.25.3.2.11 Finishing on top with cement concrete tiles or in-situ cement concrete floor topping shall be carried out in similar fashion as described for clay tiles in above paragraph. Tiles to be used shall be supplied after the first machine grinding of the surface.

1.25.4 Waterproofing of Roofs/Terraces etc.

(a) Water proofing of Horizontal Surfaces

- 1.25.4.1 The waterproofing shall be applied as follows:
- 1.25.4.2 A coat of Blown Bitumen 85/25 shall be applied at the rate of 1.45 kg/sq.km
- 1.25.4.3 A roll of Modified Bituminous Membrane shall be unrolled over the primed surface and completely bonded to the substrate by pressing down evenly for the full width of the roll using a wooden roller. Torching shall be done, where recommended by the manufacturer and where directed by the EMPLOYER, as the unrolling progresses.
- 1.25.4.4 The side overlaps shall be minimum 100 mm whereas the end overlaps shall be minimum 150 mm; both shall be bonded and sealed by flame torching.
- 1.25.4.5 Care shall be taken that the membrane is lapped with the treatment along the vertical surface and roof gutter treatment for at least 500 mm.
- 1.25.4.6 The membrane shall be properly overlapped/terminated at all openings, rainwater down takes etc. to ensure that such junctions do not become sources of leakage.
- 1.25.4.7 Top of membrane finally shall be painted with antiglouse reflective paint.

(b) Waterproofing of Vertical Surfaces at Roof Level and Gutters

- 1.25.4.8 The Water proofing shall be applied as described in (a) above.
- 1.25.4.9 Modified Bituminous membrane shall be unrolled and bonded to the substrate after applying a coat of bitumen and by pressing down evenly for the full width of the roll. Light torching shall be done to ensure complete bonding.
- 1.25.4.10 The membrane shall be overlapped with treatment for the horizontal surface by at least 500 mm.
- 1.25.4.11 The membrane shall be taken upto a pre-cut chase anchored and sealed.



1.25.5 Khurras and Rainwater Down Pipes

- 1.25.5.1 Down pipes shall be isolated from RCC work with 6 mm polyethylene foam fixed with adhesive (Araldite) and sealed with silicone sealant prior to laying membrane. A water proofing flashing composed of one layer of Hessian based self finished felt Type 3 Grade 1 and two layers of aluminium foil of 0.075 mm thickness shall be provided. This flashing shall be carried into the down take pipes for at least 150 mm and sealed with hot bitumen. The Contractor shall closely coordinate the work with the agency providing and fixing the rainwater down take pipes.

1.25.6 Testing

- 1.25.6.1 The treated area (flat and horizontal only) shall be tested by allowed water to stand on the treated areas to a depth of 150 mm for a minimum period of 72 hours.
- 1.25.6.2 The treated area (flat and horizontal) shall have continuous slope towards the rainwater outlets and no water shall pond any where on the surface.

1.26 Cement Plastering Work

1.26.1 Materials

- 1.26.1.1 The proportions of the cement mortar for plastering shall be 1:3 (one part of cement to three parts of sand). Cement and sand shall be mixed thoroughly in dry condition and then just enough water added to obtain a workable consistency. The quality of water and cement shall be as per relevant IS standards. The quality and grading of sand for plastering shall conform to IS:1542. The mixing shall be done thoroughly in a mechanical mixer unless hand mixing is specifically permitted by the EMPLOYER. If so desired by the EMPLOYER sand shall be screened and washed to meet the Specifications. The mortar thus mixed shall be used as soon as possible preferably within 30 minutes from the time water is added to cement. In case the mortar has stiffened due to evaporation of water this may be re- tempered by adding water as required to restore consistency but this will be permitted only upto 30 minutes from the time of initial mixing of water to cement. Any mortar which is partially set shall be rejected and removed forthwith from the site. Droppings of plaster shall not be re-used under any circumstances.

1.26.2 Workmanship

- 1.26.2.1 Preparation of surfaces and application of plaster finishes shall generally conform to the requirements specified in IS:1661 and IS:2402.
- 1.26.2.2 Plastering operations shall not be commenced until installation of all fittings and fixtures such as door/window panels, pipes, conduits etc. are completed.
- 1.26.2.3 All joints in masonry shall be raked as the work proceeds to a depth of 10mm/20mm for brick/stone masonry respectively with a tool made for the purpose when the mortar is still green. The masonry surface to be rendered shall be washed with clean water to remove all dirt, loose materials, etc., Concrete surfaces to be rendered shall be roughened suitably by hacking or

bush hammering for proper adhesion of plaster and the surface shall be evenly wetted to provide the correct suction. The masonry surfaces should not be too wet but only damp at the time of plastering. The dampness shall be uniform to get uniform bond between the plaster and the masonry surface.

- 1.26.2.4 Interior plain faced plaster - This plaster shall be laid in a single coat of 13mm thickness. The mortar shall be dashed against the prepared surface with a trowel. The dashing of the coat shall be done using a strong whipping motion at right angles to the face of the wall or it may be applied with a plaster machine. The coat shall be trowelled hard and tight forcing it to surface depressions to obtain a permanent bond and finished to smooth surface. Interior plaster shall be carried out on jambs, lintel and sill faces, etc. as shown in the drawing and as directed by the EMPLOYER.
- 1.26.2.5 Plain Faced Ceiling plaster - This plaster shall be applied in a single coat of 6mm thickness. Application of mortar shall be as stipulated in above paragraph.
- 1.26.2.6 Exterior plain faced plaster - This plaster shall be applied in 2 coats. The first coat or the rendering coat shall be approximately 14mm thick. The rendering coat shall be applied as stipulated above except finishing it to a true and even surface and then lightly roughened by cross scratch lines to provide bond for the finishing coat. The rendering coat shall be cured for at least two days and then allowed to dry. The second coat or finishing coat shall be 6 mm thick. Before application of the second coat, the rendering coat shall be evenly damped. The second coat shall be applied from top to bottom in one operation without joints and shall be finished leaving an even and uniform surface. The mortar proportions for the coats shall be as specified in the respective item of work. The finished plastering work shall be cured for at least 7 days.
- 1.26.2.7 Interior plain faced plaster 20mm thick if specified for uneven faces of brick walls or for random/coursed rubble masonry walls shall be executed in 2 coats similar to the procedure stipulated in above paragraph.
- 1.26.2.8 Exterior Sand Faced Plaster- This plaster shall be applied in 2 coats. The first coat shall be approximately 14mm thick and the second coat shall be 6mm thick. These coats shall be applied as stipulated above. However, only approved quality white sand shall be used for the second coat and for the finishing work. Sand for the finishing work shall be coarse and of even size and shall be dashed against the surface and sponged. The mortar proportions for the first and second coats shall be as specified in the respective items of work.
- 1.26.2.9 Wherever more than 20mm thick plaster has been specified, which is intended for purposes of providing beading, bands, etc. this work shall be carried out in two or three coats as directed by the EMPLOYER duly satisfying the requirements of curing each coat (rendering/floating) for a minimum period of 2 days and curing the finished work for at least 7 days.
- 1.26.2.10 In the case of pebble faced finish plaster, pebbles of approved size and



quality shall be dashed against the final coat while it is still green to obtain as far as possible a uniform pattern all as directed by the EMPLOYER.

- 1.26.2.11 Where specified in the Drawings to be prepared by the Contractor prepared by the Contractor, rectangular grooves of the dimensions indicated shall be provided in external plaster by means of timber battens when the plaster is still in green condition. Battens shall be carefully removed after the initial set of plaster and the broken edges and corners made good. All grooves shall be uniform in width and depth and shall be true to the lines and levels as per the Drawings to be prepared by the Contractor prepared by the Contractor.
- 1.26.2.12 Curing of plaster shall be started as soon as the applied plaster has hardened sufficiently so as not to be damaged when watered. Curing shall be done by continuously applying water in a fine spray and shall be carried out for at least 7 days.
- 1.26.2.13 For waterproofing plaster, the Contractor shall provide the water-proofing admixture as specified in manufacturers instruction while preparing the cement mortar.
- 1.26.2.14 For external plaster, the plastering operations shall be commenced from the top floor and carried downwards. For internal plaster, the plastering operations for the walls shall commence at the top and carried downwards. Plastering shall be carried out to the full length of the wall or to natural breaking points like doors/windows etc. Ceiling plaster shall be completed first before commencing wall plastering.
- 1.26.2.15 Double scaffolding to be used shall be as specified in clause 1.2.2.
- 1.26.2.16 The finished plaster surface shall not show any deviation more than 4mm when checked with a straight edge of 2m length placed against the surface.
- 1.26.2.17 To overcome the possibility of development of cracks in the plastering work following measures shall be adopted.
- a) Plastering work shall be deferred as much as possible so that fairly complete drying shrinkage in concrete and masonry works takes place.
 - b) Steel wire fabric shall be provided at the junction of brick masonry and concrete to overcome reasonably the differential drying shrinkage/thermal movement.
 - c) Ceiling plaster shall be done, with a trowel cut at its junction with wall plaster. Similarly trowel cut shall be adopted between adjacent surfaces where discontinuity of the background exists.

1.27 Cement Pointing

1.27.1 Materials

- 1.27.1.1 The cement mortar for pointing shall be in the proportion of 1:3 (one part of cement to three parts of fine sand). Sand shall conform to IS: 1542 and shall be free from clay, shale, loam, alkali and organic matter and shall be of sound, hard, clean and durable particles. Sand shall be approved by EMPLOYER and if so directed it shall be washed/screened to meet

specification requirements.

1.27.2 Workmanship

- 1.27.2.1 Where pointing of joints in masonry work is specified, the joints shall be raked at least 15mm/20mm deep in brick/stone masonry respectively as the work proceeds when the mortar is still green.
- 1.27.2.2 Any dust/dirt in the raked joints shall be brushed out clean and the joints shall be washed with water. The joints shall be damp at the time of pointing. Mortar shall be filled into joints and well pressed with special steel trowels. The joints shall not be disturbed after it has once begun to set. The joints of the pointed work shall be neat. The lines shall be regular and uniform in breadth and the joints shall be raised, flat, sunk or 'V' as may be specified in the respective items of work. No false joints shall be allowed.
- 1.27.2.3 The work shall be kept moist for at least 7 days after the pointing is completed. Whenever coloured pointing has to be done, the colouring pigment of the colour required shall be added to cement in such proportions as recommended by the manufacturer and as approved by the EMPLOYER.

1.28 Water-Proofing Admixtures

- 1.28.1 Water-proofing admixture shall conform to the requirements of IS:2645 and shall be of approved manufacture. The admixture shall not contain calcium chloride. The quantity of the admixture to be used for the works and method of mixing etc. shall be as per manufacturer's instructions and as directed by the EMPLOYER.

1.29 Painting of Concrete, Masonry & Plastered Surfaces

1.29.1 Materials

- 1.29.1.1 Oil bound distemper shall conform to IS:428. The primer shall be alkali resistant primer of the same manufacture as that of the distemper.
- 1.29.1.2 Cement paint shall conform to IS:5410. The primer shall be a thinned coat of cement paint.
- 1.29.1.3 Lead free acid, alkali and chlorine resisting paint shall conform to IS:9862.
- 1.29.1.4 Colour wash shall be made by addition of a suitable quantity of mineral pigment, not affected by lime, to the prepared white wash to obtain the shade/tint as approved by the EMPLOYER.
- 1.29.1.5 All the materials shall be of the best quality from an approved manufacturer. Contractor shall obtain prior approval of the EMPLOYER for the brand of manufacture and the colour/shade. All materials shall be brought to the site of works in sealed containers.

1.29.2 Workmanship

- 1.29.2.1 Contractor shall obtain the approval of the EMPLOYER regarding the readiness of the surfaces to receive the specified finish, before commencing the work on painting.



- 1.29.2.2 Painting of new surfaces shall be deferred as much as possible to allow for thorough drying of the sub- strata.
- 1.29.2.3 The surfaces to be treated shall be prepared by thoroughly brushing them free from dirt, mortar droppings and any loose foreign materials. Surfaces shall be free from oil, grease and efflorescence. Efflorescence shall be removed only by dry brushing of the growth. Cracks shall be filled with Gypsum. Workmanship of painting shall generally conform to IS:2395.
- 1.29.2.4 Surfaces of doors, windows etc. shall be protected suitably to prevent paint finishes from splashing on them.

1.29.3 White Wash

- 1.29.3.1 The prepared surfaces shall be wetted and the finish applied by brushing. The operation for each coat shall consist of a stroke of the brush first given horizontally from the right and the other from the left and similarly, the subsequent stroke from bottom upwards and the other from top downwards, before the first coat dries. Each coat shall be allowed to dry before the next coat is applied. Minimum of 2 coats shall be applied unless otherwise specified. The dry surface shall present a uniform finish without any brush marks.

1.29.4 Colour Wash

- 1.29.4.1 Colour wash shall be applied in the same way as for white wash. A minimum of 2 coats shall be applied unless otherwise specified. The surface shall present a smooth and uniform finish without any streaks. The finished dry surface shall not show any signs of peeling/powdery and come off readily on the hand when rubbed.

1.29.5 Cement Paint

- 1.29.5.1 The prepared surfaces shall be wetted to control surface suction and to provide moisture to aid in proper curing of the paint. Cement paint shall be applied with a brush with stiff bristles. The primer coat shall be a thinned coat of cement paint. The quantity of thinner shall be as per manufacturer's instructions. The coats shall be vigorously scrubbed to work the paint into any voids for providing a continuous paint film free from pinholes for effective water proofing in addition to decoration. Cement paint shall be brushed in uniform thickness and the covering capacity for two coats on plastered surfaces shall be 3 to 4 kg/sq.m. A minimum of 2 coats of the same colour shall be applied. At least 24 hours shall be left after the first coat to become sufficiently hard before the second coat is applied. The painted surfaces shall be thoroughly cured by sprinkling with water using a fog spray at least 2 to 3 times a day. Curing shall commence after about 12 hours when the paint hardens. Curing shall be continued for at least 2 days after the application of final coat. The operations for brushing each coat shall be as detailed above.

1.29.6 Oil bound Distemper



1.29.6.1 The prepared surfaces shall be dry and provided with one coat of alkali resistant primer by brushing. The surface shall be finished uniformly without leaving any brush marks and allowed to dry for at least 48 hours. A minimum of two coats of oil bound distemper shall be applied, unless otherwise specified. The first coat shall be of a lighter tint. At least 24 hours shall be left after the first coat to become completely dry before the application of the second coat. Broad, stiff, double bristled distemper brushes shall be used for the work. The operations for brushing each coat shall be as detailed above.

1.29.7 Acid, Alkali Resisting Paint

1.29.7.1 A minimum of 2 coats of acid/alkali resisting paint shall be applied over the prepared dry surfaces by brushing. Primer coat shall be as per manufacturer's instructions.

1.29.8 Plastic Emulsion Paint

1.29.8.1 The prepared surface shall be dry and provided with one coat of primer which shall be a thinned coat of emulsion paint. The quantity of thinner shall be as per manufacturer's instructions. The paint shall be laid on evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area with paint, brushing the surface hard for the first time over and then brushing alternately in opposite directions two or three times and then finally brushing lightly in a direction at right angles. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off constitutes one coat. The next coat shall be applied only after the first coat has dried and sufficiently become hard which normally takes about 2 to 3 hours. A minimum of 2 finishing coats of the same colour shall be applied unless otherwise specified. Paint may also be applied using rollers. The surface on finishing shall present a flat velvety smooth finish and uniform in shade without any patches.

1.29.9 Acrylic Emulsion Paint

1.29.9.1 Acrylic emulsion paint shall be applied in the same way as for plastic emulsion paint. A minimum of 2 finishing coats over one coat of primer shall be provided unless otherwise specified.

1.30 Painting & Polishing of Wood Work

1.30.1 Materials

- a) Wood primer shall conform to IS:3536.
- b) Filler shall conform to IS:110.
- c) Varnish shall conform to IS:337.
- d) French polish shall conform to IS:348.
- e) Synthetic enamel paint shall conform to IS:2932.
- All the materials shall be of the best quality from an approved manufacturer. Contractor shall obtain prior approval of the EMPLOYER for the brand of



manufacture and the colour/shade. All materials shall be brought to the site of works in sealed containers.

1.30.2 Workmanship

- 1.30.2.1 The type of finish to be provided for woodwork of either painting or polishing, the number of coats, etc. shall be as specified in the respective items of work to be prepared by the Contractor.
- 1.30.2.2 Primer and finish paint shall be compatible with each other to avoid cracking and wrinkling. Primer and finish paint shall be from the same manufacturer.
- 1.30.2.3 Painting shall be either by brushing or spraying. Contractor shall procure the appropriate quality of paint for this purpose as recommended by the manufacturer. The workmanship shall generally conform to the requirements of IS:2338 (Part I).
- 1.30.2.4 All the wood surfaces to be painted shall be thoroughly dry and free from any foreign matter. Surfaces shall be smoothened with abrasive paper using it across the grains and dusted off. Wood primer coat shall then be applied uniformly by brushing. The number of primer coats shall be as specified in the item of work to be prepared by the Contractor. Any slight irregularities of the surface shall then be made- up by applying an optimum coat of filler conforming to IS:110 and rubbed down with an abrasive paper for obtaining a smooth surface for the undercoat of synthetic enamel paint conforming to IS:2932. Paint shall be applied by brushing evenly and smoothly by means of crossing and laying off in the direction of the grain of wood. After drying, the coat shall be carefully rubbed down using very fine grade of sand paper and wiped clean before the next coat is applied. At least 24 hours shall elapse between the application of successive coats. Each coat shall vary slightly in shade and this shall be got approved by the EMPLOYER. The number of coats of paint to be applied shall be as specified in the item of work to be prepared by the Contractor.
- 1.30.2.5 All the wood surfaces to be provided with clear finishes shall be thoroughly dry and free from any foreign matter. Surfaces shall be smoothened with abrasive paper using it in the direction of the grains and dusted off. Any slight irregularities of the surface shall be made up by applying an optimum coat of transparent liquid filler and rubbed down with an abrasive paper for obtaining a smooth surface. All dust and dirt shall be thoroughly removed. Over this prepared surface, varnish conforming to IS:337 shall be applied by brushing. Varnish should not be retouched once it has begun to set. Staining if required shall be provided as directed by the EMPLOYER. When two coats of varnish is specified, the first coat should be a hard-drying undercoat or flatting varnish which shall be allowed to dry hard before applying the finishing coat. The number of coats to be applied shall be as specified. For works where clear finish of French polish is specified the prepared surfaces of wood shall be applied with the polish using a pad of woolen cloth covered by a fine cloth. The pad shall be moistened with polish and rubbed hard on

the surface in a series of overlapping circles to give an even finish over the entire area. The surface shall be allowed to dry before applying the next coat. Finishing shall be carried out using a fresh clean cloth over the pad, slight dampening with methylated spirit and rubbing lightly and quickly in circular motions. The finished surface shall have a uniform texture and high gloss. The number of coats to be applied shall be as specified.

1.31 Painting of Steel Work

1.31.1 Materials

- a) Red-oxide – zinc chrome primer shall conform to IS:2074.
- b) Synthetic enamel paint shall conform to IS : 2932.
- c) Aluminium paint shall conform to IS:2339.
- All the materials shall be of the best quality from an approved manufacturer. Contractor shall obtain prior approval of the EMPLOYER for the brand of manufacture and the colour/shade. All the materials shall be brought to the site in sealed containers.

1.31.2 Workmanship

- 1.31.2.1 Painting work shall be carried out only on thoroughly dry surfaces. Painting shall be applied either by brushing or by spraying. Contractor shall procure the appropriate quality of paint for this purpose as recommended by the manufacturer. The workmanship shall generally conform to the requirement of IS:1477 (Part 2).
- 1.31.2.2 The type of paint, number of coats etc. shall be as specified in the respective items of work.
- 1.31.2.3 Primer and finish paint shall be compatible with each other to avoid cracking and wrinkling. Primer and finish paint shall be from the same manufacturer.
- 1.31.2.4 All the surfaces shall be thoroughly cleaned of oil, grease, dirt, rust and scale. The methods to be adopted using solvents, wire brushing, power tool cleaning etc., shall be as per IS:1477 (Part – I) and as indicated in the item of work.
- 1.31.2.5 It is essential to ensure that immediately after preparation of the surfaces, the first coat of red oxide-zinc chrome primer shall be applied by brushing and working it well to ensure a continuous film without holidays. After the first coat becomes hard dry, a second coat of primer shall be applied by brushing to obtain a film free from 'holidays'.
- 1.31.2.6 After the second coat of primer is hard dry, the entire surface shall be wet rubbed cutting down to a smooth uniform surface. When the surface becomes dry, the undercoat of synthetic enamel paint of optimum thickness shall be applied by brushing with minimum of brush marks. The coat shall be allowed to hard-dry. The under coat shall then be wet rubbed cutting down to a smooth finish, taking adequate care to ensure that at no place the undercoat is completely removed. The surface shall then be allowed to dry.



- 1.31.2.7 The first finishing coat of paint shall be applied by brushing and allowed to hard-dry. The gloss from the entire surface shall then be gently removed and the surface dusted off. The second finishing coat shall then be applied by brushing.
- 1.31.2.8 At least 24 hours shall elapse between the application of successive coats. Each coat shall vary slightly in shade and this shall be got approved by the EMPLOYER.

1.32 Flashing

1.32.1 Materials

- 1.32.1.1 Anodised Aluminium sheets shall be 1.00mm thick with anodic film thickness of 0.025 mm. 7.32.1.2 Galvanised mild steel sheets shall be 1.00mm thick with zinc coating of 800 gms/sq.m.
- 1.32.1.3 Bitumen felt shall be either Hessian base self finished bitumen felt Type-3 Grade I conforming to IS:1322 or glass fibre base self finished felt Type-2 Grade 1 conforming to IS:7193.

1.32.2 Workmanship

- 1.32.2.1 The type of the flashing and method of fixing shall be as specified.
- 1.32.2.2 Flashing shall be of the correct shape and size as indicated in the construction Drawings to be prepared by the Contractor and they shall be properly fixed to ensure their effectiveness.
- 1.32.2.3 Flashing shall be of long lengths so as to provide minimum number of joints. The minimum overlap at joints shall be 100mm.
- 1.32.2.4 Fixing of the flashing shall be either by bolting with bitumen washers or by tucking into the groove 75 mm wide x 65 mm deep in masonry/concrete along with cement mortar 1:4 filletting as indicated in the Drawings to be prepared by the Contractor. Curing of the mortar shall be carried out for a minimum period of 4 days.
- 1.32.2.5 Bitumen felt flashing of the type as specified shall be provided with 2 coats of bituminous paint at the rate of 0.10 litre/sq.m after the installation.

1.33 Thermal Insulation For Ceiling

- Thermal insulation shall be “Thermocole” TF type or similar approved or Resin bonded fibre glass boards.

1.33.1 Fixing

1.33.2 “Thermocole” Boards

- 1.33.2.1 Soffit of R.C.Slab shall be thoroughly cleaned with wire brush and 85/25 industrial grade hot bitumen conforming to IS:702 shall be applied uniformly over the surface at the rate of 1.5 Kg/m².
- 1.33.2.2 Thermocole boards (T.F. variety) of 50mm thickness shall be stuck by means



of the same grade of hot bitumen.

1.33.2.3 The boards shall be further secured with screws, washers and plugs.

7.33.2.4 The joints of the boards shall be sealed with bitumen.

1.33.3 Fibre Glass Boards

1.33.3.1 Timber pegs 50mm x 50mm x 50mm shall be fixed to the slab at 600mm centres with 6mm x 65mm long wood screws. 20 gauge G.I. lacing wire shall be tied to the pegs.

1.33.3.2 'Crown' 200 fibre glass boards 50mm thick shall be stuck to the pegs with CPRX compound or any other suitable adhesive and be held in position by the 20 gauge G.I. lacing wires.

1.33.3.3 The insulation boards shall be covered with 20mm – 24 gauge hexagonal G.I. chicken wire mesh, nailed to the timber pegs and 30 gauge aluminium sheets shall be fixed over the chicken wire mesh with 50mm overlap and secured to the timber pegs by screws.

1.33.3.4 If the insulation is specified to rest on top of the false ceiling, it shall be properly installed and anchored to the framework. In case additional battens are required for proper installation, Contractor shall include its cost in the rate for insulation.

1.34 Plaster of Paris Board for False Ceiling

1.34.1 Materials

1.34.1.1 Plaster of Paris Boards

- a) The plaster of paris boards to be used in the false ceiling shall be of an approved manufacture or manufactured at site by methods and materials approved by EMPLOYER.
- b) The plaster of paris shall be of the calcium-sulphate hemi-hydrate variety and shall contain not less than 35 percent sulphur trioxide and other requirements as per IS:2547 (Part I) However, its fineness shall be such that the residue, after drying, and sieving on I.S. sieve designation 3.35mm for 5 minutes shall not be more than 1 percent by weight. Initial setting time shall not be less than 13 minutes. The average compressive strength of plaster determined by testing 5 cm cubes 24 hours after removal from moulds and drying in an oven at 40 Deg. C till the weight of the cubes is constant, shall not be less than 84 Kg per sq.cm.
- c) The plaster of paris boards reinforced with hessian cloth or coir shall be prepared in suitable sizes as shown on the drawings or as directed by EMPLOYER. Wooden forms of height equal to the thickness of boards shall be placed on truly level and smooth surface such as a glass sheet. The edges of the boards shall be truly square. The glass sheet or surface on which form is kept and the form sides shall be given a thin coat of non-staining oil to facilitate the easy removal of the board. Plaster of paris shall be evenly spread into the form upto about half the depth and hessian cloth or coir shall be pressed over the plaster of paris layer. The weight of hessian cloth or coir

in the board shall be 250 gm per sq.m. The ends of the hessian/coir reinforcement shall be turned over at all edges to form a double layer for a width of 50mm. The hessian cloth shall be of an open web texture so as to allow the plaster below and above to intermix with each other and form an integral board. The form shall then be filled with plaster of paris which shall be uniform pressed and then wire cut to an even and smooth surface. The board shall then be allowed to set initially for an hour or so and then removed from the form and allowed to dry and harden for about a week. The board after drying and hardening shall give a ringing sound when struck. The boards shall be true and exact to shape and size and the exposed face shall be truly plane and smooth.

- d) The size of boards shall generally be 600mm x 600 mm x 12 mm thick. Boards shall be kept dry in transit and stored flat in a clean dry place and shall not be exposed to moisture. The boards shall always be carried on edges.

1.34.2 Timber Frame Work

- 1.34.2.1 Timber for frame work of false ceiling grid and hangers shall be of good quality and well seasoned. It shall have uniform colour, reasonably straight and close grains and shall be free from knots, cracks and sapwood. It shall be treated with approved anti-termite preservative as directed by the EMPLOYER. Extreme care shall be taken so that the preservative treatment does not stain the ceiling boards. In case metal hangers are used, these shall be M.S. flats or bars, having two coats of red oxide zinc chromate paint primer, as shown on drawings or as approved by EMPLOYER.

1.34.3 Metal Frame Work

- 1.34.3.1 The metal frame work may be made of sections of light metal, such as anodised aluminium, mild steel or as shown on the drawings. The shape of cross-section shall be such as to facilitate proper suspension and proper fixing of the ceiling boards covering them and shall be structurally sound and rigid.

1.35 Construction

- a) Contractor shall ensure that the frame to support the ceiling is designed for structural strength and the sizes, weight and strength of ceiling boards to be fixed and other loads due to live load, air-conditioning ducts, grills, electrical wiring and lighting fixtures, thermal insulation, etc. as shown on the drawings. Contractor shall also submit a detailed drawing to show the grid work, sizes of grid members, method of suspension, position of openings for air-conditioning and lighting, access doors, etc.
- b) Structural design of timber member for the frame shall be in accordance with IS : 883, and metal sections shall be of appropriate size and thickness and shall be of approved manufacture, all as approved by EMPLOYER.
- c) The false ceiling grid work shall be carried out as per the approved drawings or as

directed by EMPLOYER. In case of timber grid work, the grid work shall consist of teak wood runners of minimum size 60mm deep x 40mm wide along one direction at 1.2m centre to centre and secondary runners of size 50mm deep x 40 mm wide at 60mm centre to centre perpendicular to the main runners.

- d) The timber grid work shall be suspended with the help of wooden hangers or metal hangers at 1.2m centre to centre in both the directions. Wooden hangers shall be adopted for flat R.C. roof slab structures whereas metal hangers for flat R.C. roof or structural steel floors / tresses. Metal hangers shall be fabricated from mild steel / galvanised flats of 35mm x 6mm size or bars of 10mm dia. Threaded at the lower end and anchored securely in the roof concrete or welded to inserts provided on the underside of slabs, beams etc. All M.S. hangers shall be given two coats of red oxide zinc chromate paint primer. In case the roof work is of A.C. sheeting supported on purlins and trusses, hangers shall be suspended from roof steel work. The arrangement of metal hangers shall be such that the level of false ceiling can be adjusted during fixing of the ceiling frame work. The ceiling frame work shall be secured to hangers by means of washers and nuts. The ends of main runners shall preferably be embedded into the masonry work.
- e) The metal frame work when it is anodisedaluminium false ceiling grid system shall consist of aluminium main member of special T-Profile of 38mm x 38mm x 1.5mm thick, interlocking with each other to form frames of various sizes, 600mm x 600 mm or as shown on the drawing. The main members shall be suspended from the roof structures by means of steel hangers as described for timber frame work and supported at the walls by means of anodisedaluminium wall angles.
- f) In the case of timber frame work, all the edges of the plaster of paris board shall be fixed to frame members by means of counter sunk and rust less screws of 2.74 mm size, 40mm long at a spacing of 100mm to 150 mm c/c and 12mm from the edge of the board. Holes for screws shall be drilled and screws slightly countersunk into the boards. The boards shall be fixed to wooden framework with a joint clearance of about 3mm. The joints shall always be in perfect line and plane.
- g) In case of aluminium grid system, boards shall be just placed into the frames formed by the main 'T' members and the cross members fitted with the clips for locking boards. Contractor shall take utmost care so as not to force the boards in position and a slight gap shall be provided so as not to make a tight joint. The boards shall be cut with a saw, if required, to any shape and size.
- h) As the work of false ceiling may be inter-connected with the work of air-conditioning ducts and lighting, Contractor shall fully co-operate with the other agencies entrusted with the above work, who may be working simultaneously . Contractor shall provide necessary openings in the false ceiling work for air-conditioning, lighting and other fixtures. Additional framing, if required, for the above opening shall also be provided at no extra cost to Employer. Removable or hinged type inspection or access trap doors shall be provided at locations specified by EMPLOYER.

1.35.1 Finishing



- 1.35.1.1 It is essential that false ceiling work should be firm and in perfect line and level and all boards free from distortion, bulge, and other defects. All defective boards and other material shall be removed from site immediately and replaced, and ceiling restored to original finish to the satisfaction of EMPLOYER.
- 1.35.1.2 The workmanship shall be of highest order and all joinery work for timber work shall be in the best workmanship manner. The joints for aluminium frame work shall be of inter-locking type so that when the cross member is in place, it cannot be lifted out.
- 1.35.1.3 The countersunk heads of screws and all joints shall be filled with plaster of paris and finished smooth. After filling the joints, a thick skin of the finishing material shall be spread about 50mm wide on either side of the joint and on to it shall be trowelled dry a reinforcing scrim cloth about 10mm wide. If metal scrim is used, a stiffer plaster will be necessary to enable the trowelling of the scrim down to the board.

1.35.2 Fire Stopping

- 1.35.2.1 In case of fire protective ceilings, fire resisting barriers at suitable intervals shall be provided. These shall completely close the gap between the false ceiling and soffit of the structural slab. The material of the barrier shall be as indicated by EMPLOYER (Reference may be made to the British Standards Institutions CP 290: Code of Practice for suspended ceiling and lining of dry construction using metal fixing system, 'for guidance).

1.36 False or Cavity Floor

1.36.1 Frame Work

- 1.36.1.1 The false floor shall consist of a framework of suitable structural member designed to carry the loads specified. This frame work shall be supported on suitably designed stools placed at 600mm centre to centre in both directions. The stools shall consist of a mild steel base plate with a mild steel stud having adjustable lock nut and coupling at the centre and another mild steel plate at top serving as a prophead. The above framework shall be suitably designed to accommodate 35mm thick, 600mm square panels. The base plate shall be fixed to the reinforced concrete floor with an approved adhesive compound or with 4 Nos. 6mm dia. anchor fasteners. Bedding of 1:2 or richer cement sand mortar shall be provided locally under the base plates of stools to provide a level surface.
- 1.36.1.2 The prophead shall be provided with mild steel lugs welded on top and each placed perpendicular to the other for proper positioning and supporting the main and cross members. The stools shall be capable of adjustment to accommodate concrete floor level irregularities upto plus or minus 15mm. The framing members shall be completely removable and shall remain in position without screwing or bolting to the propheads. All steel framework including steel stools shall be given a coat of zinc chromate primer and two



coats of enamel paint of approved colour and shade.

1.36.2 Floor Panels

- 1.36.2.1 The floor panels shall be made of 600mm x 600mm x 35 mm thick medium density unveneered/ non-prelaminated teak wood particle boards having a density of not more than 800 kg/cu.m bonded with boiling water proof phenol formaldehyde synthetic resin and shall be of fire resistant, termite resistant and moisture proof quality, generally conforming to IS:3087-specification for wood particle boards (Medium Density)for general purposes.
- 1.36.2.2 The thermal conductivity of the boards shall not exceed 0.12 kCal/hr/sq.m/deg./C/m.
- 1.36.2.3 The panel size given above may be suitably modified near electrical panel/equipment and also to suit room dimensions with panel size not more than 600mm under any circumstances. Exposed 2mm thick vinyl edging shall be provided on all edges of individual panels. Each panel shall be given a coat or primer and two coats of approved fire resistant paint from underside.
- 1.36.2.4 The particle boards shall be faced with 600mm x 600 mm x 2mm thick approved make flooring tiles conforming to IS:3462 – “Specification for unbacked flexible PVC flooring” and of approved colour and shade. The completed panel shall be completely removable and shall remain in position without screwing or bolting to the on the inner side with stickers for easy identification and reassembly whenever required.
- 1.36.2.5 Suitable backing material shall be provided on the underside of the particle board to prevent warping and / or to cater to specified loading.
- 1.36.2.6 Suitable removable covers shall be provided to serve as outlets for the cables.

1.36.3 Imposed Loading

- 1.36.3.1 The finished floor shall be capable of supporting a uniformly distributed load of 500 to 1000 Kg. per sq.metre of floor area as specified in data sheet. A point load of 450 Kg on 600 sq.mm on any part of the panel or a line load of 725 Kg on 100mm strip across the panel length shall not result in a deflection greater than 2.5mm.z

1.36.4 Finish

- 1.36.4.1 The finished floor shall be true to lines and levels and present a neat flush surface.

1.36.5 Vendor Drawing

- 1.36.5.1 Vendor shall prepare and submit a layout drawing for false floor giving all details including supporting system for approval. If so called for, vendor shall also submit his calculations for the supporting system with all relevant data assumed, to the EMPLOYER for his approval. Work shall be carried out on approved drawings only.



1.37 Fire Proof Doors

1.37.1 Material and Workmanship

- 1.37.1.1 The design of fire proof doors and the materials to be used in their fabrication have to be such that they shall be capable of providing the effective barrier to the spread of fire. The materials, fabrication and erection of fire proof doors shall confirm to IS:3614 (Part – I). The fire proof doors shall be obtained from an approved manufacturer. Specific approval for such purchase shall be obtained before hand. Sample approval shall also be obtained from testing authority as per the standard IS : 3614 (Part – 2) for the specified degree of fire rating in hours. All fire proof doors shall have specified sizes and confirm to the description in the respective items of work.
- 1.37.1.2 Fire proof door shutters shall be of zinc coated weldable steel (confirming to BS:6687) or stainless steel (conforming to IS:304) sheet (18G minimum) fixed in a frame work of rolled channel. The shutter shall consist of an insulating material like mineral wool in required thickness to satisfy the specified fire rating. Normally the thickness of door shutter shall not be less than 35mm for two hour fire rating and 46 mm for four hour fire rating.
- 1.37.1.3 The shutter with the required insulating material shall be mounted on angle iron frame or the special made frame from zinc coated (16G minimum) weldable steel sheet. The shutter shall be fixed to frame by means of suitable hinges and shall have a three way latching system. All the doors shall be provided with a coat of primer and one coat of synthetic enamel paint to attain the specified fire rating. All other accessories like hinges, door lock, hold fasts, etc. shall be provided as approved by TAC (Tariff Advisory Committee). All these accessories shall be compatible with the material used for door and shutter.

C.C Pavement (Road)

- Road shall consist of the following :
 - a) Well compacted 300 mm thick sub-grade layer.
 - b) Providing and laying 150 mm thick PCC in 1:2:4
 - c) Providing and laying 250 mm thick Concrete in M 25
 - d) TMT /Mild steel Reinforcement 200 mm c/c
 - e) Providing and applying Trimix with dewatering machine and floater machine
 - f) Groove Cutting & Filling with polysulfide selant
- All the material shall confirm to the relevant Specification/ as per MORTH section 1000 Item of PCC ,RCC& TMT/Mild steel shall be executed as per relevant specification/

MoRTh Specification

- P/A Trimix with dewatering machine and floater machine on constructed Pavement
- The purpose of vacuum processing is the removal of surplus water from the concrete to provide quicker setting & earlier maximum strength properties. Vacuum dewatering takes place immediately after the screeding operation.
- Upon the surface of the wet concrete is placed a filler pad consisting of two layers. The bottom layer in contact with the concrete is the fine nylon cloth to act as filler. The upper layer consists of a special type of plastic net & acts as a water duct. Finally the top cover consisting of a light plastic sheet is placed over the filler pad projecting slightly outside on all sides. The border of the top cover rests directly upon the wet concrete to produce an airtight seal.
- The suction net is connected with suction hoses to a vacuum pump. The normal atmospheric pressure in the pump is reduced by 90% & 90% of the atmospheric pressure compresses the concrete.

Concrete is submitted to a pressure of Air pressure .1N / mm²

Depression .01N/mm²

= Effective pressure .09 N/ mm²

- This pressure of about 9000 kp/m² compresses the concrete & compacts the aggregates. At the same time the excess water which not necessary for the hydration process of the cement is extracted from the concrete & consciously discharged with the air.
- Apart from normal compaction through vibration, static compaction takes place during vacuum dewatering with ensuring reduction w/c ratio. The initial w/c/ ratio is reduced by 10 to 20%. This explains the noticeable improvements of the concrete properties achieved through vacuum dewatering.
- Vacuuming time is about 1 to 2 min. per cm concrete thickness depending on the particle shape in the mix. M250
- One vacuum pump with two suction net can dewater 50 to 60 m². A 20 cm thick concrete slab takes about 30 min. dewater. Accordingly a normal daily production rate is about 400 m².
- Making groove in Pavement and filling it with polysulfide sealant

General

- All joints in surface slabs shall be sealed using polysulfide sealant. Joints shall not be sealed before -14 days after construction.

Preparation of joint grooves for sealing

- Joint grooves usually are not constructed to provide the minimum width specified in the drawings when saw cut joints are adopted. They shall be widened subsequently by sawing before sealing, depth/width gauges shall be used to control the dimension of the groove.
- If rough edges develop when grooves are made, they shall be ground to provide a chamfer approximately 5 mm wide. If the groove is at an angle upto 10 degree from the perpendicular to the surface, the overhanging edge of the sealing groove shall be sawn or ground perpendicular. If spalling occurs or the angle of the former is greater than 10

degrees, the joint sealing groove shall be sawn wider and perpendicular to the surface to encompass the defects upto a maximum width, including any chamfer, of 35 mm for transverse joints and 20 mm for longitudinal joints. If the spalling cannot be so eliminated then the arrises shall be repaired by an approved thin bonded arris repair using cementitious materials.

- All grooves shall be cleaned of any dirt or loose material by air blasting with filtered, oil-free compressed air. If need-arises the Engineer may instruct cleaning by pressurised water jets. Depending upon the requirement of the sealant manufacturer, the sides of the grooves may have to be sand blasted to increase the bondage between sealant and concrete.
- The groove shall be cleaned and dried at the Lime of priming and sealing.
- Before sealing the temporary seal provided for blocking the ingress of dirt, soil etc., shall be removed. A highly compressible heat resistant paper-backed debonding strip as per drawing shall be inserted in the groove to serve the purpose of breaking the bond between sealant and the bottom of the groove and to plug the joint groove so that the sealant may not leak through the cracks. The width of debonding strip shall be more than the joint groove width so that it is held tightly in the groove. In the case of longitudinal joints, heat resistant tapes may be inserted to block the leakage through bottom of the joint.

Sealing with sealants

- When sealants are applied, an appropriate primer shall also be used if recommended by the manufacturer and it shall be applied in accordance with their recommendation. The sealant shall be applied within the minimum and maximum drying times of the primer recommended by the manufacturer. Priming and sealing with applied sealants shall not be carried out when the naturally occurring temperature in the joint groove to be sealed is below 7° C.
- If hot applied sealant is used it shall be heated and applied from a thermostatically controlled, indirectly heated preferably with oil jacketed melter and pourer having recirculating pump and extruder. For large road projects, sealant shall be applied with extruder having flexible hose and nozzle. The sealant shall not be heated to a temperature higher than the safe heating temperature and not for a period longer than the safe heating period, as specified by the manufacturer. The dispenser shall be cleaned out at the end of each day in accordance with the manufacturer's recommendations and reheated material shall not be used.
- **Cold applied sealants with chemical formulation like polysulphide may be used. These shall be mixed and applied within the time limit specified by the manufacturer. If primers are recommended they shall be applied neatly with an appropriate brush. The Movement Accommodation Factor (MAP) shall be more than 10 per cent.**
- The sealants applied at contraction phase of the slabs would result in bulging of the sealant over and above the slab. Therefore, the Contractor in consultation with the Engineer, shall establish the right temperature and time for applying the sealant. Thermometer shall be hung on a pole in the site for facilitating control during the sealing operation.



- Sealant shall be applied, slightly to a lower level than the slab with a tolerance of 5 ± 2 mm.
- During sealing operation, it shall be seen that no air bubbles are introduced in the sealant either by vapours or by the scaling process.
- **Testing of applied sealants:** Manufacturer's certificate shall be produced by the Contractor for establishing that the sealant is not more than six months old and stating that the sealant complies with the relevant standard as in Clause 602.2.8. The samples shall meet the requirement of AASHTO M 282 for hot applied sealant or BS 5212: (Pan-2) for cold applied sealant.

Defect Liability Period - PENALTY

If contractor fails to do Breakdown Maintenance, then below penalty will be applicable and it will be deducted from Running Bill and/or Security deposit/performance guarantee/Retention money of Agency.

Sr. No.	Description	Penalty applicable period	Penalty amount
1	Breakdown of any installed equipment	After 1 week of intimation/breakdown of any equipment	10,000/- per week

Note: Intimation will be provided by call/ message/mail/ written and all will be considered valid.

- 1) If contractor fails to attend any kind of defect during DLP/AMC Period, VMC reserves the rights to execute the same with cost and risk of other contractor. The amount of the same work will be recovered from the Running Bill and/or Performance guarantee/Security deposit and/or retention money.

19.0 APPROVED VENDOR LIST

APPROVED VENDOR LIST FOR CIVIL ITEMS

SR. NO.	MATERIAL / WORK	SUPPLIER / MANUFACTURER / VENDOR / AGENCY
1	CEMENT (OPC) 43 GRADE / 53 GRADE	ULTRATECH / ACC / JK LAXMI / AMBUJA / BINANI / SIDDHI / KAMAL / CORAMANDEL / BIRLA SUPER., JK CEMENT LTD
2	CEMENT (SRC)	ULTRATECH / ACC / JK LAXMI / AMBUJA / BINANI / SIDDHI / KAMAL / CORAMANDEL / BIRLA SUPER,
3	CEMENT (WHITE)	BIRLA / JK / ULTRATECH
4	CEMENT (PPC)	ULTRATECH / ACC / JK LAXMI / AMBUJA / BINANI / SIDDHI / KAMAL / CORAMANDEL / BIRLA SUPER., JK CEMENT LTD
5	RMC	ULTRATECH, JK LASKHMI, LAFARGE INDIA LTD
6	BRICKS	ORDINARY BURNT CLAY BRICKS OF ANY BRAND CONFORMING TO IS: 1877 WITH MINIMUM CRUSHING STRENGTH OF 40 KG / CM ² AND WATER ABSORPTION RATIO RESTRICTED TO 25% FOR BRICKS USED IN PANEL



SR. NO.	MATERIAL / WORK	SUPPLIER / MANUFACTURER / VENDOR / AGENCY
		WALLS AND 20% FOR BRICKS USED IN LOAD BEARING WALLS
7	MILD / TOR STEEL / CRS STEEL	TISCO / SAIL / TATA / ELECTRO THERM / HYTUFF / NATIONAL
8	STRUCTURAL STEEL	SAIL / TATA IRON STEEL CO. LTD / JINDAL / ESSAR STEEL LTD / ISPAT LTD / ELECTROTHERM.
9	CERAMIC TILES	SPARTEX / KAJARIA / NITCO / JOHNSONS / PEDDER
10	GLAZED TILES (1 ST QUALITY)	H & R JOHNSON / KAJARIA / SPARTEX / NAVEEN / ROMMANO / SOMANIPILKINGTM / ECL
11	GRANITE TILES	BELL GRANITO / NAVEEN / H & R JOHNSON / RAK CERAMICS – DUBAI / RESTILE CERAMIC
12	GLASS MOSAIC TILES	BISAZZA INDIA / PINOBISAZZA
13	PAVER BLOCKS	CONWOOD PREFAB / HINDUSTAN PREFAB OR EQUIVALENT/VYARA
14	ADHESIVES	PIDILITE / FAIRMATE / BAL ADHESIVE / MC BAUCHEMIE / CEMENTONE INDIA / FOSROCK / SUNANDA SPECIALITY COATING
15	MS DOOR FRAMES & SHUTTERS (WITH GALVANISING)	AGEW / FERROSTEEL / SENHARVIC / WELDOORS
16	DOOR SHUTTERS (WOODEN)	KUTTY / ANCHOR / CLASSIC / GOYAL / TIMBER TECHNIKS / SEJPAL DOORS / WOOD DESIGNS / NORTHERN DOORS
17	DOOR SHUTTERS (FRP) & PLASTIC	EVEREST FIBRE GLASS INDUSTRIES / UNIPALS INDIA / ADVANCE MARKETING / YASHASHRI POLY EXTRUSION / SINTEX
18	HARDWARE (HANDLES / HINGES / MORTICE LOCKS)	SOBEET / VIJAYAN / NAVBHARAT BRASS WORKS / CIEF / AMARBHOY DOSSAJI
19	ALUMINIUM WINDOWS	ALUMINITE / ALUPLEX / ALMECH / INDRAJIT ASSOCIATES / ALDOWEIT / CRYSTAL CORPORATION / INDAL / JINDAL / AJIT INDIA
20	NIGHT LATCH	GODREJ / SOBEET
21	PAINTS:	
	A. INTERNAL	SNOWCEM / ASIAN / ICI / BRITISH PAINTS / SHALIMAR / NEROLAC / BURGER / JENSON & NICHOLSON
	B. EXTERNAL	SNOWCEM / ASIAN / ICI / BRITISH PAINTS / SHALIMAR / NEROLAC / BURGER / JENSON & NICHOLSON
22	SYNTHETIC PLASTER FINISH	NITCO / ACCRO / DAMANI DYE STUFF / SUPREME / RENOVA
23	WATERPROOFING WORKS	INDIA WATERPROOFING CO. / LIKPROOF INDIA / OVERSEAS WATER PROOFING CO.
24	WATERPROOFING COMPOUND	ACCOPROOF / PEDIPROOF / CICO / IMPERMO / VAMIPLAS 302 / VAMIPROOF 101 & 102
25	GLAZING	FLOAT GLASS OF MODI / ASAHI / SAINT GOBAIN
26	M.S. ROLLING SHUTTERS	SWASTIK / STANDARD / SHUDWAR
27	ALUMINIUM GRILLS	DECO / ALUMNIGRILLE
28	ALUMINIUM JOINERY	CRYSTEL CORPORATION / ALUMLITE / ALUPLEX / ALM
29	ANTI-STRIPPING AGENT	YUVA / BE 100



SR. NO.	MATERIAL / WORK	SUPPLIER / MANUFACTURER / VENDOR / AGENCY
30	CHEMICAL ADMIXTURES AND COMPOUNDS FOR RCC AND MORTAR	MC BAUCHEMIE / KRISHNA CONCHEM PRODUCTS / SUNANDA CHEMICALS / PIDILITE / FAIRMATE / FOSROC / SIKQUALCRETE / THERMAX
31	ANTI-CORROSIVE PAINT	KRISHNA CONCHEM PRODUCTS / CICO CHEMISOL ADHESIVE / BURGER
32	CAST IRON COVERS	RIFCO / MOHIT STEEL / ASHOK IRON WORKS / JAYSWAL NECO

APPROVED VENDOR LIST FOR MECHANICAL EQUIPMENT

Sr. NO.	MATERIAL / WORK	SUPPLIER / MANUFACTURER / VENDOR / AGENCY
1	NON-RETURN VALVES (SINGLE / MULTIDOOR) / DUALPLATECHECK VALVES, AIR VALVE	KIRLOSKAR / IVC / IVI / VAG /AVK VALVES / JUPITER / HAWA ENGINEERS LTD / R & D MULTIPLES
2	HOT / EOT CRANE, ELECTRIC HOIST	MORRIS / INDEF / SAFEX / JAPS / KHODIYAR ENGINEERS, ANKER, W H BRADY
3	EXPANSION BELLOWS	DHRUV/ PRECISION/ TECHNOFLEX/ PRECISE ENGG. / FLEXICAN BELLOWS & HOSES/ FLEXPART BELLOWS/ SUR INDUSTRIES (SURFLEX) / ATHULYA BELLOWS / STANFAB ENGINEERING

APPROVED VENDOR LIST - ELECTRICAL EQUIPMENT/COMPONENT

SR. No	ITEMDESCRIPTION	APPROVED MAKE
1	MV SWITCHBOARD & SWITCHGEAR MV- 11/ 33KV- INDOOR/ OUTDOOR TYPE (VCB/SF6)	ABB/ CGL / JYOTI / LAURITZ KNUDSEN/ SCHNEIDER/SIEMENS/AUTH. SYSTEM INTEGRATOR FOR HERE IN APPROVED MAKE OF OEM
2	RING MAIN UNIT (RMU) MV - 11 / 33kv - INDOOR / OUTDOOR TYPE (VCB/SF6)	ABB / SCHNEIDER / SIEMENS / CG/ C&S / AUTH. SYSTEM INTEGRATOR FOR HERE IN APPROVED MAKE OF OEM Note: System Integrator to furnish necessary certificate of authorization.
3	PROTECTIVE RELAY (NUMERICAL TYPE)	ABB/ALSTOM /CGL/GE/LAURITZ KNUDSEN/SCHNEIDER/SIEMENS / C&S/ CSPC
4	PROTECTIVE/AUXILLARY RELAYS (ELECTROMECHANICAL TYPE)	ABB/ALSTOM /C&S / CSPC/EASUN REYROLLE/GE/LAURITZ KNUDSEN/ SCHNEIDER/SIEMENS
5	ELECTRONIC CIRCUIT RELAY	ALLENBRADLEY/OEN/OMRON/PLA
6	INSTRUMENT TRANSFORMERS (CT/ PT)	AEP/ASHMOR/AUTOMATIC ELECTRIC/CGL/CONTROL &SWGR/ECS/GILBERT AND MAXWELL/INDCOIL/JYOTI/ KAPPA/PRAGATI/PRECISE/SILKAANS / SEI
7	L.V. SWITCHBOARD- DRAWOUT/FIXEDTYPE (PCC/PMCC/MCC/ MLDB/APFC)	ALPHANIPPON/ELEMBICA/ELEMECH/ GSONSPower/HORIZON/INDUSTRIAL CONTROLS/PATEL BROTHERS/POSITRONICS/POWER & INSTRUMENTATION (O) LTD./SUN AUTOMAT/SWATI SWITCHGEAR/HIGH VOLT/M.D. INDUSTRIES/ Expel Prosys / NUTRAL POWER TECH.



8	THERMAL/MICROPROCESSOR BASED MCCB	ABB/C&S/LAURITZ KNUDSEN /SCHNEIDER/SIEMENS / LEGRAND / BCH
9	SOFT STARTER (MICROPROCESSORBASED)	ABB/DANFOSS/LAURITZ KNUDSEN/ROCKWELL/SCHNEIDER/SIEMENS
10	LV CAPACITORS/ POWERCAPACITOR	ABB / EPCOS / HAVELLS/ ASIAN / CGL / KHATAU JUNKER / MADHAV / MALDE / NEPTUNE / SCHNEIDER / UNIVERSAL/ SHREEM/PRABODHAN/ SUBODHAN / POWER MATRIX/SIEMENS/VISHAY / LAURITZ KNUDSEN / BCH
11	MICROPROCESSOR BASED MOTOR PROTECTION RELAY WITH RS485	C&S/ABB/LAURITZ KNUDSEN/SCHNEIDER/SIEMENS / BCH / CSPC
12	AC/DC POWER & AUXILIARY CONTACTOR	ABB / BCH / C & S / LAURITZ KNUDSEN/ SCHNEIDER/ SIEMENS /INDOASIAN
13	BI- METAL/ELECTRONIC/MICROPRO CESSOR BASEDOVERLOAD RELAY	ABB / C&S/ GE / LAURITZ KNUDSEN/ SCHNEIDER / SIEMENS/CSPC/ALSTOM/CG/BCH
14	THERMISTOR RELAY	ALSTOM /INSTACONTROLS/MINILEC / SELEC
15	SINGLE PHASING PREVENTER WITH UV/OV PROTECTION	ABB / C&S / GEC / LAURITZ KNUDSEN/ SCHNEIDER / SIEMENS/CSPC/ALSTOM/CG / MINILEC
16	TIME SWITCH	MINILEC/ LAURITZ KNUDSEN/SCHNEIDER / SIEMENS / LEGRAND / GIC
17	TIMERS/TIME DELAY RELAY	BCH/EAPL/L&T/LEGRAND/MINILEC/OMRON/PLA/ SCHNEIDER /SIEMENS / TEKNIC / LAURITZ KNUDSEN / GEC
18	BATTERY CHARGER & DCDB	AMARARAJA/AMCOPOWER/AUTOMATIC ELECTRIC/ CHHABIELECTRICALS/EXIDE/ HBL POWER SYSTEMS / HIREL-HITACHI / MASS-TECH CONTROLS/UNIVERSALINSTRUMENTS / SERVI LINK / ELECTRONIC SYSTEMS
19	LIGHT FIXTURES	BAJAJ/CGL/HAVELLS/PHILIPS/SURYA/ WIPRO
20	CABLES H.V.- XLPE INSULATED	HAVELLS/ KEI/ POLYCAB /GLOSTER / RPG CABLES (KEC INTERNATIONAL) / TORRENT CABLES/UNIVERSAL CABLES
21	LT POWER & CONTROL CABLES/EARTHING CABLES	HAVELLS/ KEI/ POLYCAB /GLOSTER / RPG CABLES (KEC INTERNATIONAL) / TORRENT CABLES/UNIVERSAL CABLES
22	WIRES-FLEXIBLES(ALLTYPES)	HAVELLS/ KEI/ POLYCAB /GLOSTER / RPG CABLES (KEC INTERNATIONAL) / TORRENT CABLES/UNIVERSAL CABLES/ RR CABLE / FINOLEX/ ANCHOR
23	LIGHTING/SMALL POWER DISTRIBUTION BOARDS/ ENCLOSURES	ABB/BCH/C&S/HENSEL/INDO ASIAN/LAURITZ KNUDSEN/LEGRAND/ RITTAL /SCHNEIDER/SIEMENS/ HAVELLS/ STANDARD ELECTRIC /ALL LV PANEL VENDORS
24	MCB, RCCB, RCBO/MCB ISOLATORS	ABB/C&S/INDOASIAN/LAURITZ KNUDSEN/LEGRAND/SCHNEIDER/SIEMENS/HAVELLS



		/BCH
25	MPCB	ABB/C&S/LAURITZ KNUDSEN/SCHNEIDER/SIEMENS/ BCH
26	ALARM ANNUNCIATORS (SOLIDSTATE TYPE WITH LED ILLUMINATION)/FACIA ANNUNCIATOR	ALSTOM/DIGICONT/ICA/IICP/MINILEC/PROCONINST. (P) LTD/PROTONELECTRONICS/APLAB / MULTISPAN
27	DECORATIVE/MODULAR SWITCH & SOCKET	ABB/ANCHOR/CRABTREE/LAURITZ KNUDSEN/LEGRAND/ MK- HONEYWELL/SIEMENS/SCHNEIDER/ C&S
28	CEILING/WALL MOUNTING/EXHAUST/PEDESTAL FAN	ALMONARD/BAJAJ/CGL/HAVELLS/KHAITAN/ORIENT/ USHA / ATOMBERG
29	CABLE TERMINATION/ JOINTING KIT	3M/MSEAL/RAYCHEM/XICOM/ DELTON
30	CONTROL/SELECTOR SWITCH	ABB/BCH/HAVELLS/ KAYCEE/LAURITZ KNUDSEN /C & S / SCHNEIDER/SIEMENS/RECOM/SULZER/
31	INDICATING LAMPS	BCH/LAURITZ KNUDSEN /SCHNEIDER/SIEMENS/TEKNIC CONTROLS/ VAISHNO/IEC/EE/C&S
32	TERMINAL BLOCK/CONNECTORS	CONNECTWELL/ELMEX/PHEONIX/ TELEMECHANIQUE/ WAGO
33	CONSTANT VOLTAGE TRANSFORMER/ CONTROL TRANSFORMER	AE/ASHMORE/G&M/INDCOIL/NEC/PRAGATI/PRECISE /SILKAANS / KAPPA / SEI
34	SEMICONDUCTOR FUSE	BUSSMANN/FERRAZ/GE/SIEMENS
35	HRC FUSE (POWER & CONTROL)	ABB / C&S / L & T /SCHNEIDER / SIEMENS / TECHNOELECTRIC/INDOASIAN/GE
36	PUSHBUTTONS	BCH/LAURITZ KNUDSEN /RASS(C&S)/ SCHNEIDER/ SIEMENS/ TEKNIC/ VAISHNO
37	PUSHBUTTON STATIONS/ JUNCTION BOX (FOR CASTALUMINIUM ONLY)	BALIGA/BCH/CEAG/EXPROTECTA/FCG/FLEXPRO/ /HENSEL/PUSTRON/SCHNEIDER/SIEMENS/ SUDHIR/EXCEL / C&S / KAYCEE / SALZER
38	NONMETALLIC ENCLOSURES (INCLUDING INDUSTRIAL RECEPTACLES/PB STATION)	BCH / HENSEL / LEGRAND / PUSTRON / RITTAL / SCHNEIDER/SIEMENS/SINTEX / C&S / SUMIP
39	DIGITAL AMMETER/VOLTMETER/POWERF ACTORMETER	AE/KRYKARD/LAURITZ KNUDSEN /MASIBUS/RISHABH/SCHNEIDER/ SECURE/NIPPEN/ASIAN/SIEMENS/IMP/MECO/ CONZERV/NEWTEKELECTRICALS / C&S / SELEC / ABB / MULTISPAN
40	TEMPERATURE SCANNER WITH RS485 MODBUS COMMUNICATION	MASIBUS/NIVAM/NISHKO/ELECTRONET/REDIX/MULTIS PAN
41	ELECTRO MECHANICAL METERS-AMMETER & VOLTMETER	AE/IMP/MECO/RISHABH / SELEC / NIPPEN / SECURE / CONZERV / MULTISPAN
42	KWH/LOADMANAGER/MULTIFUN CTION METER	ABB/KRYKARD/LAURITZ KNUDSEN/SCHNEIDER/RISHABH/SECURE/ IMP/MECO/CONZERV/ENERCON / C&S / SELECT /



		NEWTEK / MULTISPAN
43	CABLE LUGS	3D/COMET/CONNECTWELL/DOWELLS/JAINSON/3M
44	CABLE GLANDS (SINGLE /DOUBLE COMPRESSION, NI-PLATTED BRASS)	BALIGA/BRACO/COMET/ELECTROMECH /EX-PROTECTA / FCG/HMI/JAINSON
45	CABLE GLANDS-POLYAMIDE	FIBOX/GEWISS/HENSEL/LAPP
46	UN INTERRUPTED POWER SUPPLY(UPS)	EMERSON/FUJI /HITACHI/SCHNEIDER/ VERTIV /NUMERIC-LEGRAND
47	GI CABLE TRAYS	GLOBE / INDIANA / LEGRAND /M.M. ENGINEERING /SHARDA/SILVERLINE POWER/ SHREE KRISHNA/JETCO TECH/SUPER ELECTRO/ PATEL SCREEN INDUSTRIES/ RAMDEV STEEL INDUSTRIES (STALWART)
48	PVC/ UPV CONDUIT & ACCESSORIES	AKG/CLIPSAL/POLYCAB/PRECISION /ASTRAL / PLASTO / FINOLEX
49	MS/GI CONDUIT & PIPES	BECINDUSTRIES/JINDAL/JKTUBE/SAIL/TATASTEEL/ ZENITH / ASIAN
50	SMF/VRLA/NI-CD/LEAD ACID (PLANTE/ TUBULAR) BATTERY	AMCO / EXIDE / HBL POWER SYSTEMS LTD./ AMARON
51	MS/GI LIGHTING POLES & BRACKETS (TUBULAR SWAGED /OCTAGONAL)	AMBICA ENGINEERING / BAJAJ /GAYATRI ELECTRICALS/SHAKTI POLES/SURYA/SHREE KRISHNA/ UTKARSH INDIA/FABIRON / JETCO TECH
52	BATTERY BACKED POWERPACK	ALAN/G'LEC/GIRISH/GOGATE
53	ALUMINIUM BUSBAR MATERIAL	BANCO/HINDALCO/JINDAL
54	PANEL CRCA/MS/GI PLATES & SHEET	ESSAR/TATA/JINDAL/SAIL
55	CHEMICAL TYPE EARTHING INCLUDING COPPER BONDED ELECTRODE & BACK FILL COMPOUND	ASHLOK/ECOTECHNOLOGY & PROJECTS/ENNOV INFRA/ ERICO/ISG GLOBAL/ PRAGATI ELECTROCOM/SAARA EARTHING/JETCO TECH/ AXIS / JSR / POWERTRAC /SHREE KRISHNA
56	MODULE TYPE PLUG SOCKET	ANCHOR/HAVELLS/CLIPSAL/TOYAMA/MDS / LAURITZ KNUDSEN / C&S / SEIMENS / SCHNEDER
57	SOLAR PANEL & IT'S ACCESSORIES	AS PER APPROVED VENDOR BY GEDA/ALMM.
58	CCTV	SIEMENS, GE, HONEYWELL, GODREJ, ZICOM, CP PLUS, BOSCH, PANASONIC, MATRICS, AXIS
59	PC(Computer)	SAMSUNG, HP, DELL, LENOVO
60	LED Display	SAMSUNG, SONY, PANASONIC, LG, TOSHIBA

Signature of Tenderer(s) with the seal of the firm.



SECTION - 6
FORM OF BID



FORM OF BID

Description of the Works:

BID

To :

Address :

1. We offer to execute the Works described above and remedy any defects therein in conformity with the conditions of Contract, specification, drawings, Bill of Quantities and Addenda for the sum (s) of

(-----)

2. We undertake, if our Bid is accepted, to commence the Works as soon as is reasonably possible after the receipt of the Engineer's notice to commence, and to complete the whole of the Works in the Contract within the time stated in the document.
3. We agree to abide by this Bid for the period of 120 Days from the date fixed for receiving the same, and it shall remain binding upon it and may be accepted at any time before the expiration of that period.
4. Unless and until a formal Agreement is prepared and executed this Bid, together with your written acceptance thereof, shall constitute a binding contract between us.
5. We understand that you are not bound to accept the lowest or any tender you may receive.

Dated this -----day of 20

Signature ----- in the capacity of -----

----- duly authorized to sign bids for and on behalf of -----

(in block capitals or typed)



Address

Witness

Address

Occupation



SECTION - 7
BILL OF QUANTITIES

BILL OF QUANTITIES

Preamble

1. The bill of Quantities shall be read in conjunction with the Instructions to Bidder, Conditions of Contract, Technical Specifications and Drawings.
2. The quantities given in the Bill of Quantities are estimated and provisional, 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 priced Bill of Quantities, where applicable, and otherwise at such rates and prices as the Engineer may fix within the terms of the Contract.
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, layout, supervision, materials, erection, maintenance, insurance, profit, taxes and duties, together with all general risks, liabilities and obligations set out or implied in the Contract.
4. The rates and prices shall be quoted entirely in Indian Currency.
5. A rate or prices shall be entered against each item in the Bill Quantities, whether quantities are stated or not. The cost of Items against which Contractor has failed to enter a rate or price shall be deemed to be covered by other rates and prices entered in the Bill of Quantities (in case of Item rate contract).
6. The whole cost of complying with the provisions of the Contract shall be included in the items provided in the priced Bill of Quantities, and where no Items are provided the cost shall be deemed to be distributed among the rates and prices entered for the related items of Work.
7. General direction and descriptions of work and materials are not necessarily repeated or summarized in the Bill of Quantities. References to the relevant sections of the contract documentation shall be made before entering rates or prices against each item in the Bill of Quantities.
8. The method of completed work of payment shall be in accordance with the specification for Road and Bridge works. For building works specifications for building are to be followed.
9. Errors will be corrected by the Employer for any arithmetic errors pursuant to **Clause 29** of the Instructions to Bidder.
10. Rock is defined as all materials which, in the opinion of the Engineer, required blasting, or the use of metal wedges and sledgehammers, or the use of compressed air drilling for its removal, and which cannot be extracted by ripping with a tractor of at least 150 kw with a single rear mounted heavy duty ripper.



BILL OF QUANTITIES

(A) Percentage Rate Tender (Up to INR 50 Cr.)

Item No	Description of Item (with brief specification and reference to book of specifications)	Quantity	Unit	Rate In figures	Amount

I/We am/are willing to carry out the work at..... % above/below percent(Should be written in figures and words) of the estimated rate mentioned above. Amount of my /our tender works out as under.

Estimated amount put to tender

Deduct.....% below

Net

In words

Estimated amount put to tender

Add.....% Above

Net

In words

~~(B) For Item Rate Tender (For above INR 50 Cr.):~~

Item No	Description of Item (with brief specification and reference to book of specifications)	Quantity	Unit	Rate		Amount
				In figures	In Words	

~~(A) Total Tendered Amount~~

~~(B) Rebate on above tendered amount (if any) % (in figure)~~



(in words).....

(C) Net Tendered Amount (A - B) (in figure)

(in words).....

#

1	The Contractor shall exhibit a board with detailed specification and details of work as directed by the Engineer-In-Charge for which no extra payment shall be made.(for works greater than 5 Lakhs). The Board shall mention Address, Phone number and Fax Number of Executive Engineer of department of which work is ongoing. 1% of contract value shall be put up on hold until contractor do not install board and provide photographs. The work where length is more then such boards shall be placed at starting and ending and if required in middle.
2	The labour cess will be deducted as per prevailing rules i.e. 1% of the work done.
3	GST and Income tax TDS will be deducted at a source while making payments of bills as per prevailing act and rules.
4	In all R.C.C. Items in Rate Analysis Standard Cement Consumption has been taken as per Govt. G.R.: PRC 10/2017 Cement Consumption/16/C Date:11/05/2017 as stated in S.O.R. therefore in R.C.C. items where there is a change as per actual mix design the cost of difference of cement consumption have been deducted from the rate of original item at the rate of input rate mentioned in all the tender.



SECTION - 8

SECURITIES AND OTHER FORMS



BID SECURITY (BANK GUARANTEE)

WHEREAS, ----- (name of Bidder) (hereinafter called the "The Bidder") has submitted his bid Dated ----- (Date) for the construction of -----
-- (Name of Contractor hereinafter called "the Bid")

KNOW ALL PEOPLE by these presents that We -----

(name of Bank) of----- (name of country) having
our registered ----- office at -----
----- (hereinafter called "the bank") are bound unto -----
----- (name of Employer) (hereinafter called "The Employer") in the sum of* for
which payment well and truly to be made to the said Employer the Bank itself, his successors
and assigns by these presents.

SEALED with the Common Seal of the said Bank this ----- day of 20

THE CONDITIONS of these obligations are:

(1) If after Bid opening the Bidder withdraws his bid during the period of Bid validity specified
in the Form of Bid;

Or

(2) If the Bidder has been notified of the acceptance of his bid by the Employer during the
period of Bid Validity:

A Fails or refuses to execute the Form of Agreement in accordance with the Instructions to
Bidders, if required; or

B. Fails or refuse to furnish the Performance Security, in accordance with the Instructions to
Bidders; or

C. does not accept the correction of the Bid Price pursuant to Clause 27 (Correction of Errors)

We undertake to pay to the Employer up to the above amount upon receipt of his first written
demand, without the employer having to substantiate his demand, provided that in his demand
the Employer will note that the amount claimed by him is due to him owing to the occurrence
of one or any of the three conditions, specifying the occurred conditions or conditions.

This Guarantee will remain in force up to and including the date

-----*

*days after the deadline for submission of Bids as such the deadline is stated in the Instructions
to Bidders or as it may be extended by the Employer, notice of which extension (s) to the Bank
is hereby waived. Any demand in respect of this guarantee should reach the Bank not later than
the above date



DATE -----

SIGNATURE-----

-

WITNESS -----

SEAL-----

-

(Signature, name and address)

* The Bidder should insert the amount of the guarantee in words and figures denominated in Indian Rupees. This figure should be the same as shown in Clause 16.1(Bid Security) of the Instructions to Bidders.

****45 days** after the **end of the validity period** of the Bid. Date should be inserted by the Employer before the Bidding documents are issued.



PERFORMANCE SECURITY

TO,

----- (Name of Employer)

----- (Address of Employer)

WHEREAS----- (name and address of contractor)
(hereafter called "the Contractor") has undertaken, in pursuance of Contracts No. -----
----- dates ----- to execute ----- (name of Contract and brief
description of Works) (hereinafter 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 recognized bank for the sum specified therein as security for compliance with his obligation in accordance with the Contract.

AND WHEREAS we have agreed to give the Contractors 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 types and proportions of currencies in which the Contract prices 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 your demand for the sum specified therein.

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

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

This guarantee shall be valid until 60 days from the date of expiring of the Defect Liabilities period.

Signature and Seal of the guarantor -----

Name of Bank -----

Address-----

Date-----

*An amount shall be inserted by the Guarantor, representing the percentage the Contract price specified in the Contract denominated in Indian Rupees.



ADDITIONAL PERFORMANCE SECURITY

[Clause 34.1. (A)]

TO,

----- (Name of Employer)

----- (Address of Employer)

WHEREAS----- (name and address of contractor)
(hereafter called "the Contractor") has undertaken, in pursuance of Contracts No. -----
----- dates ----- to execute ----- (name of Contract and brief
description of Works) (hereinafter 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 recognized bank for the sum specified therein as security for compliance with his obligation in accordance with the Contract.

AND WHEREAS we have agreed to give the Contractors 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 types and proportions of currencies in which the Contract prices 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 your demand for the sum specified therein.

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

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

This guarantee shall be valid until 28 days from the date of expiring of the Defect Liabilities period.

Signature and Seal of the guarantor -----

Name of Bank -----

Address-----

Date-----



BANK GUARANTEE FOR ADVANCE PAYMENT

TO,

----- (Name of Employer)
----- (Address of Employer)
----- (Name of Contractor)

Gentlemen:

In accordance with the provisions of the Conditions of Contract, sub-clause 51.1 ("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 his proper and faithful performance under the said Clause of the Contract in an amount of (amount of Guarantee)* ----- in words).

We, the (bank of 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 obligation on our part and without his first claim to the Contractor, in the amount not exceeding ----- (amount of guarantee)* words)-----

We further agree that no change or addition to or other modifications of the terms of the Contractor or Works to be performed thereunder or of any of the Contract documents which may be made between ----- (name of Employer) and the Contractor, shall in any way release us from any liability under this guarantee, and we hereby waive notice of any such change, addition or modifications.

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.

YOUR'S TRULY

Signature and Seal _____ Name of
Bank/ Financial Institution _____
Address _____
Date _____

* An amount shall be inserted by that Bank or Financial Institution representing the amount of the Advance Payment, and denominated in Indian Rupees.



Letter of Acceptance

(Letter head paper of the Employer)

_____ (date)

To,

_____ (Name and address of the Contractor)

Dear Sirs,

This is to notify you that your Bid dated _____ for execution of the _____ (Name of the contract and identification number, as given in the Instructions to Bidders) for the Contract Price of Rupees _ (₹) (amount in words and figures) as corrected and modified in accordance with the Instructions to Bidders* is hereby accepted by our agency.

You are requested to furnish performance security, in the form detailed in para 34.1 of ITB for an amount equivalent to Rs. _____ within **10 days** of the receipt of this letter of acceptance up to beyond **60 days** from the date of expiry of defects Liability period i.e. up to _____ and the Additional Performance Security for an amount equivalent to Rs. _____ shall be valid beyond 28 (twenty-eight) days of Project Completion Date i.e. up to _____ and sign the contract, failing which action as stated in Para 34.3 of ITB will be taken.

Yours Faithfully

Authorized Signature Name and title of Signatory Name of Employer

* Delete "Corrected and" or and modified if only one of these actions applies. Delete as corrected and modified in accordance with the Instructions to Bidders, if corrections or modifications have not been affected.



Issue of Notice to proceed with the work
(Letterhead of the Employer)

----- (date)

To,

_____ (Name and address of the Contractor)

Dear Sirs,

Pursuant to your furnishing the requisite security in ITB Clause 34.1 and signing of the Contract for the construction of _____

_____ at a bid Price of Rs.

_____.

You are hereby instructed to proceed with the execution of the said works in accordance with the contract documents.

Yours faithfully

(Signature, name and title of signatory authorized To sign on behalf of Employer)



AGREEMENT FORM

This agreement, made on the _____ day of _____ Between
_____ (name and address of Employer) (Hereinafter called "the
Employer) and _____ (name and address of
Contractor) hereinafter called "the Contractor" of the other part.

Whereas the Employer is desirous that the Contractor execute

Name and identification number of contract (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 Rs.

NOW THIS AGREEMENT WITNESSETH AS FOLLOWS

1. In this Agreement, words and expression shall have the same meanings as are respectively
assigned to them in the conditions of contract hereinafter referred to and they shall be
deemed to form and be read construed as part of this Agreement.
2. In Consideration of the payment to be made by the Employer to the contractor as
hereinafter mentioned, the Contractor hereby covenants with the Employer to executive
and complete the works and remedy any defects therein in conformity in all aspects with
the provisions of the contracts.
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 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 ready and construed as part of this
Agreement viz

- i) letter of Acceptance
- ii) Notice to proceed with the works:
- iii) Contractor's Bid



- iv) Conditions of contract: General and Special
- v) Contract Data
- vi) Additional conditions
- vii) Drawings
- viii) Bill of Quantities and
- ix) Any other documents listed in the Contract
data as forming part of the Contract.

In witness whereof the parties there to have caused this Agreement to be executed the day and year first before written

The Common seal of __ Was hereunto affixed in the presence of :

Signed, sealed and Delivered by the said _____

In the presence of

Binding signature of Employer _____

Binding Signature of Contractor _____



UNDERTAKING

(For Investment)

I, _____ the undersigned do hereby undertake that our firm
M/s _____ would invest a minimum cash up to
25% of the value of the work during implementation of the contract.

(Signed by an Authorized officer of the firm)

Title of officer _____

Name of firm _____

DATE _____



UNDERTAKING

(For Validity)

I, the undersigned do hereby undertake that our firm M/s
..... agree to abide by this bid for a period days for date fixed for
receiving the same and it shall be binding on us and may be accepted at any time before the
expiration of that period.

(Signed by an Authorized officer of the firm)

Title of officer

Name of firm

DATE



STATEMENT OF PHYSICAL CRITERIA

Sr No	Name of work with contract No	Name of client	Date of Completion	Qty	Cost	Qty	Cost	Cumulative Qty
(1)								
(2)								
(3)								
(4)								
	TOTAL :	,						

Note: Bidders must produce the BOQ of the mentioned works, to evaluate the cost and quantity of installed flow meter / valves along with work order and completion certificate.



Site Visit Certificate

(To be submitted separately in sealed Envelope B, Vol.-I Pre-qualification document)

I/we _____, authorized representative of M/s _____ have visited the site of "SITC of Electrical Cables, Electrification work of pump house & panel room, Plant lighting, CCTV with associated work and other electrical, mechanical and civil work at mahisagar based water sources of VMC (% Rate basis) (2nd attempt)." On Date. _____, 2025/26.

We have inspected and evaluated the existing site with reference to its location, soil conditions, sub soil water table, etc. We have submitted this offer after satisfying ourselves about the local conditions, local costs, etc.

Signature of the Tenderer



OEM Certificate
(to be submitted by manufacturers)

To,
Executive Engineer,
Water Works (Ele./Mech.),
Vadodara Municipal Corporation

Sub: Product Compliance with the tender specifications

Dear Sir
Tender No
Equipment Name

1. We (Name of the OEM) declare that we are the original manufacturers of the above equipment having registered office at (Full address with telephone number/fax number & email ID and website), and having factories at
2. We hereby declare that we are willing to provide guarantee/warranty and after sales service during the period of warranty/guarantee as per the above tender.
3. We also hereby declare that we have the capacity to manufacture and supply the quantity of the equipment's tendered within the stipulated time

(Name) for and on behalf of
M/s. _____
(Name of manufacturers)

Date:
Place:

Note: This letter of authority shall be on the letterhead of the manufacturing concern and signed by a person competent and having the power of attorney to bind the Manufacturer. The products coated are not end of life and shall be available and support spares and service of the coated products for the 5 yrs.

Remarks:

- Contractor shall provide OEM Certificate for All types of Cables, LED Lights, CCTV, Solar plant, EOT, Electric hoist and other Major item as directed by EIC.
- OEM certificate is required to submit at the time of approval of respective item by successful bidder.



MANUFACTURER'S AUTHORISATION FORM
(to be submitted by authorized dealers/representatives/importers)

Dated:

To
Executive Engineer,
Water Works (Ele./Mech.),
Vadodara Municipal Corporation

Sub: Product Compliance with the tender specifications

Tender No

Equipment Name:

Dear Sir,

1. We (name of the Manufacture) are the original manufacturers of the above equipment having registered office at (full address with
2. telephone number/fax number & email ID and website), having factories at and, do hereby authorize/s _____ (Name and address of tenderer) to submit tenders, and subsequently negotiate and sign the contract with you against the above tender no..
3. We also hereby undertake to provide full guarantee/warranty /CMC/AMC as agreed by the tenderer in the event the tenderer is changed as the dealers or the tenderer fails to provide satisfactory after sales and service during such period of Comprehensive warranty/CMC/AMC and to supply all the spares/reagents during the said period.
4. We also hereby declare that we have the capacity to manufacture and supply, install and commission the quantity of the equipment's tendered within the stipulated time.

(Name) for and on behalf of

M/s. _____

(Name of manufacturers)

Date:

Place:

Remarks:

- Contractor shall provide Manufacturer's Authorization form for All types of Cables, LED Lights, CCTV, Solar plant, EOT, Electric hoist and other Major item as directed by EIC.
- Manufacturer's Authorization form is required to submit at the time of approval of respective item by successful bidder.



Declaration Form

1. I/We hereby declare that I/We have visited the site of the work and have fully acquainted myself/ourselves with the local situation and other factors pertaining to the work before submitting the tender.
2. I/We hereby declare that I/We have carefully studied the Condition of Contract, specification and other Tender Documents of this work and agreed to execute the same accordingly.
3. I/We hereby declare that I/We am/are partner(s) not blacklisted or connected with firm blacklisted in state, semi govt. Municipal Corporation, or any government undertaking institute or any autonomous corporate bodies.
4. We, then partners of this firm hereby, give an undertaking that we are jointly and severally responsible to meet all liabilities over and above the business of this firm and make good any the above financial loss sustained by the VMC as a result of our abandoning the work or works, entrusted to us i.e. this firm. I/We hereby undertake and submit in the bid along with supporting documents, are true which are corrected and valid throughout the contract period.
5. I/We hereby agree to abide by and fulfil the terms and provisions of conditions of contract annexed here to so far as applicable and in default thereof to forfeit the earnest money mentioned in the said condition.

1. Receipt No. _____ dated _____ from the _____
2. Signature of Contractor (Before Submission of tender) _____
3. Name of Tendered: _____
4. Address _____
5. Dated the _____ day of _____ 20
6. (Witness) _____
7. (Address) _____
8. (Occupation) _____

Date:

Signature with seal of the company



Schedule - Planning

Method Statement

1. The project is for Selection of Agency for – (Name of work as per Notice Inviting Tender)

The Employer's indicative guidelines on Methodology are given in the Employer's Requirement which may be followed.

2. The Bidder is required to submit Approach and Method Statement for carrying out work of along with the technical bid. The Bidder's approach and method statement shall be in line with the overall principle of the Employer.
3. The activities for methodology shall also include following:
 - (i) Phasing of works, cost effective value Engineering and drawings
 - (ii) Implementation schedule along with methodology as per scope of works:
 - (iii) Comprehensive Operation and maintenance Services:
 - (iv) Customer services;
 - (v) Safeguard activities;

Work plan:

1. The Bidder will submit detailed work plan as part of Technical proposal covering all sections of work to achieve sectional and full work key milestones as shown in Employer's Requirement

Mobilization Schedule

2. The Bidder shall submit mobilization and de-mobilization schedule of personnel and equipments in detail for all phases of works. The mobilization schedule should include mobilization of skilled and unskilled manpower, different machineries and equipment, materials, as required in each Phase.

Construction Schedule

The Bidder shall prepare and submit overall construction schedule. The construction schedule shall be designed and documented in a series of tasks and task assignments complete with projected completion target dates with the aid of computer operated management software like Microsoft project office, Primavera or latest by using Gantt charts and PERT diagrams to allow all actors to know their contribution towards fulfilling the Employer's Requirement.



ACCEPTANCE OF TENDER

Tender No:

To,

The Municipal Commissioner,
Vadodara Municipal Corporation,
Khanderao Market Building,
Palace Road, Vadodara-390 209.

I/We hereby accept tender for execution of the work of "SITC of Electrical Cables, Electrification work of pump house & panel room, Plant lighting, CCTV with associated work and other electrical, mechanical and civil work at mahisagar based water sources of VMC (% Rate basis) (2nd attempt)."

As per tender within the time schedule of completion of work for jobs, signed and accepted by me/us, at the rates quoted by me/us for the whole work on turnkey basis in accordance with Tender Notice, Terms and Conditions of the contract, Specifications for materials and workmanship, drawing etc. all as detailed in the tender document.

It has been explained to me / us that time stipulated for completion of jobs in all respect and in different stages mentioned in the "Time Schedule of Completion of job" and signed and accepted by me/us is the essence of the contract. I/We agree that in the case of failure on my/our part to strictly observe the time of completion of work in all respect according to the schedule set out in the said "Time Schedule of Completion of job", I/We shall pay compensation to the owner as per provision and stipulations contained in conditions of contract and I/We agree for recovery being made as specified therein. In exceptional circumstances extension of time which shall always be in writing may however be granted by the Engineer - in - charge at his entire description of some items of work and I/We agree that such extension of time will not be counted for the extension of completion of works as stipulated for jobs and for the final completion of works as stipulated in the said "Time Schedule of Completion of jobs."

I/We agree to pay the earnest money and security deposit and accept the terms and conditions as laid down in the memorandum below in this respect.

Signature of Tenderer(s) with the Seal of the firm



Acceptance of Bank Guarantee as
Security Deposit and Earnest
Money Deposit.

Government of Gujarat

Finance Department

GR. No.: FD/MSM/e-file/4/2024/2859/D.M.O.

Date: 01/05/2025

Read: FD GR. No.: FD/MSM/e-file/4/2023/4020/D.M.O Dt 11/03/2024

Preamble:

Tendering authorities of the State Government and its Boards/Corporations/PSUs frequently take Bank Guarantee from the bidders towards Security Deposit and Earnest Money Deposit. The State Government had issued the list of eligible banks vide above mentioned resolutions of this department dated 11/03/2024.

After careful consideration, the Government has decided to approve the list of Banks whose Bank Guarantees would be accepted for the purpose mentioned above. It has now been decided to resolve as follows:

Resolution:

Government Departments and State Government Boards/Corporations/PSUs would accept Bank Guarantee (towards Security Deposit and Earnest Money Deposit) issued by any of the banks included in the **Annexure I**, attached to this Resolution.

The tendering authority will be required to ascertain the authenticity of the Bank Guarantee and set up necessary internal control procedures.

By order and in the name of the Governor of Gujarat.



(Arvind V.)

Joint Secretary (Budget)
Finance Department



Annexure I.

Finance Department, GR. No.: FD/MSM/e-file/4/2024/2859/D.M.O.

Date: 01/05/2025

- (A) Guarantees issued by the following banks will be accepted as SD/EMD on a permanent basis:

❖ All Nationalized Banks

- (B) Guarantees issued by the following Banks will be accepted as SD/EMD for the period up to March 31, 2026. The validity cut-off date in the GR is with respect to the date of issue of Bank Guarantee irrespective of the date of termination of Bank Guarantee.

Sr No	Name of Banks	Sr No	Name of Banks
1	AXIS Bank	22	South Indian Bank
2	AU Small Finance Bank	23	Standard Chartered Bank
3	Bandhan Bank	24	Tamilnad Mercantile Bank
4	Barclays Bank	25	Utkarsh Small Finance Bank
5	City Union Bank	26	YES Bank
6	CSB Bank	27	Ahmedabad Mercantile Co-op. Bank
7	DBS Bank India Limited	28	Nutan Nagrik Sahkari Bank Ltd.
8	DCB Bank	29	Rajkot Nagarik Sahakari Bank Ltd.
9	Equitas Small Finance Bank	30	Saraswat Co-Operative Bank Ltd
10	ESAF Small Finance Bank	31	SBPP Co-operative Bank Ltd.
11	FEDERAL Bank	32	SVC Co-Operative Bank Ltd.
12	HDFC Bank	33	The Cosmos Co-op Bank Ltd.
13	HSBC Bank	34	The Gujarat State Co-operative Bank
14	ICICI Bank	35	The Mehsana Urban Co-Op. Bank
15	IDBI Bank	36	The Surat District Co-op Bank
16	IDFC First Bank	37	The Surat People's Co. Op. Bank Ltd
17	Jammu and Kashmir Bank	38	The Kalupur Commercial Co-op. Bank
18	Jana Small Finance Bank	39	The Panchmahal District Co-operative Bank
19	Karnataka Bank	40	The Baroda District Co-operative Bank
20	Karur Vysya Bank	41	Baroda Gujarat Gramin Bank
21	Kotak Mahindra Bank	42	Saurashtra Gramin Bank

All the eligible banks are instructed to collect the original documents/papers of guarantee from the concerned tendering authority.

(Arvind V.)

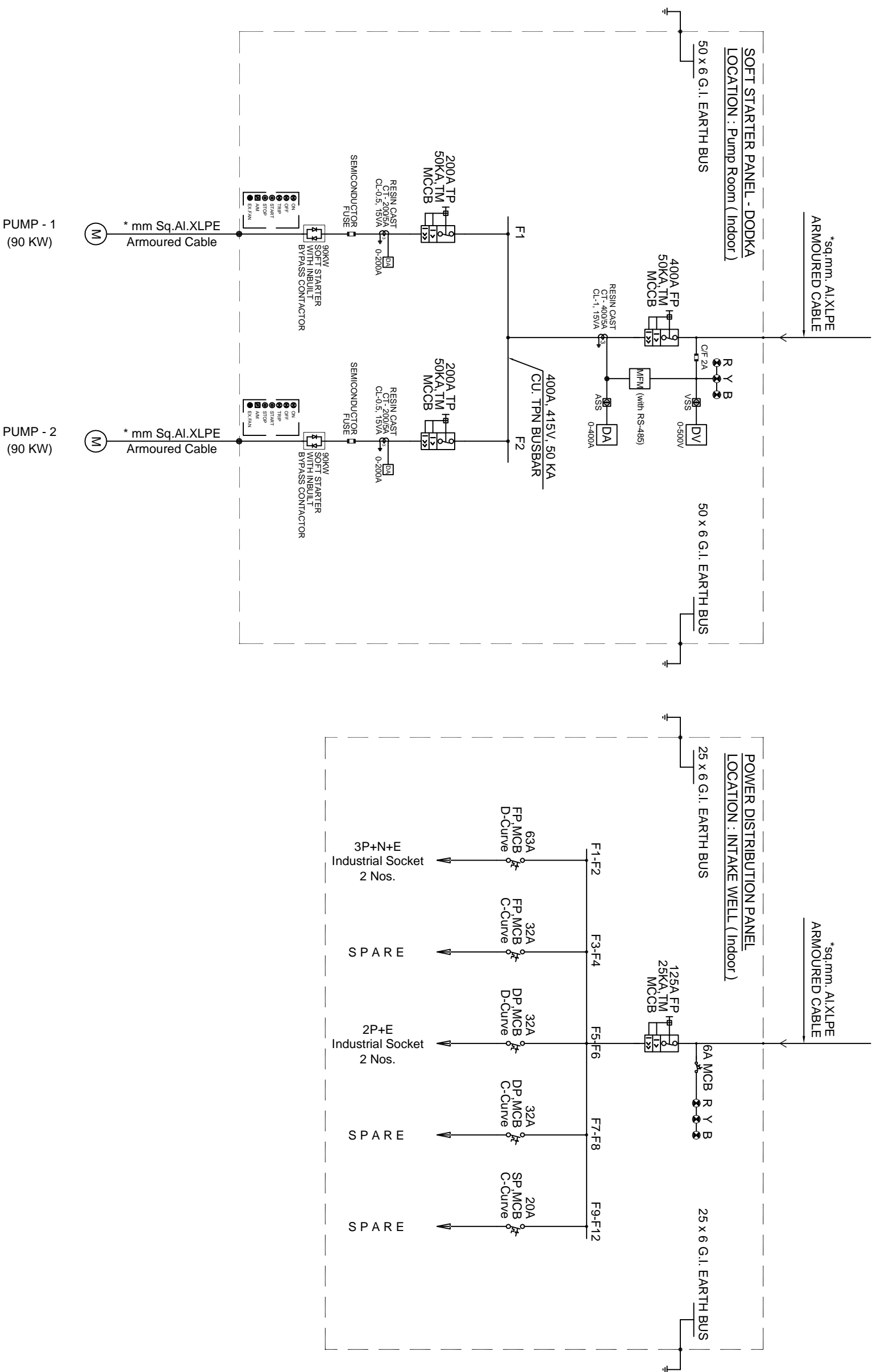
Joint Secretary (Budget)
Finance Department



SECTION - 9

Drawings

























INCOMER FROM EXISTING LT PANEL



NOTE :

- (1) In Manual Mode, Local/Remote operation shall be considered. Necessary control wiring shall be provided by Vendor.
- (2) ALC's shall be Cast Resin Type only. VA purifiers shown are indicative. Vendor shall indicate burden as per actual Requirement.
- (3) AILMeters shall be 96, 9.6mm Digital Type Only.
- (4) Capacitor shall be APF CAN Type.
- (5) Cable Entry shall be from Top & Bottom.
- (6) Necessary cooling fans for Ventilation shall be provided.
- (7) Panel shall be suitable for A/UO operation through PLC System.
- (8) Panel Height Shall not be more than 2300mm including base frame.
- (9) The Maximum Height of the Operating Handle and switches shall not exceed 1900mm and the minimum Height shall not be below 300mm
- (10) Louvers for Ventilation shall be provided on both sides of panel.
- (11) Space Heater with Thermostats Shall be provided in Panel.

EMI	ELECTRICAL & MECHANICAL INTERLOCK
PMU	PUMP MONITORING UNIT
SPP	SINGLE PHASING PREVENTER
C/F	CONTROL FUSE
SC	SPRING CHARGE
CT	CURRENT TRANSFORMER
DP	DOUBLE POLE
MCCB	MOULDED CASE CIRCUIT BREAKER
MPCB	MOTOR PROTECTION CIRCUIT BREAKER
MCB	MINIATURE CIRCUIT BREAKER
DA	DIGITAL AMMETER
MFM	MULTI FUNCTION METER
SPD	SURGE PROTECTION DEVICE
LDB	LIGHTING DISTRIBUTION BOARD
TNC	TRIP NEUTRAL CLOSE

LEGEND			
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
	MOULDED CASE CIRCUIT BREAKER		MINIATURE CIRCUIT BREAKER
	AIR CIRCUIT BREAKER		MOTOR PROTECTION CIRCUIT BREAKER
	ILLUMINATED PUSH BUTTON		PUSH BUTTON
	INDICATING LAMP		MULTIFUNCTION METER (CLASS-1)
	AMMETER SELECTOR SWITCH		VOLTMETER SELECT SWITCH
	DIGITAL VOLTMETER		DIGITAL AMMETER
	AUTO / MANUAL SELECTOR SWITCH		VARIABLE FREQUENC DRIVE (VFD)
	OVERLOAD RELAY		SOFT STARTER
	ON, OFF		CURRENT TRANSFORMER
	EXHAUST FAN		CONTROL TRANSFORMER
	CONTACTOR		CAPACITOR
	TNC SWITCH		HOOTER

FOR REFERENCE PURPOSE ONLY

CLIENT		 VADODARA MUNICIPAL CORPORATION	
CONSULTANT		 RAY INFRASTRUCTURES PVT.LTD. 2023/24 CHANDRASEKHAR DAVE ROAD CHANDRASEKHAR DAVE CHOWK PLOT NO. 40/2, 40/3/23/1/4/2 (OPP. RAY PARK)	
PROJECT	DODKA INTAKE WELL SOFT STARTER PANEL STD PDB PANEL AT EACH INTAKE WELL STD		
TITLE			
DRAWN BY :- P.B	PROJECT NO	DRAWING NO	SHEET NO
CHECK BY :- R.K			
APPD BY :- R.K	RIP/VMC/DODKA 55	01/01	NTS
DATE :- 28/12/2025			