AN ISO 9001 & 14001 COMPANY

TENDER DOCUMENT

TENDER No: DLI/CON/728/549

FOR

“Renovation Work of Existing Government Polytechnic Institute” at Ranchi, Jharkhand

VOLUME - II

Additional Conditions of Contract
&
Technical Specifications
CONSTRUCTION OF “RENOVATION WORK OF EXISTING GOVERNMENT POLYTECHNIC INSTITUTE” AT RANCHI, JHARKHAND.

ADDITIONAL CONDITIONS OF CONTRACT

1. Intent:

These additional conditions of contract (ACC) shall be read in conjunction with the Instructions to the Tenderers & General Conditions of Contract for the work of Construction of Renovation Work of Existing Government Polytechnic Institute” at Ranchi, Jharkhand. These Additional Conditions of Contract shall supercede the instructions to the Tenderers & General Conditions of Contract (G.C.C.) wherever they are at variance.

2. Site:

The site is located in the main town itself. The distance is approx 4 kms from Ranchi Railway Station.

3. Scope of work:

The contractor shall be responsible for supply, construction, supervision and commissioning of Renovation Works of Guard wall, boundary wall & approach road, main building, workshop, machine section, practical room, class room, old hostel building, hostel building, hostel block a, toilet hostel block a, hostel block b, toilet hostel block b, septic tank 150 users 3 nos., landscaping, electrical works (including solar panel) etc. at Polytechnic Campus Ranchi, Jharkhand as per the technical specifications, designs, drawings, instruction and terms and conditions given in the tender documents.

4. Tender Documents:

4.1 Following documents shall form the complete set of Tender Documents for this contract.

4.1.1 Instructions to the Tenderers & General Conditions of Contract – 128 Pages

4.1.2 Notice Inviting Tender. Addendum to ITT, Special Instructions to Bidders for e-tendering.

4.1.3 Additional Conditions of Contract

4.1.4 Technical Specifications

4.1.5 Form of Price Bid

4.1.6 Bill of Quantities

4.2 Notwithstanding sub-division of the documents into separate sections, every part shall be deemed to be supplementary of every other part and shall be read with and into the contract.
5. Tender Price & Amount:

5.1 The tenderer shall fill up the prescribed format of Price Bid (enclosed) forming part of tender documents, with his rates at percentage below, above or par (both in figures and words) the estimated cost for each head separately in summary cost he will be willing to execute the work. The tenderer shall take due notice of other requirements of clause 4 of Instructions of Tenderers.

5.2 Comparative estimate after tendering has to be approved by Deptt. of Higher & Technical Education (Client).

5.3 All other terms and conditions will be as per G.C.C. and Instruction to the Tenderer.

6. Secured Advance:

Secured advance shall be admissible to the contractors under the guidelines of G.C.C. (Cl. No. 35.0) if the owner agrees to pay such advance.

7. Payment:

In addition to Cl. No. 37 of General Conditions of Contract, the following shall also govern the terms of payment:

7.1 Payment will be made based on measurements entered in Measurement Book (MB) & certification of the same by Engineer – in-charge. The owner (Deptt. of Higher & Technical Education) may arrange for checking the MB by Civil Engineers of Govt. Engineering College/Polytechnic or equivalent organization. The contractor shall remain bound to render all assistance to the Engineer – in-charge or his authorized representative during such checking of the measurements.

8. Compensation for Delay and Remedies:

The rates of agreed Compensation stipulated at Clause 72.1 of G.C.C. shall be read amended as under:

8.1 In case completion of the project is delayed due to reasons attributable to the contractors/agencies/suppliers engaged for the project by the PMC, PMC shall impose liquidated damages @ 0.5% (zero point five percent) on awarded contract value for each week of delay subject to a maximum of 10% (Ten percent) of the awarded contract value which shall be credited to the Department.

9. Challan & Royalty etc.

Contractor at time of submission of each bill shall produce royalty clearance certificate/challan against payment of royalty of materials used for the work. In case he fails to submit such certificate/challans along with the bill, the royalty for
materials will be deducted from each RA Bill against work done as per the prevailing directives of the State Mining Department.

10. Progress Monitoring, Quantity & Quality Check:

Time schedule and progress monitoring shall be guided by C. No. 43 of G.C.C. However the owner reserves his right to monitor the progress including all technical requirements of work in association with the representatives of EPI or themselves. The owner also reserves the right to get the quantity & quality of work tested by another Government agency or Private body. The Contractor shall have no objection to such monitoring and testing and shall be deemed to have include the expenses to be incurred on such accounts in the rates as agreed in the Contract.

11. Carriage of materials:

Carriage of materials will be paid for the items quoted based on Jharkhand Schedule of Rates (JSR) 2015 only as mentioned in the tender. If the lead is found less than provided in the tender payment will be made as per actual lead. No payment towards extra carriage over provision made in the tender will be admissible under any circumstances.

No payment for carriage of materials for the items quoted based on CPWD Schedule and Non-schedule items will be paid under any circumstances.

12. Accuracy of Works:

The various works to be done true to line, level and grade. The periodical checking by the supervising engineer shall not absolve the contractor of his responsibility regarding accuracy. In case any deviations or discrepancy in the line, level or grade the contractor shall make good discrepancy at his own cost and without any compensation for the additional work involved.

13. Mobilization Advance:

Mobilization advance of 12% of the total individual project value at the annual interest of 12% and as mentioned in memorandum of the tender document will be released to contractor against submission of Bank Guarantee as per Clause No.8.0 of GCC as under:

13.1 50% of Mobilization advance after fulfillment of conditions in Cl. 8.1 (i) of G.C.C.

13.2 Second installment of 25% of total mobilization advance after fulfillment of conditions in Cl. 8.1 (ii) of GCC.

13.3 Balance 25% of Mobilization advance after fulfillment of conditions in Cl. 8.1 (iii) of G.C.C.

Other provisions of Cl. 8.0 of GCC shall remain unaltered.
14. Escalation Clause:
The escalation will be paid if approved and paid by Department of Higher & Technical Education, Government of Jharkhand (The client), as per clause 47 of standard bidding document applicable in Jharkhand government department as given below.

Contract Price shall be adjusted for increase or decrease in rates and price of materials in accordance with the following principles and procedures and as per formula given below in the contract data. **This will be paid to the contractor only when the client, Department of Higher & Technical Education will release the payment/fund against this clause.**

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.

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

Following expressions and meanings are assigned to the work done during each month:

\[ R = \text{Total value of work done during the month. It will exclude value for works executed under variations (Extra Items) for which price adjustment will be worked separately based on the terms mutually agreed and approved by Department of Science and technology (The Client).} \]

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 clauses 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.

The formula (e) for adjustment of prices is:
\[ R = \text{Value of work as defined above.} \]

**Adjustment for labour component**

(i) Price adjustment for increase or decrease in the cost of labour shall be paid in accordance with the following formula.
\[ V L = 0.85 \times \frac{P L}{100} \times R \times \frac{(L1 - L0)}{L0} \]

\[ V L = \text{Increase or decrease in the cost of work during the month under consideration due to change in the rates of labour.} \]

\[ L0 = \text{The consumer price index for industrial workers for the state on 28 days preceding the date of opening of Bids as published by Labour Bureau, Ministry of Labour, Government of India.} \]

\[ L1 = \text{The consumer price index for industrial workers for the month under consideration as published by Labour Bureau, Ministry of Labour, Government of India.} \]

\[ P L = \text{Percentage of Labour Component of the work.} \]
Adjustment for cement component

(ii) Price adjustment for increase or decrease in the cost of cement procured by the contractor shall be paid in accordance with the following formula:

\[ V_c = 0.85 \times \frac{P_c}{100} \times R \times \frac{(C_i - C_0)}{C_0} \]

\( V_c \) = increase or decrease in the cost of work during the month under consideration due to changes in rates for cement.

\( C_0 \) = The all India wholesale price index for cement on 28 days preceding the date of opening of Bids as published by the Ministry of Industrial Development, Government of India, New Delhi.

\( C_i \) = The all India average wholesale price index for cement for the month under consideration as published by Ministry of Industrial Development, Government of India, New Delhi

\( P_c \) = 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:

\[ V_s = 0.85 \times \frac{P_s}{100} \times R \times \frac{(S_i - S_0)}{S_0} \]

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

\( S_0 \) = The all India wholesale price index for steel (Bars and Rods) on 28 days preceding the date of opening of Bids as published by the Ministry of Industrial Development, Government of India, New Delhi

\( S_i \) = The all India average wholesale price index for steel (Bars and Rods) for the month under consideration as published by Ministry of Industrial Development, New Delhi

\( P_s \) = Percentage of steel component of the work

Note: For the application of this clause index of bars and rods has been chosen to represent steel group.

Adjustment of POL (Fuel and lubricant) component:-

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

\[ V_f = 0.85 \times \frac{P_f}{100} \times R \times \frac{(F_1 - F_0)}{F_0} \]

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

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

\( F_1 \) = The official retail price of HSD at the existing consumer pumps of IOC at Nearest center for the 15th day of month of the under consideration.

\( P_f \) = Percentage of fuel and lubricant component of the work.
Note: For the application of this clause, the price of High Speed Diesel oil has been chosen to represent fuel and lubricants group.

**Adjustment of other materials component:**

(v) 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:

\[ V_m = 0.85 \times P_m /100 \times R_x (M_i - M_o )/M_o \]

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

\( M_o = \) The all India wholesale price index (all commodities) on 28 days preceding the date of opening of Bids, as published by the Ministry of Industrial Development, Government of India, New Delhi.

\( M_i = \) The all India wholesale price index (all commodities) for the month under consideration as published by Ministry of Industrial Development, Government of India, New Delhi.

\( P_m = \) Percentage of local material component (other than cement, Steel, bitumen and POL) of the work.

The following percentages will govern the price adjustment for the entire contract:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Labour</td>
<td>P1 35%</td>
</tr>
<tr>
<td>2. Cement</td>
<td>Pc 5%</td>
</tr>
<tr>
<td>3. Steel</td>
<td>Ps 5%</td>
</tr>
<tr>
<td>4. POL</td>
<td>Pf 5%</td>
</tr>
<tr>
<td>5. Other Materials</td>
<td>50%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

15.0 Specified material as per Technical Specifications shall be used. Material other than specified shall be used only with prior approval of client/EPI and recovery at prevailing market rate shall be done.

16.0 **ARBITRATION:** Modification of arbitration’s clause no 76.0 of GCC

General Conditions of Contract (GCC) Sub Clause no.76.1 and 76.3 of Arbitration Clause no.76.0 are amended as given below. Sub Clause no.76.2 will remain the same.

76.0 **ARBITRATION**

76.1 Before resorting to arbitration as per the clause given below, the parties if they so agree may explore the possibility of conciliation as per the provisions of Part III of the Arbitration and Conciliation Act, 1996 as amended by Arbitration and Conciliation (Amendment) Act, 2015. When such conciliation has failed, the parties shall adopt the following procedure for arbitration:

i) Except where otherwise provided for in the contract, any disputes and differences relating to the meaning of the Specifications, Design, Drawing and Instructions herein before mentioned and as to the quality of workmanship or materials used in the work or as to any other questions, claim, right, matter or
things whatsoever in any way arising out of or relating to the Contract, Designs, Drawings, Specifications, Estimates, Instructions, or these conditions or otherwise concerning the works of the execution or failure to execute the same whether arising during the progress of the work or after the completion or abandonment thereof shall be referred to the Sole Arbitrator appointed by the Chairman & Managing Director (CMD) of Engineering Projects (India) Limited (EPI) or any other person discharging the functions of CMD of EPI. The person approached for appointment as Arbitrator shall disclose in writing circumstances, in terms of Sub-Section (1) of Section (12) of the Arbitration and Conciliation Act, 1996 as amended by Arbitration and Conciliation (Amendment) Act, 2015 as follows:

a) such as the existence either direct or indirect, of any past or present relationship with or interest in any of the parties or in relation to the subject-matter in dispute, whether financial, business, professional or other kind, which is likely to give rise to justifiable doubts as to his independence or impartiality; and

b) which are likely to affect his ability to devote sufficient time to the arbitration and in particular his ability to complete the entire arbitration within a period of twelve months.

The Arbitrator shall be appointed within 30 days of the receipt of letter of invocation of arbitration duly satisfying the requirements of this clause.

ii) if the arbitrator so appointed resigns or is unable or unwilling to act due to any reason whatsoever, or dies, the Chairman & Managing Director aforesaid or in his absence the person discharging the duties of the CMD of EPI may appoint a new arbitrator in accordance with these terms and conditions of the contract, to act in his place and the new arbitrator so appointed may proceed from the stage at which it was left by his predecessor.

iii) It is a term of the contract that the party invoking the arbitration shall specify the dispute/ differences or questions to be referred to the Arbitrator under this clause together with the amounts claimed in respect of each dispute.

iv) The Arbitrator may proceed with the arbitration ex-parte, if either party, in spite of a notice from the arbitrator, fails to take part in the proceedings.

v) The work under the contract shall continue as directed by the Engineer-In-Charge, during the arbitration proceedings.

vi) Unless otherwise agreed, the venue of arbitration proceedings shall be at the venue given in the “Memorandum” to the “Form of Tender”.

vii) The award of the Arbitrator shall be final, conclusive and binding on both the parties.

viii) Subject to the aforesaid, the provisions of the Arbitration and Conciliation Act, 1996 as amended by Arbitration and Conciliation (Amendment) Act, 2015 or any statutory modifications or re-enactment thereof and the Rules made there under and for the time being in force shall apply to the arbitration proceedings and Arbitrator shall publish his Award accordingly.

76.3 JURISDICTION:

The courts in Delhi alone will have jurisdiction to deal with matters arising from the contract.
### Deployment of Technical Staff for the work

<table>
<thead>
<tr>
<th>Requirement of Technical Staff</th>
<th>Minimum experience (Years)</th>
<th>Rate of recovery (₹/month)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Qualification</strong></td>
<td><strong>Number</strong></td>
<td></td>
</tr>
<tr>
<td>i) Project Manager with degree</td>
<td>1</td>
<td>₹100,000/- p.m</td>
</tr>
<tr>
<td>ii) Planning /Quality Control Engineer Degree</td>
<td>1</td>
<td>₹50,000/- p.m</td>
</tr>
<tr>
<td>iii) Junior Engineer Diploma (Civil)</td>
<td>1</td>
<td>₹25,000/- p.m</td>
</tr>
<tr>
<td>iv) Safety Officer</td>
<td>1</td>
<td>₹20,000/- p.m</td>
</tr>
<tr>
<td>v) Supervisors (Diploma Engineering in Electrical/ Mechanical/Civil or ITI)</td>
<td>2</td>
<td>₹30,000/- p.m</td>
</tr>
</tbody>
</table>

Rate of recovery in case of non-compliance of above will be stipulated as above.

### 18.0 The Contractor shall engage a specialized agency for execution of MNRE Approved Solar Power Plant System, HVAC, Fire Fighting works etc... .The specialized agencies should have relevant license for execution of these works. The Contractor will submit the credentials of the specialized agencies for obtaining the approval of EPIL before engaging them. It may, however, be noted that the entire responsibility towards quantity and quality of the entire project including services shall remain with the main Contractor. Nothing extra will be paid on this account.
TENDER DOCUMENT
(VOLUME-II)

(technical specifications)

NIT NO. : DLI/CON/728/549

Renovation Work of Existing Government Polytechnic Institute” at Ranchi, Jharkhand

ISSUED TO

______________________________
______________________________
______________________________

ENGINEERING PROJECTS (INDIA) LIMITED
(A GOVT. OF INDIA ENTERPRISE)
1.0 INFORMATION ABOUT THE SITE:

The site is located in the main town itself. The distance is approx 4 kms from Ranchi Railway Station. All tenderers are advised to visit the site and collect necessary information from site.

1.1 SCOPE OF WORK

The contractor shall be responsible Renovation Work of Existing Government Polytechnic Institute” at Ranchi, Jharkhand as per the technical specifications, designs, drawings, BOQ, instructions and terms and conditions given in the tender documents.

1.2 GENERAL SPECIFICATION

1.2.1 The work in general shall be carried out as per CPWD specifications, (volume I to IV) (updated with correction slips issued up to last date of submission of tender), general specification 2005 for Electrical works (updated with correction slips issued up to last date of submission of tender).

1.2.2 All Electrical installation shall comply with the requirements of Indian Electricity rules, 1956 and Indian Electricity Act-1910 as amended up to date and bye laws of authority of State Government or any other department.

1.2.3 All mechanical works related to Public Health Engineering will conform to the requirements of manual of Water Supply by the Ministry of Urban Development and various Indian Standards as listed therein.

1.2.4 All electrical works will conform to various Indian Codes as listed in the Technical Specifications.

1.2.5 For the items not covered under the specifications as stated above, the work shall be done as per relevant IS Codes.

1.2.6 For the items not covered under any of the specifications stated above, the work shall be executed as per Manufacturer’s specifications/ General Engineering Practice and / or as per direction of Engineer in Charge.

2.0 ADDITIONAL PARTICULAR SPECIFICATION

In the absence of any definite provisions or any particular issue in the aforesaid specification, reference to be made to the latest codes and specifications of BIS, IRC, BS and ASTM in that order. Where even these are silent, the construction and completion of works shall conform to
sound Engineering practice as approved by Engineer in Charge. In case of any dispute arises out of the interpretation of the above, the decision of the Engineer in charge shall be final and binding on the contractor.

Where ever reference is made in the contract to specific standard codes to be met by the materials, plants and other supplies to be furnished and work performed and tested, the latest edition or revision of the relevant codes in effect shall apply, unless otherwise explicitly stated in the contract. Where such standards and codes are national, or related to a particular country of region, other internationally recognized standards which ensure a substantially equal or higher performance than the standards and codes specified will be accepted subject to the Engineer in charge prior review and written approval. Differences between standards must be fully described in writing by the contractor and submitted to the Engineer in Charge at least 15 days prior to the date when contractor desires the Engineer in Charge’s approval. If the Engineer in Charge determines that such proposed deviation do not ensure substantially equal performance, the contractor shall comply with the standards specified in the documents.

3.0 PARTICULAR SPECIFICATION OF ITEM OF WORKS NOT COVERED IN SPECIFICATION MENTIONED ABOVE.

3.1 FILLING WITH LOCALLY AVAILABLE SAND

Sand should spread in uniform layer of 150mm thickness and each layer shall be watered up to the full saturation condition and each layer to be compacted with manual / mechanical compacting device to achieve maximum density. After completion of the full depth of filling the surface of the filled sand to be neatly dressed and leveled.
3.2  SINGLE BRICK FLAT SOLING

Brick for soling should be of picked jhama quality of uniform size and shape. The under bed to be properly rammed and leveled before laying of soling. The joints between the bricks shall be filled with local sand (or available earth, if permitted by Engineer in Charge).

3.3  EXPANSION JOINT SEALANT

The specified gap of the expansion joint to be made uniform by cement mortar of appropriate strength, after curing is over, the mortar surface to be cleaned from all dust, dirt, lump of mortar, any grease materials etc. The depth of the expansion joint to be adjusted as per specified depth with suitable filler board. The surface of the expansion joint to be painted with manufacturer’s approved primer. Polysulphide based sealant compound shall be used as per specified width X depth to seal the joint. The total process of execution shall be as per manufacturer’s specification and instruction of Engineer in Charge.

Water used for manufacture of concrete or cement-sand mortar shall be clean and free from injurious amounts of oils, acid, alkali, salt, sugar, organic materials or other substances that may be deleterious to concrete or steel as detailed in clause 4.3 of I.S. 456 – 2000

4.0  PARTICULAR TECHNICAL SPECIFICATION FOR ELECTRICAL WORK

4.1  SCOPE

This specification covers supply of materials, fabrication, and erection, testing and commissioning of Electrical Switch boards, wiring system, light fittings and other associated items required for successful completion of the work. Any equipment, device, component or work not specifically mentioned in this specification but considered essential for proper design and operation shall be included by the tenderer in his offer. Applicable provisions and conditions of contract shall govern the work under the Section.

4.2  GENERAL

The power supply system in the buildings shall be of 415/240 Volts, 50 Hz., A.C. 3 phase 4 wire, earthed neutral system.

All supply and installation work shall be carried out as per specification and in accordance with the construction drawings and shall conform to requirements called for in the Indian Electricity Rules 1956 with its latest amendment, Indian Electricity Acts and all relevant
codes and practices issued by the Bureau of Indian Standard as amended up-to-date. The work shall also comply with the provisions of the general or local set of legislatures and regulations of any local or other statutory authority which may be applicable.

The Contractor for electrical work must possess valid Electrical contractor's License endorsed by the Licensing Board, Directorate of Electricity of concerned State Government for the type of work he shall execute.

The work to be provided for by the Contractor, unless otherwise specified, shall include but not limited to the following:

i. Furnish all labour, supervision, services, materials, supports, scaffolds, construction equipment, tools, plants and transportation etc required for the proper execution of the job as per drawings, specification and schedule of items and get all necessary tests on materials and work conducted at their cost.

ii. Notwithstanding the electrical layout shown in the drawing, the contractor shall obtain further approval of the layout at site from the Engineer-in-Charge before commencement of the work.

iii. Furnish samples of materials on display board at site for approval including arranging necessary tests on samples, as directed by the Engineer-in-Charge in an approved Laboratory.

iv. To extend facilities to the Engineer-in-Charge to inspect work and assist them to obtain samples, if they so desire.

v. Furnish general arrangement drawings of the switchboard and other fabrication items, which the Engineer-in-Charge may direct for their approval.

vi. To employ a full time experienced supervisor having electrical supervisor's certificate of competency endorsed by the Licensing Board, Directorate of Electricity of concerned State to supervise the work. The Engineer-in-Charge have the right to stop the work if the contractor's supervisor is not present when the work is being carried out.

vii. To keep the appropriate Electrical Inspector & supply authority be informed from time to time as per the execution programme of the work shall be the responsibility of the contractor and he shall be responsible to ensuring that all work passes their approval.

viii. To provide all incidental items not shown or specified in particular but necessary for proper execution of works in accordance with the drawing, specification and schedule of items.

ix. To maintain the work and keep them maintained till handed over to the owner in proper working condition.
x. Co-ordinate with all agencies including those engaged by the owner for proper execution of the job.

4.3 MATERIALS

Materials shall be of the approved make & quality. A list of materials of approved brand and manufacturer is indicated in the annexure. If the list of materials mentioned above stipulates two or more or alternative brands/makes of any product, the decision as to which brand/make shall be used in the work shall be taken by the Engineer in charge and the contractor shall provide the brand/make so selected without any extra cost.

In case, materials are required to be obtained from any manufacturer other than those listed on account of non-availability then prior approval from Engineer-in-Charge will be necessary, supported by relevant test certificates qualifying the required standard. Further tests as directed by the Consultant shall also be carried out by the contractor at their own cost, if required.

Contractor shall obtain approval from the Engineer-in-Charge of sample of all materials before placing order and the approved sample shall be carefully preserved on the display board in an appropriate manner at the site office for verification by the Engineer-in-Charge.

For standard bought out items, the sizes manufactured by the firms listed shall prevail when there is discrepancy in the sizes mentioned in the schedule without any financial adjustment.

4.4 SPECIFICATIONS

Unless specifically mentioned otherwise, all applicable codes and standards published by the Bureau of Indian Standard and all other such publication as may be published by them after construction work starts, shall govern in respect of design, workmanship, quality and properties of material and method of testing.

4.5 SAFETY

All equipment shall be complete with approved safety devices wherever a potential hazard to personnel exists and with provision for safe access of personnel to and around equipment for operation and maintenance functions.

Special care shall be taken to ensure against entry of rats, lizards and other creeping reptiles, which may create electrical short circuit inside live equipment.
4.6 DRAWINGS

On completion of all work the contractor shall furnish three copies of Ammonia print along with the original tracing of the following “As built” drawings to the Engineer-in-Charge without any extra cost.

i. Wiring diagram for final power / lighting distribution system showing the rating/ size of switchgear, cables, conduits, lighting fixtures and all accessories for individual installation.

ii. Detailed general arrangement drawings of the switchboard complete with dimension in metric units.

iii. Drawings showing the route of conduits and cables with sizes, lengths, sources and destination of all cables with the circuit designation number, etc.

iv. Drawings showing the balancing of phases with connected load in each circuits, etc.

4.7 TEST CERTIFICATES AND INSTRUCTIONS

Unless specifically mentioned otherwise, the contractor shall furnish, in duplicate, Manufacturer's Test Certificate with the delivery of the equipment to the Engineer-in-Charge and Instruction Manual in English for operations and maintenance of equipment wherever required.

4.8 TESTING AND COMMISSIONING

Before each field test, the contractor shall obtain the permission from the Engineer-in-Charge and all tests shall be conducted in the presence of duly authorised representative. Records of each test shall be prepared immediately after the test and this record shall be signed by contractor's representative conducting the test and the site engineer attending the test. Copies of their record in quadruplicate shall be handed over to the Engineer-in-Charge.

A certificate in quadruplicate shall be furnished by the contractor countersigned by the certified supervisor under whose direct supervision the installation was carried out and the Engineer-in-Charge. This certificate shall be in the prescribed forms in addition to the test certificate required by the Local Electric Supply Authorities.
4.9 **COMPLETION OF WORK**

Each item of the electrical work shall be considered as complete in all respects only after obtaining permanent service connection from local power supply authority, energising, testing and final commissioning of the complete installation as directed by the Engineer-in-Charge.

Payment on each item of electrical work shall be made as per measurement and proportionate to the quantum of work completed. In the event of any dispute with regard to the proportion of work complete, the decision of the Engineer-in-Charge shall be final and binding to the contractor.

4.10 **PREAMBLE TO THE SCHEDULE OF WORK**

The successful tenderer shall carefully go through the Clauses of Invitation to Tender, Specification, Schedule of Work and drawings and shall include in his rates any sum he may consider necessary to cover the fulfillment of the various clauses contained therein. Unit prices stated in the schedule of work against the item of work shall be inclusive of all installation, accessories and consumables necessary to complete the said work within the contemplation of the contract. Beyond the unit prices no extra amount will be paid for incidental contingent work and materials.

The quantities mentioned in the schedule of work are probable quantities and it must be clearly understood that the contract is not a lump sum contract, that the probable quantities, the value of the entire tender are only indicative and Employer does not in any way assure the tenderer or guarantee that the actual quantity of work would correspond to the probable quantities in the tender.

No change in unit rate will be admissible on any variation of quantity.

4.11 **PARTICULAR TECHNICAL SPECIFICATION FOR WIRING SYSTEM**

**SCOPE**

This specification covers supply of materials, erection and commissioning of distribution wiring, connection to distribution boards, cable laying, earthing and miscellaneous items. Applicable provisions and conditions of contract shall govern the work under the section.
GENERAL

Work to be provided for by the Contractor, unless otherwise specified, shall include but not be limited to the following:

i. Furnishing of labour, materials, supports, scaffolds, transportation, etc required for the work.

ii. To provide all incidental items not shown or specified in particular but reasonably be implied or necessary for successful completion of the work in connection with the drawings, specification and schedule of items.

iii. To provide all supervision for proper execution of the work.

iv. To conduct and bear all costs in respect of any test advised.

After completion of supply and installation of wiring system and earthing, if any defect in the material or workmanship is found by the Engineer-in-Charge, the contractor shall remove the same and supply better and approved materials at his own cost.

All precaution against theft and fire shall also be taken by the contractor.

MATERIALS

All materials used in the work shall be ISI approved quality and in its absence conforming to the IS Specification.

WIRING SYSTEM

The electric load of all lights, power outlets, etc. shall be balanced across the three phases.

Generally the final loading of any sub-circuit for lights and fans shall not exceed 800 watts and shall not be connected to more than total 10 fans, lights, socket outlets, etc. Bell push if operated at low voltage shall be fed from a separate circuit of distribution board.

The 16 Amps sub-circuit for power shall be connected to a maximum one 16 Amp. socket outlet or two 6 Amp. socket outlets.

A power circuit shall always be originating from a distribution board or MCB DB and the same shall run in a separate conduit.

The point wiring shall mean wiring from one way of distribution board to point of utilisation of electricity i.e. where the load is applied and this shall include complete wiring from distribution board, supply and fixing of switch board, controlling switches, ceiling rose, batten holder and socket outlet, etc.
Insulated or covered earthing conductors where used, shall have green insulation braiding or covering as appropriate. Under no circumstances shall the colour green be used for other than earthing conductor. In addition where it is required, cables of different colours be used. For identification purposes the following system shall be employed:

| Red or any colour (other than black or green) | For phase or switch wire |
| Black | For Neutral |
| Green | For earth |

Unless otherwise mentioned in the schedule of quantities, single way porcelain/ bakelite terminal connectors with nickel plated brass inserts and screws to suit the conductor size shall be used for intermediate wiring/ joints in junction boxes and in switch boards or by any other method approved by the Consultant/ Engineer-in-Charge.

Distribution wiring in conduit to light, fan, plug points etc. shall be done in looping in system. In this system, no joints or connections shall be made anywhere of the system except at terminating points such as, at terminals of switches, ceiling roses, etc. and in case of socket outlets, at the socket terminals. Intermediate wiring joints of neutral wire in junction boxes will not be permitted.

In the looping back system of wiring on hard wood batten, the wiring shall be done without any junction or connector boxes on the line. All intermediate joints or connections shall be made in the switch board only. Intermediate wiring joints of neutral wire in the junction box will not be permitted.

**CONDUIT WIRING**

All conduit shall be ISI marked and finished with galvanised or stove enameled surface. All conduit accessories shall be conforming to IS:2667-1988 and be threaded type. Conduit less than 20mm in diameter shall not be used. All conduits shall be 1.4 to 1.8 mm thickness below 32 mm dia. and 1.6 to 2.2 mm thickness for 32 mm dia. and above.

The conduit for each circuit shall be erected complete with necessary bushes before drawing in of any wire. Galvanised M.S. Spacer of 3 mm thick minimum shall be used between the conduit saddle and fixing surface. The saddle shall be fixed at an interval of not more than 750 mm apart for vertical run and 600 mm apart for horizontal run.
The joint in conduits shall be made by means of threaded couplers and threaded accessories only to ensure electrical continuity throughout. All pipes after cutting, the threading shall be carefully reamed out with special reamer to remove any burr and then painted immediately with an anti-corrosive preservative after removing all traces of oil or grease. Junction boxes shall be provided with gasketed covers to render them dust and damp proof. The conduit accessories having pull outlet for conductors shall only be used in all conduit installation.

Where specified, P.V.C. conduit conforming to IS: 7537 (Part-III) shall be used. The thickness of P.V.C. conduit shall be adequate to withstand mechanical injuries. PVC conduit accessories conforming to IS: 3419-1976 shall be used along with P V C conduit.

The entire conduit system shall be effectively earthed by means of suitable earthing conductors and the resistance from any point to earth shall not be more than one OHM.

After installation of conduit pipes and fittings are completed in all respects, the exposed outer surfaces of the conduit and accessories shall be painted with two coats of approved enamel paints or aluminium paint over a coat of red oxide primer as required to match the surrounding wall finishing. To protect against rust the bare thread portion shall be painted with anti-corrosive preservative.

**CONCEALED WIRING**

This system of wiring shall comply with all the requirements of surface conduit wiring system specified in Causes 5.1 to 5.6 in addition to the following points:

**Making of chase** : The chase in the wall shall be filled up neatly made and be of ample dimensions to permit the conduit to be fixed in the manner desired. In case of buildings under construction, chases shall be provided in the wall, ceiling etc. at the time of their construction and shall be filled up neatly after erection of conduit and brought to the original finish of the wall. Specially for ceiling, conduit shall be laid before casting.

**Fixing of conduit in chase** : The conduit in chase in the wall shall be fixed by means of staples or by means of saddles not more than 60 cm apart. Fixing of standard bends or elbows shall be avoided as far as practicable and all curves maintained by bending the conduit pipe itself with a long radius which will permit easy drawing of PVC insulated wires. All threaded joints of conduits shall be treated with some approved preservative compound to secure protection against rust.

**Inspection boxes** : Suitable inspection boxes shall be provided to permit periodical inspection and to facilitate removal of wires, if necessary. These shall be provided with inspection box covers.
Types of accessories to be used: All outlets, such as switches, wall sockets, etc. may be either flush mounting type or of surface mounting type.

The outlet box shall be mounted flush with the wall. The metal box shall be effectively earthed with conduit by an approved means of earth attachment.

Fish wire: 1 x 18 SWG G.I. wire inside the conduit and accessories to be provided with an extension of 250 mm at both the conduit ends.

Conduit laying in floor/ roof slabs before casting: M.S./ G.I./ rigid PVC/ polythene conduit shall be laid straight as far as practicable and properly placed including binding with the steel reinforcement rods with 22 SWG G.I. binding wire so that proper positions of conduits are maintained.

While laying the conduits for concealed wiring in the ceiling / beams / columns / walls before casting, the contractor shall ensure that both ends of the conduit are plugged by means of dead-end sockets or otherwise to prevent the entry of any foreign material against conduit choking.

All precaution must be taken while laying the conduits in the slabs, R.C. walls, columns, etc. and the contractor shall rectify at his own cost, if any defects are found during process of drawing cables through the concealed prelaid conduits.

Each M.S. / G.I. conduit shall be provided with protruding length of 150 mm on free end of the conduits with sockets under the bottom level of slab/ beam.

Each rigid PVC/ polythene conduit shall be provided with protruding length of 150 mm on free end of the conduits under the bottom level of slab/ beam.

There shall be no intermediate joints in one straight run of conduit.

All ceiling outlets shall be terminated in a round M.S./ G.I. circular box (80 mm depth minimum)/ deep box to suit standard size ceiling rose or/ and rectangular M.S. junction box or Fan Hook Box as the case may be.

It will be mandatory for the contractor to get the layouts approved by the Engineer-in-charge/Consultant, measurements are checked when the conduits are laid and bound to steel reinforcement rods, before he can release the work for casting of slabs/ floor/ beams etc.

Connector Boxes, Draw-in-Box, Junction Boxes:

These shall be constructed from 16 SWG M.S. sheet and have M.S. cover. Minimum size for connector box is 150mm x 100mm and for Draw-in-Box is 100mm x 100mm with required depth upto 80mm.
**Fan Hook Box**: These shall be 100mm dia x 80mm depth, constructed from 14 SWG M.S. sheet and provided with one 12 mm dia. M.S. rod of 300mm long having 'U' bend inside the box.

**Painting**: Both inside & outside wall of switch board, connection box, draw-in-box and other M.S. accessories shall be painted with two coats of anti-corrosive paint in addition to other painting instructions given elsewhere.

**WIRES**

Unless otherwise mentioned in the schedule of quantities, only single core PVC insulated / PVC insulated & sheathed cable consisting of multistrand / flexible copper conductor and of approved manufacturers conforming to relevant I.S. shall be used for wiring in conduit system.

The maximum number of wires drawn in one conduit shall not be greater than the recommended number given in the Table – 1 given in this section.

**INSTALLATION AND WIRING OF DISTRIBUTION BOARD/ MCB DISTRIBUTION BOARD.**

Where fixing of distribution board/ MCB DB on double teak wood board is specified only hinged type wooden board with brass hinge shall be provided and the size of the board shall be such as to match the size of the Distribution board/ MCB DB. A minimum margin of 25 mm shall be provided on all sides of the distribution board/ MCB DB. The outgoing circuit shall be taken out through a horizontal slot at the rear side of the distribution board/ MCB DB enclosure.

Where fixing of Distribution board/ MCB DB on M.S. frame is specified, the frame shall have sufficient mechanical strength to carry the weight of the DB./ MCB DB.

Where fixing of Distribution board/ MCB DB will be of concealed type, the chase in the wall shall be neatly made and be of ample dimensions to permit the DB to be recessed in wall and flushed with finished wall surface.

The cable / wires shall be connected to the terminal only by soldered or crimped lugs, unless the terminal is of such a form that it is possible to securely clamp them without cutting away of cable strands.

All bare conductors shall be rigidly fixed in such a manner that a clearance of at least 25 mm is maintained between conductors and material other than insulating material.
4.12 CABLES

TYPE AND QUALITY OF CABLES
Unless otherwise specified in the Schedule of Quantities all wiring cables shall be P V C insulated and P V C sheathed conforming to relevant IS Standard. The conductor of cable shall be of stranded wires of aluminium or copper as specified. All power cables shall be 1100 volts grade, PVC insulated, PVC. sheathed and armoured with stranded aluminium conductor. Materials should be obtained from the approved list of manufacturers/ brands as indicated in the document.

HANDLING OF CABLES
It shall be ensured that both ends of the cables are properly sealed to prevent ingress / absorption of moisture by the insulation.

When the cable drums have to be moved over short distances, they should be rolled in the direction of the arrow marked on the drum. While removing cables, the drum shall be properly mounted on jacks or on a cable wheel or any other suitable device, making sure that the spindle, jack, etc. are strong enough to take the weight of the drum.

DEFECTIVE CABLES
Cables with kinks and straightened kinks or with similar apparent defects like defective armouring, etc. shall not be installed.

BENDING RADIUS
Cable runs shall be uniformly spaced, properly supported and protected in an approved manner. All bends in runs shall be well defined and made with due consideration to avoid sharp bending and kinking of the cable. The minimum safe bending radius for all types of P V C cables shall be taken as 12 times the overall diameter of the cable. Wherever practicable, larger radius shall be adopted.

LENGTH OF CABLES
All cables shall be laid in one length. No joint shall normally be made at any intermediate point in through runs of cables, unless the length of the run is more than the length of the standard drum supplied by the cable manufacturer. In such cases where jointing is
unavoidable, the same shall be made by means of standard cable joint boxes/ kits. Before cutting the cables, the requisite length between terminals (including extra length required at loops) shall be carefully measured.

**STRIPPING OF OUTER COVERING**

While cutting and stripping the outer covering (i.e. sheathing of the cable, care shall be taken that the sharp edge of the cutting instrument does not cut or damage the inner insulation of the conductor. The protective outer covering of the cable shall be stripped off near the connecting terminal, the protective covering being maintained upto a point as close as possible to the connecting terminal.

**CABLE LAID IN TRENCHES**

Cables shall be laid generally in accordance with Indian Standard Code of Practice IS: 1255.

**SIZE OF TRENCH**

Unless otherwise mentioned in the Schedule of Quantities, the minimum width and average depth of trench for laying a single cable in ground shall be 460mm and 760mm for L.T. and 1000 mm for H.T. cable respectively. For laying of multiple 11 KV and 6.6 KV grade power cables, horizontal axial spacing shall be 250mm. For 1100 volt grade power cables, the horizontal axial spacing shall be 150mm. However, communication cable shall not be taken in a common trench. Where more than one cable are to be laid in the same trench in horizontal formation, the width of trench shall be increased according to the above stated inter-axial spacing between the cable, (except where otherwise specified). There shall be a clearance of at least 150 mm between the trench edge and axis of the end cable.

**EXCAVATION OF TRENCH AND PREPARATION OF BED**

The trench shall be excavated in reasonably straight line. Where there is a change in direction, suitable curvature shall be provided. Where gradients and changes in depth are unavoidable, these shall be gradual.

Adequate precautions shall be taken during excavation not to damage any existing cables, pipes or similar installations in the proposed route. Where bricks, tiles or protective covers or bare cables are encountered, further excavation shall not be carried out without the approval of the Engineer-in-Charge.
The bottom of the trench shall be level across the width and free from stone, brick bats, etc. The trench shall be then provided with a cushion of fine sand, the thickness of the cushion being not less than 75mm.

**LAYING OF CABLES**

All cables shall be tested for proper insulation prior to laying. The cable drums shall be transported on wheels to the place of work. The cables shall be laid out in proper direction as indicated on the drum using cable drum lifting jacks. In case of higher size cables, the laid out cables shall run over rollers placed at close intervals and finally transferred carefully on to the trenches and racks, care shall be taken so that kinks and twists or any mechanical damage does not occur in cables. Only approved cable pulling grips or other devices shall be used. The entire length of cable shall, as far as possible, be paid in one operation. However, if this is not possible, the remainder of the cable may be shifted from position by 'falking' i.e. by making one long loop in the reverse direction. For crossing water, gas or sewerage pipes, etc, cables shall be taken above the pipes where minimum 500 mm clearance is not available. The cable shall cross these pipes through RC/ GI pipes at a minimum depth of 750 mm from finished ground level keeping the distance between the utility pipes and pipe carrying cables 300 mm minimum.

While laying cables parallel to building, railway track, utility pipe lines, drainage, sewerage, etc. the minimum clearance shall not be less than 1000mm.

Adequate length of cables shall be pulled inside the switch boards, control panel terminal boxes, feeder pillar etc. so as to permit neat termination of each core.

**SURPLUS CABLE**

At the time of original inspection, approximately 1 meter of surplus cable (in the form of a loop or otherwise) shall be left at each entry or exit of the cable at a pole or at the pillar box, or near any terminal as may be directed by the Consultant / Engineer-in-Charge.

**PROTECTIVE COVER FOR CABLES DIRECTLY BURIED IN GROUND**

Except where otherwise directed by the Consultant/Engineer-in-Charge, the cable (for the entire length in trench) shall be protected by a layer of bricks laid flat on top and shall be provided at least by 75 mm sand cushioning both at top and bottom. This brick protection shall cover all the cables in the trench (single cable or multiple cables, in horizontal formation). In case of a single cable, the brick protection shall consist of one brick flat (with
the length along the width of the trench) and supported on two lines of brick-on-edge, one on each side of the cable (with the length of the bricks along the length of the trench).

For multiple cables in horizontal formation, in addition to the two outer lines of brick-on-edge, there shall be additional lines in between adjacent cables. The top cover of brick flat shall extend to cover all the cables, each brick being supported on the lines of brick-on-edge.

**BACK FILLING OF TRENCH**

After laying of cables the remaining portion of the trench shall be back filled with good excavated soil and well rammed in successive layers not exceeding 300 mm depth each and duly compacted to the satisfaction of the Consultant/ Engineer-in-Charge. Surplus soils of excavation shall be removed or disposed of as per direction of the Engineer-in-Charge.

All material like sand, brick and clamp, etc. shall be supplied by the contractor. The cable laying rate shall be inclusive of all these items.

**CABLES LAID THROUGH PIPE SLEEVES**

Entry of cable from underground trenches to the building or tunnel shall be through pipe sleeves. Necessary precaution shall be taken to make entry point fully water tight by properly sealing the pipe sleeves in a manner approved by the Engineer-in-Charge.

Where cables are required to cross roads, railway tracks and surface drains, they shall be taken through pipe sleeves at a minimum depth of 1000 mm.

**LAYING OF CABLES ON RACK/ TRAY/ BRACKET/ HOOKS/ MASONRY TRENCH**

Where cables are required to be laid directly along structure walkway, walls, ceiling, they shall generally be taken exposed on brackets, cable racks, trays, hooks laid along building structure. Spacing of saddles/ hooks shall be such that the cables are straight and shall not exceed 750 mm.

The cable rack/ trays shall be ladder type / pre-fabricated perforated type and bends / curvature shall be smooth and suitable for bending the largest cable running in the rack / tray. The cable rack/ trays shall be suitably installed on the building structure with proper support at regular intervals.

Cable rack/ trays shall be so arranged that they do not obstruct or impair clearance of passage way.
Where there is possibility of mechanical damage cable racks / trays shall be adequately protected by sheet steel cover.

Unless otherwise specified in the schedule of quantities the rack/ trays shall be painted with corrosion resistant paint and finished with enamel paint of shade battleship grey or any other colour shade acceptable to Consultant/ Engineer-in-Charge.

**CABLE ROUTE MARKER**

Cable route markers shall be provided at each joint, entry to buildings, each turn, either side of the road crossings and at 30 meter intervals for straight cable runs and at location directed by the Engineer-in-Charge.

The cable marker shall be of cement concrete slab of R.C.C. type (l:2:4) and of size 600mm x 300mm at the bottom and 500 mm x 200 mm at the top with a thickness of 100 mm with marking 'CABLE' and shall be laid flat at finished ground level centered over the cables for easy identification.

Unless otherwise specified in the schedule of quantities, galvanised Iron type cable route marker of size 100mm dia 50 mm thick G.I. Plate with marking 'CABLE' thereon welded to 35 mm x 35mm x 6mm angle iron 600mm long fixed in a rigid manner may also be used as approved by the Engineer-in-Charge.

All materials like cable route marker, sand and cement, etc. for fixing the same to be supplied by the contractor. The cable laying rate shall be inclusive of all these items.

**CABLES TERMINATION**

Power cable termination shall be carried out in such a manner as to avoid strain on the terminals by providing suitable clamp near the terminals. All power cables shall be terminated to the circuit breaker, switch fuse units, busbars, etc. by means of suitable sizes crimping type or soldering type cable socket / lugs / ferrules and empire tape upto palm of the cable lug. PVC tape shall not be used directly, because of its poor thermal stability. It may however, be used over the empire tape. Control cables shall be terminated by crimping or directly clamped in the terminal blocks by screws.

When pinching the smaller size conductor directly in the terminal bore of the switches, the individual strands shall be fanned out and cleaned by wire wool or emery paper and the cleaned surface shall be coated with a thin layer of oxide inhibiting grease. The conductor shall be tightened fully to the terminal bore but over tightening shall be avoided.
For connection to busbars and other terminals, brass or cadmium plated nuts/ bolts and washers shall be used. Copper cables shall never be terminated directly on aluminium busbar. Suitable measure shall be taken to avoid heating due to bimetallic contacts.

A selection chart of crimping type cable lugs for various combination of cables/ busbar/ fuse switch terminals is shown below:

<table>
<thead>
<tr>
<th>Material of busbar/ switch terminals</th>
<th>Material of Cables</th>
<th>Material of crimping lug</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aluminium</td>
<td>Aluminium</td>
<td>Aluminium over tin plated copper</td>
</tr>
<tr>
<td>Copper</td>
<td>Aluminium</td>
<td>Aluminium lug with copper plated palm</td>
</tr>
<tr>
<td>Silver/tin plated copper</td>
<td>Aluminium</td>
<td>Aluminium or tin plated copper</td>
</tr>
<tr>
<td>Aluminium</td>
<td>Copper</td>
<td>Tin plated copper</td>
</tr>
<tr>
<td>Copper</td>
<td>Copper</td>
<td>Copper or tin plated copper</td>
</tr>
</tbody>
</table>

4.13 EARTHING

All non current carrying metallic part of various electrical equipments as well as cable armouring, metallic conduit, cable racks/ trays, brackets, supporting structures, etc. shall be effectively earthed by not less than two separate and distinct earth connection in accordance with Indian Electricity Rules, and the relevant Indian Code of Practice for earthing 3043-1987.

PIPE ELECTRODE

The earth electrode for earthing station shall comprise G.I. pipe 'B' Class of 50mm internal diameter and 3 Mtr long in one single piece with holes 12mm dia on all sides at 150 mm centre, upto a minimum height of 2.5 metre from bottom. Removable caps / wire mesh funnel shall be provided at the top of pipe to facilitate pouring of water. Suitable clamps made of 40mm x 6mm galvanised M.S. flats complete with bolt and nut shall be provided with the electrodes at 100 mm from the top end for connecting earth conductor. No joints will be
allowed in the earth electrode. The electrode shall be driven at least 2 metre clear from masonry structure and the distance between two electrode shall be not less than 2 metre when installed in parallel and preferably placed twice the length of the electrode i.e. 6 metre. A masonry inspection pit of inside dimension 300mm x 300mm x 300mm deep (unless otherwise stated) shall be built with 125 mm thick cement mortar (6:1) brick work both inside and outside plastered with 20mm thick and neatly cemented 1.5 mm thick, inside top and outside around the top of the earth pit, so that the top of the G.I. pipe is 250 m below the finished ground level and the opening on top shall be provided with C.I. manhole ring having lockable C.I. cover fixed & flush with the outside finished ground level.

**PLATE ELECTRODE**

Where plate electrode for earthing is to be employed, the size of the plate shall not be less than 600 mm x 600 mm x 6.3 mm for G.I. plate in thickness and 600 mm x 600 mm x 3.15 mm thickness in case of copper plate.

The plate shall have a drilled hole 14 mm dia. at the centre. The G.I. flat of not less than 40 mm x 6 mm (1 no. 25 mm x 6 mm G.I. flat for lightning conductor installation) should be connected to the plate by means of a 65 mm long 12 mm dia galv. bolt, double nuts using double galv. washers. In case of copper plate, copper flat of not less than 25 mm x 6.0 mm shall be used as the earth lead. The flat shall first be fastened on one side of the plate, leaving adequate length of flat, which shall be taken over to the other side i.e. to the earth busbar, switchboard, pole, continuous earth wire for O.H. line, service bracket, lightning arrester or the object to be earthed and be fastened as per the details of IS:3043-1987. No joint on the earth lead conductor is permitted. Every care shall be taken to ensure that the ends of the wire/ flats have been securely clamped by the bolt on cleaned surface of the plate and establish a good electrical contact.

The plate shall be buried vertically at a minimum of 3.6 M below the ground level for sandy soil and 2.0 m below the ground level for normal soil. In order to place the same at the prescribed depth, the dimension of pit to be excavated shall be 900 mm x 900 mm x 4 m deep. The G.I. plate shall be placed in position by the contractor only after the inspection of excavated pit and approval is obtained from the Consultant/ Employer.

After placing the plate the earth lead conductor shall be protected by means of a continuous length of G.I. pipe (Class B) having 50 mm dia (minimum) bore or route depending upon the size of the lead, right from the plate upto a height of 600 mm metre (2 ft.) above ground level. The whole length of pipe shall be filled with bituminous compound of approved make and brand. The molten compound shall be poured from the top end of the pipe and topped upto overflowing.
A masonry inspection pit for the earth station of inside dimension approximately 300 mm x 300 mm x 300 mm depth (unless otherwise stated) shall be built with 125 mm thick cement mortar (6:1) brick work with 1st class bricks, both inside and outside plastered with 20 mm thick and neatly cemented 1.5 mm thick, inside, top and outside around the top of the earth pit. The opening on top shall be provided with C.I. manhole ring having lockable C.I. cover fixed and flush with the outside finished ground level.

Electrodes shall be buried at least 2 meter away from masonry structure/ building/ pole or object to be earthed. However, earthing electrodes for L.C. installations should be as close to the down conductors as possible. Electrodes when installed in parallel, shall not be placed less than 2 meter apart and preferably placed at distance greater than 6 meters.

All the excavations shall be duly back filled, dressed and rammed.

4.14 EARTH BUSBAR

GALVANISED M.S. FLAT

Unless otherwise specified in the schedule of quantities, the earth bus bars shall be of heavily galvanised M.S. Flat of cross section 50mm x 6mm having adequate number of drilled holes with 10mm galvanised steel bolts, nuts, plain and spring washers for securely connected the earth leads and the continuity of conductor. The bulbar shall be fixed on wall, having clearance of 6mm from wall with spacing insulators with 13mm dia G.I. rag bolts, spaced about 50mm apart.

COPPER FLAT

To be used, as specified in the schedule of items, where earthing requirements are more stringent, with use of brass bolts, nuts, washers for connections.

4.15 EARTH LEAD CONDUCTOR

The earth lead for each electrode shall be 7/10 S W G stranded G.I. wire connected securely to the earth electrode and earth bulbar. The earth lead shall be mechanically protected with a continuous length of 25mm dia G.I. Pipe (Class ‘B’) right from the electrode to the earth bulbar and the pipe shall be filled with bituminous compound.

Galvanised M.S. Flat earth conductor directly buried in ground shall generally be taken at a depth of 600 mm and shall be provided with one coat of bituminized paint, one layer of half lapped bituminized tape and a final coat of bituminized paint to prevent corrosion.
The earth conductor when laid inside building/ sub-station shall be taken either exposed on cable racks/ trays, walls, ceiling, etc. or embedded in concrete depending on installation. Galvanised M.S. saddles clamped to M. S. flat spacers with tapped holes shall be used for clamping earth conductor. Flats shall be supported at intervals not exceeding 500 mm and stranded wires at intervals of 300mm.

Connection of earthing leads to earth electrodes and termination of flat earth continuity conductor to equipment shall be made by means of bolting. Connection of stranded earth wire to earth bus as well as to equipment shall be made through crimping type lugs and bolting. Jointing and tapping of flat earth conductor shall be done by means of welding.

The earth resistance from any point of the earthing system shall not be more than one ohm.

WORKMANSHIP AND INSTALLATION WORK

The workmanship shall be of good commercial quality and all supply material and installation work shall be completed to the full satisfaction of the Engineer-in-Charge.

4.16 PARTICULAR TECHNICAL SPECIFICATIONS FOR LIGHTNING PROTECTION SYSTEM

SCOPE

This specification covers supply of materials, fabrication and erection of Lightning protection system comprising air terminations, horizontal conductors, down conductors and earth electrodes. Applicable provisions and conditions of contract shall govern the work under the section.

GENERAL

Work to be provided for by the Contractor, unless otherwise specified, shall include but not be limited to the following :

i. Furnishing of labour, materials, supports, scaffolds transportation, etc required for the work.

ii. To provide all incidental items not shown or specified in particular but reasonably be implied or necessary for successful completion of the work in connection with drawings, specifications and schedule of items.

iii. To provide all supervision for proper execution of the work
After completion of supplying and installation of lightning protection system, if any defect in the material or workmanship is found by the Engineer-in-Charge the contractor shall remove the same and supply better and approved materials at his own cost to the satisfaction of the Engineer-in-Charge.

All precaution against theft and fire shall also be taken by the contractor.

MATERIAL

All material used for lightning conductors, down conductors, earth termination network, etc. of the protection system shall be reliably resistant to corrosion or be adequately protected against corrosion and generally conforming to IS:2309.

The entire lightning protection system shall be mechanically strong to withstand the mechanical forces produced in case of a lightning stroke.

HORIZONTAL AIR TERMINATION CONDUCTOR

Unless otherwise specified air termination shall be horizontal conductor. The horizontal air termination shall be so interconnected that no part of the roof is more than 9 meters away from the nearest horizontal conductor. For flat roof horizontal conductor shall generally be provided along the outer periphery of the roof. The conductor shall be exposed to atmosphere.

All metallic protections, vent pipes, railways etc. on or above the main surface of the roof shall be properly bonded to the air termination network.

DOWN CONDUCTOR

Down conductors shall follow the most direct path possible connecting the horizontal air termination conductor and the earth termination i.e. the ground electrode avoiding sharp bends, upturns and kinks. Joints shall as far as possible be avoided in down conductors.

JOINTS

The joints in the lightning protection system shall be avoided as far as possible. There shall be no joints in the down conductor below ground level. Where joints are necessary they shall be mechanically and electrically effective and shall be so made as to exclude moisture completely.
The joints may be soldered, riveted or bolted and mentioned in the schedule of work. With overlapping joints the length of the overlap shall not be less than 50 mm for all types of conductor. Contact surface shall first be cleaned and then inhibited from oxidation with a suitable noncorrosive compound. Strips shall be tinned, soldered, welded or brazed and at least double riveted. Bolted joints shall not be used on test points or on bonds to existing metal. For rust protection the welded joints shall be treated with barium chromate. Welded surface shall then be painted with red lead and aluminium paint.

**TESTING POINTS**

Each down conductor shall be provided with a testing point in a position convenient for testing but inaccessible for interference. No connection, other than one direct to an earth electrode shall be made below a testing point.

**EARTH TERMINATIONS**

Each down conductor shall have an independent earth termination and arrangement of isolation for testing purposes. The earth termination shall be located as close as practicable to the down conductor. Inter connections with other termination of the conductor system and with other buried metal services and earth terminations shall be made with G.I. tape laid directly at an average depth of 700 mm below finished ground level for the purpose of equalising the potential distribution in the ground.

**EARTH ELECTRODE**

Earth electrode shall be constructed and installed as specified in Part-B. The pipe/ plate electrode shall be driven into the ground as close as practicable but outside the circumference of the structure.

**FIXING OF CONDUCTOR**

Unless otherwise mentioned in the Schedule of Quantities the wall shall be drilled and plugged with teak wood pins of not less than 50mm long by 25mm square inner and 19 mm square outer surface. The void shall be finished according to the nature of wall surface with cement plaster.

Conductors shall then be securely attached to the building to be protected by galvanised steel fasteners of 2mm thick which shall be substantial in construction and wood screws and approved by the Engineer-in-Charge.
EARTH RESISTANCE

Properly made earth connections are essential for effective functioning of a lightning protection system and every effort shall be made to provide ample contact with the earth so that the earth resistance can be kept as low as possible.

The whole of the lightning protection system shall have a combined resistance to earth not exceeding 1 ohm.

WORKMANSHIP AND INSTALLATION WORK

The workmanship shall be first class and all supply material and installation work shall be completed to the full satisfaction of the Engineer-in-Charge.

CONTRACTORS RATE TO INCLUDE

Apart from other factors mentioned elsewhere in this contract, the rates for the above shall include for the following:

i. All labour, materials, tools and construction equipment required for proper execution of job

ii. Scaffolding including erection and removal

iii. Making good of all damaged civil work, if any

4.17 PARTICULAR TECHNICAL SPECIFICATION FOR ELECTRICAL EQUIPMENT

SCOPE

This specification covers supply of materials, fabrication, erection, testing and commissioning of switch boards, Distribution boards, Meter board, Lighting equipment, Switches, socket outlets and miscellaneous items. Applicable provisions and conditions of contract shall govern the work under the section.

GENERAL

The contractor shall have to submit manufacturer's Test Certificate for switchboards, switch fuse units, meters, fuse fittings, circuit breaker, isolating switches and other items as directed by the Engineer-in-Charge.
After completion of such supply and installation work of the electrical equipment, if any defect in the material or workmanship is found by the Engineer-in-Charge, the contractor shall remove the same and supply better and approved materials at his own cost.

All precaution against theft and fire shall also be taken by the contractor.

The contractor shall provide complete supervisions for proper execution of the work.

MATERIALS

All materials used in the work shall be of ISI marked wherever available, and of approved make and quality and in its absence conforming to the I.S. Specification.

For fabricated equipment, special care shall be taken to make the enclosed equipment proof against entry of creeping reptile, which may create electrical short circuits inside the live equipment.

L.T. MAIN DISTRIBUTION SWITCH BOARD /DIST. SWITCH BOARD

The 415 Volt main distribution switch board shall have incoming unit fed from L.V. side of transformer/ main distribution board.

STANDARDS

The equipment shall be designed to confirm to the requirements of I.S: 4237, I.S: 2147 and I.S: 375.

CONSTRUCTION

The main L.T. P.C.C board shall be of totally enclosed, topicalised, vermin proof, free standing, cubical type dead front minimum 2.0 mm thick sheet steel construction work housing incoming ACB/ MCCB/ SDFU, requisite number of outgoing ACB, MCCB, fuse switch or switch fuse units, busbars, Switch board shall be readily extensible on both sides. The L.T. terminal of the transformer shall be connected to the incoming terminal of the MCCB/Air Circuit Breaker through adequate number and size of aluminium conductor 1.1 KV grade PVCA cable.

The incoming and outgoing functional units shall be arranged in multitier formation, to provide a compact switch board having a pleasant appearance. Each unit shall be accommodated in a separate compartment having gasketed hinged door which shall be interlocked with the operating mechanism so as to prevent opening of the door when the
switch is in the 'ON' position and also to prevent closing of the switch with the door not properly secured.

The 'ON' and 'OFF' positions of the switch handle shall be distinctly indicated by proper marking. Modular construction shall be adopted to cater for different units with each cubicle having a busbar chamber and cable compartment. The maximum height of the devices on the panel shall not exceed 2000mm.

Suitably engraved identification levels shall be provided on each unit.

When switch board of floor or wall mounting type is specified instead of cubicle type with incoming and outgoing Fuse switch units or switch fuse units, the board shall comprise a suitable length of Busbar chamber. The board shall have provision for future extension. The floor stands or wall bracket shall have sufficient mechanical strength to carry the weight of the entire switch board.

The height shall be such that maximum operating height of the top unit shall not exceed 1800 mm.

**BUSBAR**

The main horizontal busbar shall be air insulated and made of high conductivity, high strength aluminium alloy or electrolyte copper complying with the requirements of grade E 91 E of IS 5082. The current density in each busbar shall not exceed 160 Amp. per sq. cm. for copper of 125 amp. per sq. cm. for aluminium.

The main phase busbar shall have continuous current rating throughout the length of power control centre and the neutral busbar shall have a continuous rating of at least 50% of the phase busbar.

Large clearance and creepage distance shall be provided on the busbar system to minimise the possibility of a fault.

The busbar and vertical risers horizontal connectors shall be fully insulated with PVC sleeve or tape to prevent accidental touch.

The busbar including neutral and earth bar shall be short circuit tested for fault withstand of 60 KA RMS for one second as per IS:8623 for factory Built Assemblies.

In no case, the rating of busbars shall be less than the Incoming Circuit Breaker or switch.

Busbar should be supplied with insulating material such as Permali, Hylam, and support shall be sufficient close and robust and support should permit sufficient movement for compensation of comparative stress in the event of short circuit.
AIR CIRCUIT BREAKER

The circuit breaker would be constructed in modular construction or would be enclosed in cassettes, designed for easy Switch Board Construction. The formed and welded steel construction should be given corrosive resistance treatment following fabrication work.

The breaker would have three distinct position, service/ test/ isolated within the cubicle, achieved by a racking cam and slide rails, simplifying inspection and from this position breaker should be able to withdrawn from housing. With door closed, the breaker should be withdrawn to test and isolated position.

The contact system should be designed to ruggedly and to effectively utilize the magnetic force generating in the current path ensuing high short time withstand current and interrupting capacity and reducing the let through energy. The ACB should be provided with separate set of arcing contacts and main contacts ensuring high mechanical and electrical life. Arc chutes on arcing contacts with de-ionisation plate should be provided. The contact tips should be made of Silver Nickel Alloy and arcing contact tips are of Silver Tungsten Alloy.

ACB should be suitable for manual or Motor wound stored charge spring closing mechanism. ACB should be provided with static trip release, inherent safety interlocks, such as safety shutters and door interlock, "OFF" & "ON" indicator auxiliary switches and contacts. ACB should be complete with overload protection, short circuit protection, under voltage trip, auxiliary contacts and instruments as specified in the schedule.

The ACB should comply with Indian Standard Specification I.S. 2516-1977 and IEC 157 and should be certified by CPRI.

MOULDED CASE CIRCUIT BREAKER

The MCCB should comprise of a switching mechanism, contact system, arc extinguishing device and the tripping unit, contained in a compact moulded case and cover.

The insulating case and cover shall be made of high strength, heat resistant, flame retardant thermo setting material, providing interphase insulation of a very high dielectric strength and an insulated enclosure with high withstand capability against thermal and mechanical stresses with protection against any fire hazards.

The trip free toggle mechanism should ensure that the trip command overrides all other commands.

MCCB should employ a maintenance free contact system designed to minimize the let through energies while handling abnormal currents. The special sintered contact tip should provide a wiping action, high resistance to erosion during interruption and a stable contact for normal service current.
A series of grid plates should be mounted in parallel between supports of insulating material. The profile of the de-ion steel plates extends directly over the contacts and draws the arc from the moving contact up into the divider chamber, thus confining, dividing and extinguishing the Arc.

The handle position should give positive indication of whether the MCCB is 'ON' (top), 'OFF' (bottom) or 'TRIPPED' (midway).

The tripping element provided on each pole of the MCCB should operate on a common trip bar because of which it does not create single phasing in the event of a fault on any of the phases.

The base design ambient temperature of the MCCB should be 40 degree C.

When specified the MCCB should be fitted with under voltage protection, earth fault protection, alarm & auxiliary switch etc.

**FUSE SWITCH UNIT**

The fuse switch units shall be of double break type suitable for load break duty, with quick make and break mechanism and front drive mechanism, generally conforming to IS:4064 - 1978 having fully shrouded contacts. All switch contacts shall be self aligning, spring loaded, silver plated. The isolators shall be connected on the busbar side or incoming side and fuses on the load side. However, fully withdraw able carriage to facilitate quick fuse link replacement is preferred.

The individual fuse switch units shall be either triple pole and neutral or single pole and neutral as specified with a front operating handle. The fuse links shall be non-deteriorating HRC type complying with IS:2208-1962.

The units which are to be installed separately should be totally enclosed fully shrouded sheet steel clad/cast steel casing.

**INSTRUMENTS**

The measuring instruments shall comply with IS:1248 in all respects.

Moving iron, square, flush mounting type instruments shall be used for measuring A.C. Voltage and currents.

The instruments shall normally be mounted on the hinged door of an all welded fabricated sheet steel housing of rigid construction to allow easy access to small wirings. Circuits shall be protected by H R C type fuse links complying with IS: 9224 (Part-II) -1979. The fuses shall be mounted near the tap-off point from the main connections so that a fault in the
instrument wiring does not affect the main supply. Small wiring shall be of 660 Volt grade single core flame retardant low smoke PVC insulated cable with copper conductor having minimum size 2.5 sq. mm. These shall be coloured coded for identification of circuits. The instruments shall be of approved make & acceptable to the Consultant/ Engineer-in-Charge.

CABLE TERMINATIONS

Separate cable compartment with doors having bolted cover plates shall be provided to facilitate cable termination to individual units. The design shall ensure generous availability of space for easy installation and maintenance of cabling and adequate safety for working in one vertical section without coming into accidental contact with live parts in an adjacent section. The compartments shall have detachable cover plate with gaskets at the bottom of the cable compartment unless specified otherwise. Cable glands and lugs of suitable sizes shall be provided for cable termination. Suitable arrangements shall be provided in the compartment for clamping of the cables.

EARTHING

G.I./copper flats shall run the entire length of the switch board. Two bolted type earthing terminals shall be provided in the board for connecting to the earth grid.

METAL TREATMENT

All steel materials used in the construction of the switch board shall undergo a rigorous rust proofing process comprising alkaline digressing, descaling in dilute sulphuric acid, cold rinsing, recognised phosphating process. Passivating and drying with compressed air in dust free atmosphere. It shall then receive two coats of highly corrosion resistant enamel paint of approved shade.

4.18 DISTRIBUTION BOARD

The distribution board shall comply with IS: 2675-1983 and B.S. 214 in all respects.

The distribution board shall be housed in a dust and vermin proof metallic enclosure fabricated from 2mm thick all welded sheet steel suitable for wall / column mounting and complete with a door of rigid construction fitted with dust protecting gasket, and robust fasteners. The enclosure shall have suitable provision for fixing of switch fuse units, fuse fittings and neutral bar on high grade rigid insulating support. The fuse fittings shall be connected by a tinned copper busbar. Each fuse bank shall be provided with a cable socket
for the incoming cable. The socket shall be situated centrally and must be covered by an insulating shroud for safety. Phase separation barriers made out of arc resistant materials shall be provided between the fuse banks. All bare current carrying parts shall be protected with a bakelite sheet of 3.5 mm thick to prevent accidental contact.

The distribution board of single phase and neutral type shall be fitted with an earth bar for termination of each continuity conductor of outgoing circuits.

In case of concealed system, the boxes are to be flushed with the wall and the cover shall be made from 5 mm thick opal acrylic sheet or 3 mm thick decorative white top bakelite Electrical switch board cover of Hylam make.

The sheet steel parts shall undergo a rigorous rust proofing process comprising alkaline degreasing, descaling in dilute sulphuric acid, cold rinsing and a recognised phosphating process. The steel work shall then receive two coats of high corrosion resistant primer paint before final painting by application of synthetic enamel paint.

MINIATURE CIRCUIT BREAKER DISTRIBUTION BOARDS (MCBDB)

SPN MCB DISTRIBUTION BOARDS (SPN MCBDB)

The SPN MCB Distribution Board (SPN MCBDB) shall be housed in rust protected sheet steel enclosure shall be designed to provide protection against ingress to IP42 of IS-2147. This shall also be provided with the add on acrylic door/ double door (Metallic) when specified. The MCB DB shall be supplied complete with tinned copper busbar of adequate rating and incorporating Isolator; MCB or equivalent RCCB as incomer. MCB's shall be mounted onto specially designed din channel. The special mounting channel shall permit easy removal even of MCB in the middle of the bank without disturbing other MCBs.

The incomer phase shall accept 35 sq.mm cable while the neutral shall accept 16 sq.mm cables. The consumer unit shall have provision of 20 mm/ 25 mm knockouts at top and bottom and two 32mm/ 25 mm knockout on sides facilitates wiring space making for flexibility and convenience of wiring.

TPN MCB DISTRIBUTION BOARD (TPN MCBDB)

The TPN MCB Distribution Board (TPN MCBDB) shall be fabricated from CRCA sheet. This shall be painted in aesthetically appealing two-tone powder coated finish. The TPN DB shall have provision for incorporating isolator, MCB or RCCB as incomer. The busbar shall be integral type single piece busbar (Cu) and coupling links. The MCBs shall be arranged in
two vertical banks with switch lever operating in horizontal plane for on-off switching. Specially designed mounting channel for quick shop fitting and easy removal shall be fitted.

The sheet steel enclosure fitted with add-on acrylic door/ double metallic door shall be provided with protection against ingress IP42 or IS:2147. The incomer phase shall accept upto 35 sq.mm cable while the neutral shall accept 16 sq.mm cables.

Two conduit entry plates at top and bottom shall be provided to facilitate drilling conduit holes at site to suit site requirements. The TPN DB shall conform to IS: 8623 for factory built assembly

METER BOARD

Unless otherwise mentioned in the schedule of quantities the Meter Board shall house a kwh meter in a dust and vermin proof metallic enclosure fabricated from 2 mm thick all welded sheet steel suitable for wall mounting. The door shall be secured by fasteneners, enabling dust protecting gasket to be compressed easily. The kWh meter shall be of approved make and the same shall be mounted on a rigid insulating support. There must be a viewing aperture on the M.S. door covered with a 2mm thick clear acrylic sheet for easy meter reading and it shall be possible to seal the enclosure against unauthorized opening.

The sheet steel enclosure shall undergo rust proofing process and painting as specified in Part-B.

FUSE CUT OUTS

The fuse cut outs shall be totally enclosed, metal clad suitably for mounting on flat vertical surface and shall be provided with a screwed top cover. It shall be possible to seal the enclosure against unauthorized opening.

PUSH BUTTONS AND CONTROL SWITCHES

All push button switches shall be of sturdy design suitable for all types of control circuit. Unit construction shall be adopted so as to have any desired arrangement of contact.

Control and selector switches shall be of sturdy design with modular construction comprising rotary type switch with pistol grip or twist type operating handle and a number of switching elements operated by a single shaft and shall have suitable position indicator to show that the switch is in selected position.

The push button and control switch shall be of approved make.
**CONTACTOR UNITS**

The contactor unit shall comply with IS:2959 in all respects.

The main contactor unit shall be of robust in design having double break bounce free type contacts and pressure type terminal clamps. The contacts shall be made of antiweld silver cadmium oxide. The coil shall be vacuum impregnated, backed with inter-layer paper insulation and finally moulded in hard resin.

The contactor units shall be of approved make.

**4.19 LIGHTING EQUIPMENT**

The luminaires for fluorescent lamps shall be shop assembled, fully wired and suitable for 1 No. 4 ft. tube or 2 Nos. 4 ft. tubes as the case may be. The salient features of these luminaires are basic channels/ rails, 240 volt ballasts with copper winding wire, spring loaded bipin type lamp holders, glow type starters and condensers. Reflectors and/ or decorative covers shall be supplied as specified in the Schedule of Quantities.

The luminaires for incandescent lamps shall be as specified in the schedule of quantities and approved by the Engineer-in-Charge before the same is used.

The incandescent Bulkhead type fittings shall be of cast aluminium alloy body, finished by application of synthetic enamelled silver grey paint outside, white insides, with front glass, wire guard, tropicalised gasket, B. C. Lamp holder and suitable for use with 100 Watt G.L.S. Lamp. The fittings shall have tapped 19mm E.T. for conduit entry.

The Highbay luminaires for sodium/ mercury vapour/ metal halide lamps shall be integral type unit having a spun aluminium canister at the top for housing control gear, terminal block for the incoming supply, earthing terminal and suspension arrangement. The luminaire shall have reflectors of spun anodized aluminium with a secular finish and suitable for use with 150/ 250 / 400 watt HPSV / HPMV / Metal Halide lamp as the case may be.

The Post-top lantern type luminaires shall have a die-cast aluminium electrical unit/ housing with provision for pipe entry from below, a canopy made of spun aluminium and an opal white acrylic diffuser resistant to ultraviolet radiation and heat. The luminaire shall be rain proof, insect tight and fully wired upto the terminal block and suitable for use with 70/ 80/ 125 watt HPMV or 100 watt GLS Lamp as specified in the schedule of quantities.

The flood lighting luminaires shall have a rugged construction housing made of cast aluminium alloy of low copper content for corrosion resistant, highly polished and anodised aluminium reflector for beam control, a heat resistant front glass with gasket and terminal block. To facilitate aiming and fixing, bracket shall be provided on the housing. The
luminaire shall be rain proof, and suitable for use with 1000 W tungsten halogen lamp or 250 / 400 Watt HPSV lamp/ metal halide lamp as specified in the schedule of quantities.

The ballasts for fluorescent tube shall conform to IS: 1534 & IS:1534(Part-I) 1977 and the same for high intensity discharge lamps shall conform to IS:6616-1982 and these shall have high grade synthetic enamelled copper winding wires, quality grade insulation materials, good quality low hysteresis loses electrical stampings, and complete unit shall have polyester filling. The ballasts shall be suitable for use on single phase 240 Volts 50 Hz. A.C. system and of approved make.

The capacitors shall comply with IS: 1569-1976 and be of hermetically sealed type.

4.20 EXHAUST FANS

The Exhaust fans shall conform to IS:2312-1967 and suitable for operation on 230/ 240 Volt single phase. 50 Hz. A.C. system. The fans shall be ring mounted type designed to give maximum air volume changes under free air flow conditions.

4.21 SWITCHES

Light and fan switches shall be rated for 6 amp. 250 volts and of Piano-key type and suitable for flush mounting on sheet steel board with moulded bakelite cover (manufactured by switch manufacturer). The switches shall be of approved make & acceptable to the Engineer-in-Charge. The switches shall comply with relevant I.S.

4.22 SOCKET OUTLET AND PLUG

These shall be of 3 pin type and of rating 6 amps (for light) and 16 amps. (for power). Each socket outlet shall be complete with controlling switch and plug top. Protective fuse links shall be provided with 16 amps. power socket outlet. The socket outlets shall have piano-key type switches of approved make and acceptable to the Engineer-in-Charge. The socket outlet and plug shall comply with the relevant I.S. specifications.

4.23 SWITCH BOXES

Sheet metal (16 SWG) switch boxes/ connection boxes with 3 mm thick bakelite top cover flushed in wall by housing the box after cutting brick wall. Sheet metal boxes shall be treated against corrosion by passivation or other approved method.
4.24 FEEDER PILLAR

The feeder pillar shall be of the floor mounting type, totally enclosed and weather proof. The cubicle shall be fabricated out of heavy gauge sheet steel of thickness not less than 10 gauge with suitable side frames and 12 gauge stiffeners.

Hinged doors of not less than 3mm thick shall be provided at the front and rear of the cubicle to provide access for installations, operations, tests and inspection. All doors shall be fitted with dust excluding gaskets. The door shall also be fitted with suitable locking arrangement to prevent unauthorised opening. The cubicle shall be designed for mounting over cement concrete plinth by the roadside and shall be of substantial construction capable of withstanding the vibration normally experienced due to vehicular traffic.

The sheet steel materials used in the construction of the cubicle shall undergo a rigorous rust proofing process comprising alkaline degreasing, descaling in dilute sulphuric acid, cold rinsing and a recognised phosphating process. After metal treatment, the interior of the cubicle shall be painted with two coats of air drying red lead primer followed by two coats of air drying anti-condensation paint. The exterior of the cubicle shall be painted with two coats of red oxide primer and finished by application of two coats of enamel paint or any other colour shade acceptable to Engineer-in-Charge.

Ventilation louvers in the form of finely divided wire mesh shall be provided on the two sides to ensure natural ventilation.

4.25 TUBULAR POLE/G.I. PIPE POLES

Where tubular steel pole are specified (either swagged or stepped), the same should be manufactured and supplied as per I.S. 2713 part I to III - 1980. Where G.I. pipe pole are specified the same should be approved to I.S.

4.26 LOOP-IN JUNCTION BOX

The junction boxes shall be drip proof type dust and vermin proof construction fabricated from 2mm thick sheet steel having internal dimensions of 200 x 150 x 130mm depth for single phase distribution system and 250 x 200 x 130 mm depth for three phase distribution system. These shall have moulded Bakelite base connector block with anti-vibration nickel plated brass terminals of suitable size and rating and porcelain fuse fittings.
4.27 MANUFACTURER’S DRAWING

The successful tenderer shall submit for approval General arrangement and dimensioned drawings for Power and Lighting distribution switch board, Motor Control centre, Bus-duct arrangement, Miniature circuit breaker distribution board, Distribution board, Interlocked Switch socket outlets, Clock switch control panel, T P Power Cable junction box and cable rack etc. as required in three sets before commencing manufacture.

4.28 WORKMANSHIP AND INSTALLATION WORK

The workmanship shall be of good commercial quality and all supply materials and installation work shall be completed to the full satisfaction of the Engineer-in-Charge.

4.29 MANDATORY TEST

<table>
<thead>
<tr>
<th>SL. No</th>
<th>Item Description</th>
<th>Nature of Test</th>
<th>Approved Specification</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>H.T. Switchgear</td>
<td>a. Shop Test</td>
<td>IS: 10118,(Part-III)1982</td>
<td>All Routine Test including High Voltage Test</td>
</tr>
<tr>
<td>2</td>
<td>Power Transformer</td>
<td>a. Shop Test</td>
<td>IS:2026-1977</td>
<td>All Routine Test including temperature rise Test</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. Site Test</td>
<td>IS:10028(part-II)1981</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>L.T. Switch Board, Dist. Board, Power Control Panel, Feeder Board</td>
<td>a. Shop Test</td>
<td>IS: 4237</td>
<td>2500V to withst for 1min. and Clearance and creepage to be check.</td>
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<td></td>
<td></td>
<td>b. Site Test</td>
<td>IS: 5039</td>
<td>Do</td>
</tr>
<tr>
<td>4</td>
<td>A.C.B</td>
<td>a. Shop Test</td>
<td>IS 2516 (Part I &amp; II)1985</td>
<td>Shop test to be witnessed by NBCC. Test certificate to be produced.</td>
</tr>
<tr>
<td></td>
<td>Shop Test</td>
<td>Site Test</td>
<td>Specification</td>
<td>Test Requirement</td>
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<td>4</td>
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<tr>
<td>5</td>
<td>MCCB</td>
<td>a. Shop Test</td>
<td>IS: 2516 (Part I &amp; II) 1985</td>
<td>Manufacturers Test Certificate to be furnished</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. Site Test</td>
<td>Do</td>
<td>Operation of the breakers to be tested.</td>
</tr>
<tr>
<td>6</td>
<td>RCCB</td>
<td>a. Shop Test</td>
<td>IS: 12640</td>
<td>Manufacturers Test Certificate to be furnished</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. Site Test</td>
<td>Do</td>
<td>Operation of the breakers to be tested.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. Diameter of each strand of wires/ cables</td>
<td>IS: 8130</td>
<td>Diameter to be measured at site before use to confirm the correctness of the wire/ cables.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>c. Overall diameter</td>
<td>IS: 694, IS: 1554</td>
<td>Do</td>
</tr>
<tr>
<td></td>
<td></td>
<td>d. Resistance</td>
<td>IS: 8730</td>
<td>Resistance of 100M of wires/cables to be measured.</td>
</tr>
<tr>
<td>8</td>
<td>Wires/ Cables</td>
<td>a. Shop Test</td>
<td>IS: 694, IS: 1554</td>
<td>Manufacturers Test Certificate to be furnished</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. Diameter of each strand of wires/ cables</td>
<td>IS: 8130</td>
<td>Diameter to be measured at site before use to confirm the correctness of the wire/ cables.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>c. Overall diameter</td>
<td>IS: 694, IS: 1554</td>
<td>Do</td>
</tr>
<tr>
<td></td>
<td></td>
<td>d. Resistance</td>
<td>IS: 8730</td>
<td>Resistance of 100M of wires/cables to be measured.</td>
</tr>
<tr>
<td>9</td>
<td>Conduit Thickness</td>
<td>IS: 9537</td>
<td>Only ISI marked conduit to be used.</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Earthing Earth Electrode Resistance.</td>
<td>IS: 3043-1978</td>
<td>Resistance to be measured.</td>
<td></td>
</tr>
</tbody>
</table>
### PARTICULAR TECHNICAL SPECIFICATION FOR FIRE FIGHTING SYSTEM

**Risk Classification**: Educational Building under Group B1 of NBC.

**Fire Protection & Fire Alarm System**

<table>
<thead>
<tr>
<th>DESCRIPTION OF SYSTEM / INSTALLATION</th>
<th>REQUIREMENT AS PER N.B.C.</th>
<th>SYSTEM ENVISAGED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hose reel</td>
<td>Required</td>
<td>To <strong>Provide</strong> with each down comer.</td>
</tr>
<tr>
<td>Down Comer</td>
<td>Not Required</td>
<td>To <strong>Provide</strong> 2 Nos. for Hose Reel only &amp; 1 no. for Hose Reel &amp; Landing Valve.</td>
</tr>
<tr>
<td>Yard Hydrant</td>
<td>Not Required</td>
<td>To <strong>Provide</strong> 1 No. including 1 No. F.B. Inlet.</td>
</tr>
<tr>
<td>Manual Electrical Fire Alarm System.</td>
<td>Not Required</td>
<td>Not To <strong>Provide</strong></td>
</tr>
<tr>
<td>Automatic Detection &amp; Alarm System.</td>
<td>Not Required</td>
<td>Not To <strong>Provide</strong></td>
</tr>
<tr>
<td>i) Underground Fire Water Tank.</td>
<td><strong>Not Required</strong></td>
<td>Not To <strong>Provide</strong></td>
</tr>
<tr>
<td>i) Near the underground static tank.</td>
<td><strong>Not Required</strong></td>
<td>Not To <strong>Provide</strong></td>
</tr>
<tr>
<td>ii) Terrace Tank.</td>
<td><strong>Not Required</strong> 10,000 Ltrs.</td>
<td>To <strong>Provide</strong> 15,000 Ltr.</td>
</tr>
<tr>
<td>ii) At the Terrace level.</td>
<td><strong>Not Required</strong></td>
<td>Not To <strong>Provide</strong></td>
</tr>
<tr>
<td>Pump (Fire / Jockey)</td>
<td>One electric Booster Pump of capacity 450 Lpm.</td>
<td>To <strong>Provide</strong></td>
</tr>
<tr>
<td>Others</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Portable Extinguisher.</td>
<td>Required</td>
<td>To <strong>Provide</strong></td>
</tr>
<tr>
<td>b) Fire Order / Notice.</td>
<td>Required</td>
<td>To <strong>Provide</strong></td>
</tr>
<tr>
<td>c) Exit Sign.</td>
<td>Required</td>
<td>To <strong>Provide</strong></td>
</tr>
</tbody>
</table>
CODES & STANDARDS.

All the systems and equipments within the scope of this tender shall be of reputed proven makes, designed and manufactured in accordance with the stipulations of latest versions of Indian Codes or recommendations of State F.E.S / T.A.C. / F.O.C. / N.F.P.A.

When an equipment is offered conforming to standards other than those listed below, it shall be clearly brought in Schedule of Deviation.

01. IS:1646 : Code of practice for fire safety of building (general), Electrical Installations.
02. IS:1648 : Code of Practice for fire safety of buildings (general), Fire Fighting Equipment and its Maintenance.
03. IS:3034 : Code of Practice for Fire of Industrial Buildings, Electrical Generating and Distributing Stations.
04. IS:884 : First Aid Hose Reel for Fire Fighting (For Fixed Installations).
05. IS:2171 : Portable Fire Extinguisher, Dry Powder Type.
06. IS:2878 : Portable Fire Extinguishers, CO₂ type.
07. IS:1239 : Part - I : Mild Steel Tubes (upto 150mm).
   Part - II : Mild Steel tubulars and other wrought steel pipe fittings.
08. IS:778 : Gunmetal gate, globe and check valves for general purposes.
10. IS:14846 : Sluice Valve for water works purposes (50 to 1200mm size) – Specification.
11. IS:5312 : Swing Check type Reflux (Non-Return) Valves.
12. IS:940 : Portable Fire Extinguisher ,Water CO2 Type.
13. IS:10204 : Portable Fire Extinguisher, Foam Type.
15. IS:5290 : Landing / Hydrant Valve.
16. IS:8423 : Controlled Percolation Hose for fire fighting.
17. IS:903 : Fire Hose Delivery Couplings, Branch Pipe, Nozzles & Nozzle spanner.
18. IS:2062 : Structural Steel (Fusion / Welding Quality ).
TECHNICAL SPECIFICATION

01.00 PORTABLE FIRE EXTINGUISHERS.

01.01 All the portable extinguishers shall be of free standing type and shall be capable of discharging freely and completely in upright position. Each extinguisher shall have the instructions for operating the extinguisher on its body itself and shall be supplied with initial charge with accessories as required.

01.02 Portable type extinguishers shall be provided with suitable clamps for mounting on walls or columns and shall be painted with durable enamel paint of fire red colour, conforming to relevant Indian standards or NFPA standard 10.

01.03 The Water CO₂ type extinguisher shall comprise of suitable thickness sheet body coated with leaded tin alloy internally and externally (by electrolytic deposition process), an inner container, a CO₂ gas cartridge, a plunger rod for CO₂ release and other accessories. It shall conform to IS:940.

01.04 Carbon-di-oxide type extinguisher shall comprise of high pressure steel cylinder body with wheel type valve, braided reinforced hose, non-conducting horns and accessories, wheeled trolley or mounting clamp, etc. It shall conform to IS:2878.

01.05 Dry chemical extinguisher shall comprise of suitable thickness sheet steel body coated with leaded tin alloy internally and externally (by electrolytic deposition process), an inner container, a carbon-di-oxide gas cartridge, a plunger rod for carbon-di-oxide release, a high pressure hose, a nozzle, a nozzle holder, wall mounting brackets and other accessories. It shall confirm to IS:2171. The powder shall confirm to IS:4861 or IS:4308.

01.06 Any other kind of portable fire appliances provided shall confirm to NFPA standard 10 and of approved make.
02.00 FIRE WATER PUMP

02.01 The pump shall be of submersible type and designed for continuous operation at its best efficiency point. The drive unit of the pump shall be suitably rated, so that the same can take the load of full open condition. The pump set along with its drive unit shall run smoothly without undue noise and vibration. Parts of pump like impeller, shaft sleeve, wearing ring etc. shall be of non-corrosive metal.

02.02 Under certain conditions, there may be occasions when fluid flow through the pump would be reversed, as in case of loss of power to the pump drive. The pump should be so designed that the impellers and other accessories are not damaged under such conditions of flow reversal.

03.00 ELECTRIC MOTOR.

03.01 Notwithstanding anything stated in this specification, the motor has to satisfy the requirement of the mechanical system during normal and abnormal conditions. All motors shall conform to the latest applicable Indian Standard (IS:325) & IEC.

04.00 PUMP STARTING PANEL.

04.01 The panel should be of free standing floor / wall mounting consols as required and out of CRCA sheet steel. Suitable terminal blocks shall be provided for termination of external cable / wires. The panel feature shall be able to match the system description or philosophy for water based fire protection system.

04.02 The panel shall be suitable to accept electric feeding of 440 (10% Volts, 3 phase & 50Hz/ 5% A.C. supply. The panel shall have the visual indication for power supply and of pump status. The starting interlock of the pump motor shall meet the system philosophy. The starter for Fire Pump shall be of Star-Delta type and that of Jockey Pump shall be of D.O.L. type.

04.03 The make of components and SLD of the panel shall be in accordance with the approval of Purchaser / Architect / Consultant.

05.00 HYDRANT / LANDING VALVE.

05.01 The Hydrant Valve (Alloy Steel) should conform to IS:5290 type ‘A’ and should be suitable for indoor or outdoor installation. The hydrant valve must be completed in all respect i.e. with blank cap & chain. It should have flanged inlet suitable for 80mm Nb
and oblique type female instantaneous coupling outlet of 63mm size to receive male
coupling as per IS:903.

06.00 PIPING

06.01 Mild Steel Black Pipe should be as per IS:1239, Part-I, medium / heavy grade. The complete piping system should withstand hydraulic test pressure equal to 1.5 times of maximum working pressure. Piping to be laid overground shall be supported properly on wall / column / beam /floor to suit site condition. Piping to be buried under ground shall be provided with protection of the outer surface, against soil corrosion by using two wrap of 2mm thick anticorrosion tape.

06.02 Outer surface of overground pipes shall be thoroughly cleaned of mill scale, rust etc. by wire brush, there after, one coat of red lead primer shall be applied. Finally two coats of synthetic enamel paint of approved colour shall be applied.

07.00 BRANCH PIPE WITH NOZZLE

07.01 The Branch Pipe (Aluminium) with Nozzle should conform to IS:903. The branch pipe should have male inlet connection of 63mm size at one end and other end should be threaded with a nozzle of 18mm bore.

08.00 HOSE WITH COUPLING.

08.01 63mm size controlled percolation hose should conform to IS:8423 and of 7.5 M / 15 M long. Both the end of the hose should be properly riveted and copper wire bounded with pair of male & female G.M. Hose Coupling as per IS:903.

09.00 FIRE SERVICE INLET (4 -WAY / 3 -WAY).

09.01 Fire Service Inlet connection should generally conform to IS:904 and complete with four / three 63mm dia instantaneous type gunmetal inlets with built in check valves and 150mm Nb / 100mm Nb connection for installation with the fire main.

10.00 SWINGING HOSE REEL.

10.01 First aid fire fighting swinging Hose Reel should conform to IS:884 and complete with reputed make 20mm dia rubber hose of 30 M / 33 M. long. It should be powder coated and should be complete in all respect i.e. with swivel joint, nozzle, etc.
11.00 SLUICE VALVE / GATE VALVE

11.01 Valves 40mm and below shall be heavy pattern gunmetal valves with cast iron wheel tested to 16 Kg./Cm² pressure. Valves shall be leader or equivalent make.

11.02 Sluice Valves 50mm and above shall be cast iron double flanged with non rising spindle. Sluice valves below ground shall be provided with suitable valve chamber. Sluice valves in exposed locations i.e. pumps house etc. shall be provided to with cast iron wheels. Sluice valves shall conform to IS:14846 class PN 1.0 and tested to 16 Kg/Cm² has pressure. Sluice valves shall be of approved make.

12.00 NON-RETURN VALVE

12.01 Non-Return valve shall be of cast iron double flanged & Swing Check type. The valve should have a permanent “ Arrow ” inscription on its body to indicate direction of flow of water. The valve shall generally conform to IS: 5312. The pressure rating of the valve shall be in accordance with the system design and the make shall be of approved type.

13.00 SAFETY SIGNAGE (EXIT SIGN WITH ARROW / FLOOR NUMBER)

13.01 The “Exit” Board & “Arrow” marking to indicate direction of escape route shall be of size 150mm X 300mm & 150mm X 150mm. The signage shall be of Photoluminescent nature. The signage shall get charged from the existing light present in the area and shall come alive to glow as soon as the light goes out by the luminous crystals containing mainly zinc sulphide in protective glass-like shell which is non toxic & non radioactive or non hazardous. The intensity of glow in the dark of the said signage shall decrease continuously but should last not less than 4 hours and strongest glow should produce during first 30 minutes of darkness.
## APPROVED LIST OF MATERIALS

<table>
<thead>
<tr>
<th>SL.No</th>
<th>NAME OF ITEMS</th>
<th>LIST OF APPROVED MANUFACTURERS / BRAND / APPLICATORS</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIVIL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Cement</td>
<td>LAFARGE, ACC, ULTRA - TECH, Dalmia, Konark.</td>
</tr>
<tr>
<td>2</td>
<td>Reinforcement</td>
<td>SAIL/TISCON/RINL/JINDAL STEEL &amp; POWER LTD (JSPL) /ELECTROSTEEL STEELS LTD., BOKARO</td>
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<tr>
<td>3</td>
<td>Mild Steel and Medium tensile steel</td>
<td>Brand to be approved by the E-I-C.</td>
</tr>
<tr>
<td>4</td>
<td>White Cement</td>
<td>Birla, J.K</td>
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<tr>
<td>5</td>
<td>Ceramic Floor Tiles</td>
<td>NITCO, ORIENT, SOMANY, KAJARIA, JOHNSON</td>
</tr>
<tr>
<td>6</td>
<td>Ceramic Tiles for Dado</td>
<td>NITCO, ORIENT, SOMANY, KAJARIA, JOHNSON</td>
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<tr>
<td>7</td>
<td>Vitrified Tiles</td>
<td>NITCO, ORIENT, SOMANY, KAJARIA, JOHNSON</td>
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<tr>
<td>8</td>
<td>Chequered Tiles</td>
<td>NITCO, Basant Betons, Bezelal</td>
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<tr>
<td>9</td>
<td>Ironmongery</td>
<td>Subject to prior approval of EIC.</td>
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<tr>
<td>10</td>
<td>Cement based paint</td>
<td>Snowcem Plus or equivalent</td>
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<tr>
<td>11</td>
<td>Exterior grade textured paint</td>
<td>Asian Paint, Berger, ICI, Nerolac</td>
</tr>
<tr>
<td>12</td>
<td>Distemper</td>
<td>Asian Paint, Berger, ICI, Nerolac</td>
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<tr>
<td>13</td>
<td>Plastic emulsion Paint</td>
<td>Asian Paints, ICI, Berger, Nerolac</td>
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<tr>
<td>14</td>
<td>Synthetic Paint</td>
<td>Asian Paint, Berger, ICI, Nerolac</td>
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<tr>
<td>15</td>
<td>Zinc Chromate Primers</td>
<td>Shalimar, Asian Paint, Berger, ICI</td>
</tr>
<tr>
<td>16</td>
<td>Flush Door/ Block Board/ Ply</td>
<td>Kit ply, Sarda Ply, Kutty, Greenply, Tower</td>
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<tr>
<td>17</td>
<td>Glass</td>
<td>Modi/ Saint Gobin/ Asahi</td>
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<tr>
<td>18</td>
<td>Chemical / Mechanical Anchor Fastners</td>
<td>HILTI, FISCHER</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Supplier(s)</td>
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<tr>
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<td>----------------------------------------------------------------------------</td>
</tr>
<tr>
<td>19</td>
<td>Pre-coated anti-corrosive steel sheet</td>
<td>Colour roof (India) Ltd., Interarch Building Products Pvt. Ltd., Kirbey Building Systems Ltd.</td>
</tr>
<tr>
<td>20</td>
<td>Hydraulic door closer</td>
<td>Hardwyn make (Eddy) or equivalent</td>
</tr>
<tr>
<td>21</td>
<td>Floor spring for aluminium door</td>
<td>Hardwyn, Garnish</td>
</tr>
<tr>
<td>22</td>
<td>Fittings for Aluminium doors and windows.</td>
<td>Ebco, Doorline</td>
</tr>
<tr>
<td>23</td>
<td>Water Proofing Compound/ Admixtures</td>
<td>Choksey, Sika Qualcrete, Degussa, Fosroc, Roffe, Cico, Impermo, ACCO proof</td>
</tr>
<tr>
<td>24</td>
<td>Epoxy Paints</td>
<td>Choksey, Dr. Beck, Asian Paint, Garwara Paints.</td>
</tr>
<tr>
<td>25</td>
<td>Extruded Aluminium Sections</td>
<td>INDAL, JINDAL, Hindalco</td>
</tr>
<tr>
<td>26</td>
<td>Polysulphide Sealant</td>
<td>Choksey, Sika Qualcrete, Degussa</td>
</tr>
<tr>
<td>27</td>
<td>Gypsum False Ceiling</td>
<td>India Gypsum Ltd.</td>
</tr>
<tr>
<td>28</td>
<td>Polycarbonate Sheet</td>
<td>GE Plastic or Equivalent</td>
</tr>
<tr>
<td>29</td>
<td>PVC flooring</td>
<td>Armstrong, Birla Vinoleum, Polyfloor Challenger Vinyl flooring.</td>
</tr>
</tbody>
</table>

### SANITARY ITEMS

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Supplier(s)</th>
</tr>
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<tbody>
<tr>
<td>1</td>
<td>Vitreous China Sanitary Ware</td>
<td>Parry, Cera, Hindustan</td>
</tr>
<tr>
<td>2</td>
<td>Plastic W.C seats</td>
<td>Commeander, Patel</td>
</tr>
<tr>
<td>3</td>
<td>GI Pipes</td>
<td>Tata, Jindal, NEZONE</td>
</tr>
<tr>
<td>4</td>
<td>GI fittings</td>
<td>HB, Zoloto, K.S</td>
</tr>
<tr>
<td>5</td>
<td>Stainless Steel Sink</td>
<td>Neelkantha, AMC, Corba</td>
</tr>
<tr>
<td>6</td>
<td>Mirror</td>
<td>Akoi, Atul, Silver, Fish, Jolly</td>
</tr>
<tr>
<td>7</td>
<td>C.P Pillar cock, Bibcocks, stop-cocks and other CP fittings</td>
<td>Essco, Parko, GEM, Jaquar</td>
</tr>
<tr>
<td>8</td>
<td>Brass Bib &amp; Stop cock</td>
<td>GPA, SANT, L &amp; K</td>
</tr>
<tr>
<td>9</td>
<td>Valves</td>
<td>Leaders, Kent, Zoloto</td>
</tr>
<tr>
<td>No.</td>
<td>Item Description</td>
<td>Brands/Models</td>
</tr>
<tr>
<td>-----</td>
<td>-------------------------------------------------------</td>
<td>--------------------------------------------------</td>
</tr>
<tr>
<td>10</td>
<td>Soil, Waste &amp; Rainwater pipe and fittings</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Unplasticised-PVC</td>
<td>Oriplast, Suprime, Prince</td>
</tr>
<tr>
<td>12</td>
<td>Sand Cast</td>
<td>RIF, BIG, NECO</td>
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<tr>
<td>13</td>
<td>Stonaware Pipes &amp; Gully</td>
<td>Perfect, Burn</td>
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<tr>
<td>14</td>
<td>RCC Pipe</td>
<td>Laxmi, Sood &amp; Sood, Jain &amp; Co.</td>
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<tr>
<td>15</td>
<td>C.I. S/S Pipes</td>
<td>IISCO, Kesoram, Electro Steel</td>
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<tr>
<td>16</td>
<td>C.I. Manholes</td>
<td>Kirloskar, IVC</td>
</tr>
<tr>
<td>17</td>
<td>C.I. Double Flanged non-return</td>
<td>Kirloskar or equivalent</td>
</tr>
<tr>
<td>18</td>
<td>PVC Tank</td>
<td>Sintex, Patton</td>
</tr>
</tbody>
</table>

**ELECTRICALS**

<table>
<thead>
<tr>
<th>No.</th>
<th>Item Description</th>
<th>Brands/Models</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>ACB, MCCB, SFU, CFS, HRC Fuse</td>
<td>GE, MDS, Schneider, L &amp; T, Siemens, Cromton Greaves, Power Control, C&amp;S</td>
</tr>
<tr>
<td>2</td>
<td>TPN switch fuse unit / switch disconnector fuse unit with HRC fuses</td>
<td>Siemens, L &amp; T, GE, C&amp;S, Schneider, Cromton Greaves, Power Control, Gerard, Indo Asian</td>
</tr>
<tr>
<td>3</td>
<td>DP/SPN SFU/ SDFU with HRC fuse</td>
<td>LK, HPL, Havell’s, L&amp;T, Indo Asian, C&amp;S</td>
</tr>
<tr>
<td>4</td>
<td>All moulded fuse with HRC fuses/Distribution fuse board with HRC fuses</td>
<td>Siemens, Larsen &amp; Toubro, GE, C&amp;S, Havell’s, Gerard</td>
</tr>
<tr>
<td>5</td>
<td>KWH Meter</td>
<td>Alstom, HPL-SOCOMEC, L&amp;T, Havell’s, Jaipur</td>
</tr>
<tr>
<td>6</td>
<td>Motor Starter</td>
<td>Siemens, L &amp; T, Schneider (CG), GE, T &amp; C., BCH, C&amp;S.</td>
</tr>
<tr>
<td>7</td>
<td>Rewireable type porcelain Switchgear, fuse fittings</td>
<td>Anchor, GE, Standard, Havell’s, Gerard</td>
</tr>
<tr>
<td>8</td>
<td>Changeover Switch</td>
<td>L &amp; T, ELECON/ Gerard, Havell’s, Clipsal</td>
</tr>
<tr>
<td>9</td>
<td>Miniature Circuit Breaker &amp; MCB</td>
<td>MDS, Merlin Gerin, ELECON/ Gerard, L &amp; T, Hager, Siemens, Havels, Legrand,</td>
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<tr>
<td></td>
<td>Distribution Boards</td>
<td>Indo Asian.</td>
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<tr>
<td>10</td>
<td>Earth Leakage current circuit breaker</td>
<td>MDS, Merlin Gerin, L &amp; T, Hager, Siemens, Gerard, Indo Asian</td>
</tr>
<tr>
<td>11</td>
<td>1100 Volts grade PVC insulated steel armoured and over all PVC sheathed cables with size in sq.mm embosed on cable surface</td>
<td>NICCO, Fort Gloster, National, CCI, Havell’s, Polycab,</td>
</tr>
<tr>
<td>12</td>
<td>PVC insulated stranded/ flexible copper conductor wire with size in sq.mm. embosed on cable surface (for internal wiring)</td>
<td>National (NC), Finolex, L&amp;T, R.R. Kabel, Polycab, Havell’s, Gerard, Indo Asian</td>
</tr>
<tr>
<td>13</td>
<td>Rigid PVC Conduit</td>
<td>B.E.C., Plaza, Kalingha, AKG, Precision, Gerard</td>
</tr>
<tr>
<td>14</td>
<td>Black stove enamelled conduit and galvanised steel conduit with ISI marked embosed on conduit surface</td>
<td>B.E.C., NIC, AKG</td>
</tr>
<tr>
<td>15</td>
<td>Decorative Electrical Switch Board cover with white top Lamination</td>
<td>Hylam or equivalent</td>
</tr>
<tr>
<td>16</td>
<td>Metal clad socket &amp; plug having scraping earth arrangement</td>
<td>Hager, Schneider (CG), MDS, L &amp; T, Gerard, Indo Asian, Havells. Indo Asian</td>
</tr>
<tr>
<td>17</td>
<td>250 Volt 6 Amp. Piano reed type switch/ Buzzer Push (Flush type), 250 Volt 16 Amp. 3 Pin socket with switch combined</td>
<td>Anchor, CPL, Precision</td>
</tr>
<tr>
<td>18</td>
<td>250 Volt 6 Amp. Ceiling rose, 250 Volt 16 Amp 3 pin socket with switch combined</td>
<td>Anchor, CPL, Precision, SSK, Magic, Kolor</td>
</tr>
<tr>
<td>19</td>
<td>Clock switch/time switch</td>
<td>L &amp; T, MDS, Hager, GIC, Indo Asian</td>
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<tr>
<td>20</td>
<td>‘CLIP ON’ Terminal assembly</td>
<td>Tosha, Elmex</td>
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<tr>
<td>22</td>
<td>ON/OFF Rotary Switch/ Selector Switch/ programme switch</td>
<td>Siemens, Hager, Larsen &amp; Toubro, Kaycee</td>
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<td>23</td>
<td>Cable Glands</td>
<td>COMIC, Raychem</td>
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<td>24</td>
<td>Cable Tray</td>
<td>Pilco, MEK</td>
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<td>Item Description</td>
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<tr>
<td>25</td>
<td>Battery</td>
<td>EXIDE, STANDARD</td>
</tr>
<tr>
<td>26</td>
<td>Fluorescent light fittings (All types) &amp; lamp.</td>
<td>Philips, Thorn, Bajaj, Wipro, Crompton</td>
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<tr>
<td>27</td>
<td>Decorative wall bracket/ ceiling mounted Luminaire for PL /incandescent lamp</td>
<td>Philips, Thorn, Bajaj, Wipro, Crompton</td>
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<tr>
<td>28</td>
<td>Fluorescent Street Light Luminaire &amp; lamp</td>
<td>Philips, Thorn, K-litr, Bajaj, Metal Coats</td>
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<td>29</td>
<td>Metal halide luminaire &amp; lamp</td>
<td>Philips, Thorn, K-litr, Bajaj, Metal Coats</td>
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<td>30</td>
<td>Lamp Holder (Pendent racket or Batten)</td>
<td>Anchor, SSK, Magic</td>
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<td>31</td>
<td>Exhaust Fan</td>
<td>G.E.C., Crompton, Polar, USHA</td>
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<td>32</td>
<td>Ceiling Fan</td>
<td>Crompton, Orient, Polar, USHA</td>
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<td>33</td>
<td>Ammeter/Voltmeter selector switch</td>
<td>Kaycee, L&amp;T, Switron</td>
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<td>34</td>
<td>Relay</td>
<td>Alsthom, GE, L&amp;T, Syntron, Control Group</td>
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<tr>
<td>35</td>
<td>Current Transformer</td>
<td>Kappa, L&amp;T, C&amp;S, AE, SIEMENS</td>
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<tr>
<td>36</td>
<td>Capacitor</td>
<td>L&amp;T, Manual, EPCOS</td>
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<tr>
<td>37</td>
<td>Sodium vapour, Murcury vapour MHL fittings and lamps</td>
<td>Philips, Crompton, Bajaj, Wipro</td>
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<tr>
<td>38</td>
<td>HT Switch Gear</td>
<td>MEI, Electrotecnica, BICCO, Siemens</td>
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<td>39</td>
<td>Distribution Transformer</td>
<td>Eastern Transformer &amp; Equipment, Truvolt, Voltamp</td>
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<tr>
<td>40</td>
<td>AC alternator</td>
<td>Kirlosker, Crompton, Stamford</td>
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**FIRE FIGHTING WORKS**

<table>
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<tr>
<th>No</th>
<th>Item Description</th>
<th>Brands/Manufacturers</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Fire Pump / Jockey Pump (Submersible type)</td>
<td>Kirloskar or Mather &amp; Platt or K.S.B</td>
</tr>
<tr>
<td>2</td>
<td>C.I. Valves (Sluice / Non-return / Check)</td>
<td>H. Sarkar / KSB / Audco / Subhash Engineering.</td>
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<tr>
<td>3</td>
<td>M.S. / G.I. Pipe.</td>
<td>Jindal or Tata.</td>
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<td>Item Description</td>
<td>Supplier Details</td>
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<td>-------------------------------------------------------</td>
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<tr>
<td>4</td>
<td>G.M.Valves.(gate / globe / check)</td>
<td>Leader or bearing ISI mark.</td>
</tr>
<tr>
<td>5</td>
<td>Hydrant / Landing Valve.</td>
<td>Ghosh Engineering / Asco Strumech.</td>
</tr>
<tr>
<td>6</td>
<td>63mm Fire Fighting Hose.</td>
<td>C.R.C. or Newage or B.R.G.</td>
</tr>
<tr>
<td>7</td>
<td>20mm Rubber Hose.</td>
<td>Dunlop or Diamond or Raihno.</td>
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<tr>
<td>8</td>
<td>Hose Box and Swinging Hose Reel.</td>
<td>Any fabricator, acceptable by local Fire Brigade authority.</td>
</tr>
<tr>
<td>9</td>
<td>Pressure Switch.</td>
<td>Indfoss / System Sensor.</td>
</tr>
<tr>
<td>10</td>
<td>Pressure Gauge.</td>
<td>H.Guru or Fiebig .</td>
</tr>
<tr>
<td>11</td>
<td>Portable Extinguishers.</td>
<td>D.Flame / Minimax/ Cease Fire</td>
</tr>
<tr>
<td>12</td>
<td>Power &amp; Control Cable.</td>
<td>Gloster / Nicco / Phinolex / Havells.</td>
</tr>
</tbody>
</table>

(If items not covered in above list of approved make, ISI make brands to used after obtaining prior approval from Engineer in Charge)

In case of non availability of makes mentioned above equivalent make brands may be used after obtaining prior approval from Engineer in Charge)
### GENERAL NOTES:

1.0 The items given in this schedule are provisional. The Contractor shall be paid for the actual quantity of work executed as measured at the site at the rates tendered. The client/consultant reserves the right to increase or decrease any of the quantities, or to omit to tally any item of work. Any claim by the Contractor on these accounts will not be entertained.

2.0 All the items of work given in this schedule of quantities shall be executed strictly in accordance with the latest Indian Standard Specifications and the requirements of the Electricity Supply Authority read in conjunction with the relevant drawings and Specifications.

3.0 The Contractor shall visit the site and shall satisfy himself as to the conditions under which the work is to be performed. He shall also check and ascertain the location of any existing structure or equipment or any other situation which may affect the work. No extra claim as a consequence of ignorance or on ground of insufficient description will be allowed at a later date.

4.0 All equipment and material shall be NS/IS/BS approved.

5.0 All approvals shall be obtained from Client/Consultant.

6.0 All equipment and material shall be inspected at manufacturer's works as per relevant IS by the Owner or his representative before despatch to site.

7.0 All Shop drawings has to be approved by the Client/Consultant before work at site or fabrication starts.

8.0 All Testing and Commissioning shall be as per relevant IS for equipment and IS: 732:1989 for the installation. All these testing records are to be maintained and submitted for Client/Client's representative.

9.0 The Contractor shall provide detail shop / working drawing and receive approval from client/consultant before commencement of work.
SOLAR PV SYSTEM

GENERAL

Technical Specifications in this section covers:

- Solar PV modules and array
- Module mounting structures for Solar PV Modules
- Junction Boxes
- Power Conditioning Unit (MPPT solar charge controller + Bi-directional Inverter)
- Battery Bank with Accessories
- Distribution Boards
- Cables and installation accessories
- Earthing and lightning protection
- Battery and control room.

2 STANDARDS AND CODES

The following Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract. In addition the relevant clauses of the Indian Electricity Act 1910 and Indian Electricity Rules 1956 as amended up to date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable.

BIS certified equipment shall be used as a part of the Contract in line with Government regulations. Necessary test certificates in support of the certification shall be submitted prior to supply of the equipment.

It is to be noted that updated and current Standards shall be applicable irrespective of those listed below.


16047:2012 Secondary Cells and Batteries containing Alkaline or other non-acid Electrolytes - Secondary Lithium Cells and Batteries for Portable Applications

16048(Part 1): 2013 Secondary Cells and Batteries Containing Alkaline or Other Non-Acid Electrolytes - Portable Sealed Rechargeable Single Cells Part 1 Nickel-Cadmum

16048(Part 2):2013 Secondary Cells and Batteries Containing Alkaline or Other Non-Acid Electrolytes-Portable Sealed Rechargeable Single Cells Part2 Nickel-Metal Hydride

3 SOLAR PV MODULES AND ARRAY

Crystalline high power cells shall be used in the Solar Photovoltaic module. Each Solar module shall consist of 72(minimum) Photovoltaic cells redundantly interconnected and peak power rating shall not be less than 165 W. The bidder offering single module with highest wattage shall be given preference provided all other things are equal.
To connect the solar module interconnection cable shall be provided. Photo / electrical conversion efficiency of SPV module shall be greater than 12%. Module shall be made of high transmissivity glass front surface giving high encapsulation gain and hot butyl rubber edge sealant for module protection and mechanical support.

All materials used shall have a proven history of reliable and stable operation in external applications. It shall perform satisfactorily in relative humidity up to 100% with temperatures between -10 Deg C and +85 Deg C and with stand gust up to 200km/h from back side of the panel.

Solar module shall be crystalline type, employing lamination technology using established polymer (EVA) and Tedlar or Polyester laminate.

Sample modules, representative of the production processes employed in the manufacture of the offered module shall be in accordance with the requirements of IEC 61215 or UL or CE approval. Offered module may also be intrinsically safe for being used in retail outlets. The bidder shall submit appropriate certificates.

<table>
<thead>
<tr>
<th>Type Crystalline</th>
<th>silicon</th>
</tr>
</thead>
<tbody>
<tr>
<td>Efficiency</td>
<td>&gt;= 13%</td>
</tr>
<tr>
<td>Fill factor</td>
<td>&gt;= 70%</td>
</tr>
</tbody>
</table>

Degradation warranty

- Panel output (Wp) capacity to be >=90% of design nominal power after 10 years and >=80% of design Nominal power after 25 years.

Module frame

- Non-corrosive and electrolytically compatible with the mounting structure material

Termination box

Thermo-plastic, IP 65, UV resistant

Blocking diodes

Schottky type

Module minimum rated power

The nominal power of a single PV module shall not be less than 74Wp.

RF Identification tag for each solar module

- Shall be provided inside the module and must be able to withstand environmental conditions and last the lifetime of the solar module.

RF Identification tag data

- a) Name of the manufacturer of PV Module
- b) Name of the Manufacturer of Solar cells
- c) Month and year of manufacture (separately for solar cells and module)
- d) Country of origin (separately for solar cells and module)
- e) I-V curve for the module
- f) Wm, Im, Vm and FF for the module
- g) Unique Serial No and Model No of the module
- h) Date and year of obtaining IEC
PV module qualification Certificate
i) Name of the test lab issuing IEC
j) Other relevant information on traceability of solar cells and module as per ISO 9000 standard

### Power output rating
To be given for standard test conditions (STC). I-V curve of the sample module shall be submitted.

### Compliance with standards and codes
IEC 61215 / IS 14286
IEC 61730 Part 1 and 2

### Salt Mist Corrosion Testing
As per IEC 61701

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### 4. Module mounting structure

- The array structure shall be made of hot dip galvanized MS angles of size not less than 50 mm x 50 mm x 6 mm size. The minimum thickness of galvanization shall be at least 70 microns. All nuts & bolts shall be made of very good quality stainless steel. The minimum clearance of the lowest part of the module structure and the developed ground level shall not be less than 500 mm. The structure shall have tilt span of 0 to 60 deg in Steps of 5 deg.

- Leg assembly of module mounting structure made of different diameter galvanized tubes may be accepted. The work should be completed with supply, fitting fixing of clamps, saddles, nut & bolts etc. While quoting the rate, the bidder may mention the design & type of structure offered. All nuts & bolts shall be made of very good quality stainless steel.

- The structure shall be designed to allow easy replacement of any module and shall be in line with site requirements.

- The structure shall be designed for simple mechanical and electrical installation. It shall support SPV modules at a given orientation, absorb and transfer the mechanical loads to the ground properly. There shall be no requirement of welding or complex machinery at site.

- The array structure shall be so designed that it will occupy minimum space without sacrificing the output from SPV panels at the same time it will withstand wind speed as per IS 875

- The supplier/manufacturer shall specify installation details of the PV modules and the support structures with appropriate diagrams and drawings.

- The drawings along with detailed design and calculations for wattage requirements shall be submitted to HPCL for approval before starting the execution work.

### PCC ARRAY FOUNDATION BASE:
The legs of the structures made with GI angles will be fixed and grouted in the PCC foundation columns made with 1:2:4 cement concrete. The minimum clearance of the lowest part of any module structure shall not be less 500 mm from ground level. While making foundation design, due consideration shall be given to weight of module assembly, maximum wind speed as per IS 875 and seismic factors for the site.
5. Junction Boxes
The junction boxes shall be dust, vermin and waterproof and made of FRP.
The terminals shall be connected to copper bus bar arrangement of proper sizes.
The junction boxes shall have suitable cable entry points fitted with cable glands of appropriate sizes for both incoming and outgoing cables. Suitable markings shall be provided on the bus bar for easy identification and cable ferrules shall be fitted at the cable termination points for identification. The junction boxes shall have suitable arrangement for the following:
Combine groups of modules into independent charging sub-arrays that shall be wired to the PCU.
Provide a test point for each sub-group for quick fault location.
To provide group array isolation.
The rating of the JB’s shall be suitable with adequate safety factor to inter
Connect the Solar PV array.

6. Power Conditioning Unit
As SPV array produce direct current electricity, it is necessary to convert this direct current into alternating current and adjust the voltage levels before powering equipment designed for nominal mains AC supply. 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” OR simply PCU. In addition, the PCU shall also house MPPT (Maximum Power Point Tracker), an interface between Solar PV array & the Inverter, to maximize Solar PV array energy input into the System.

**PCU refers to combination of charge controller and bi-directional inverter and shall be supplied as integrated unit.**

**Maximum Power Point Tracker (MPPT)**

Maximum power point tracker (electronic) shall be integrated into the PCU to maximize energy drawn from the Solar PV array. The MPPT shall be microprocessor / micro-controller based to minimize power losses. The efficiency of the MPPT shall not be less than 94% and shall be suitably designed to meet array capacity. The PCU shall be microprocessor / micro controller based suitable for automatic grid interaction. The time delay for grid interfacing should be minimum possible.

**Main features of PCU**

The PCU shall be capable of complete automatic operation, including wake-up, synchronization and shut down.

The PCU shall be self-commutated and shall utilize a circuit topology and components suitably for meeting the specifications listed above at low cost, high conversion efficiency and with high reliability.

The PCU shall be designed to withstand starting in-rush current when pump is started and provide trip free operation.

In PCU there shall be a direct current isolation provided at the output by means of a suitable isolating transformer.

The PCU shall include appropriate self-protective and self-diagnostic features to protect itself and the PV array from damage in the event of PCU component failure or from parameters beyond the PCU’s safe operating range due to internal or external causes. The self-protective features shall not allow any operation from the PCU front panel to cause the PCU to be operated in a manner which may be unsafe or damaging.
The PCU generated harmonics measured at the point of connection to the utility service, when operating at the rated power shall not exceed a total harmonic distortion of 3%.

The high voltage and power circuits of the PCU shall be separated from the low voltage and control circuits. All conductors shall be made of stranded copper and suitable insulation shall be used for the power and control cables.

The PCU shall withstand a high voltage test of 2 kV rms, between either the input or the output terminals and the cabinet (chassis).

Full protection against accidental open circuit, short circuit and reverse polarity at the input shall be provided.

The PCU shall not produce Electromagnetic Interference (EMI) which may cause malfunctioning of electronic and electrical instruments including communication equipment, which are located within the facility in which the PCU is housed.

The PCU shall include ground lugs for equipment and PV array grounding. The DC circuit ground shall be a solid, single point ground connection in accordance with prevailing national standards.

All exposed surfaces of ferrous parts shall be thoroughly cleaned, primed and painted or otherwise suitably protected to survive a nominal 15 year design life of the unit. The PCU enclosure shall be weatherproof and capable of surviving intact under all ambient conditions. Moisture condensation and entry of rodents and insects shall be prevented in the PCU enclosure.

Components and circuit boards mounted inside the enclosures shall be clearly identified with appropriate permanent designations, which shall also serve to identify the items on the supplied drawings.

All doors, covers, panels and cable exits shall have gasket or otherwise designed to limit the entry of dust and moisture. All doors shall be equipped with locks. All openings shall be provided with grills or screens with openings not larger than 0.95 cm (about 3/8 inch).

In the design and fabrication of the PCU the site temperature (0 to 50 degree C), incident sunlight and the effect of ambient temperature on component life shall be considered carefully. Similar consideration shall be given to the heat sinking of MOSFET’s, blocking diodes and similar components.

6. PCU Specifications

| Solar Charge Controller + Inverter+ Battery Charger |
| Switching device | MOSFET (Metal Oxide Semi-Conductor Field Effect Transistor) |
| Type | MPPT based PWM charger to charge 96V/48 V (nominal) battery bank with not less than 94% Solar charge controller efficiency |
| Input voltage from PV array | 48 /96V (nom) |
| Protections | Short circuit protection |

68 V/136V max
Input under voltage / Deep discharge of battery
Input surge voltage protection
Over current
Battery reverse polarity protection
Solar array reverse blocking diode (provided in array junction box)
DC rated fuse at input and AC rated fuse at output with suitable contactor/solid-state switches for safe start-up & shutdown of system
Load surge current
Over temperature
Under / Over output voltage
Under / Over frequency
Automatic / manual isolation at input & output
Suitable protection for solid-state switching devices

### Dielectric strength
1.1kV between input/output and ground with EMI protections removed

### Cooling
Forced air cooling with temperature sensitive fan operation

### Ambient operation (max)
50 deg C

### Relative humidity
95% maximum

### Assembly & mounting
As per normal industry practice

### Finish
Epoxy powder coating

### Cable entry
From rear 200mm above ground level

### Load test at factory
Minimum 6 hours at full load

### Features
Bi-directional type inverter
Stand-alone and hybrid mode of operation.
High quality with high efficiency and reliability
Microprocessor based intelligent controller
Self monitoring capability.
Integral design with MPPT solar charge controller and inverter
Highly reliable & efficient solid-state switching devices
Rated for continuous operation at full load
High over-load capability of 200% surge for 10 seconds
Inverter output power factor of 0.8 lag
Automatic re-start facility after over load triggered shutdown
Sleep mode feature: Inverter shall switch off output when output load falls below 1-2 % of rated capacity to save no load losses.

### Efficiency
90% at rated load and normal operating conditions
83% (min) at 25% load and nominal input voltage with UPF load

### %THD
Sine wave output with 3% THD at full load UPF and nominal input voltage

### Output voltage
415V +/- 1%

### Output frequency
50Hz ± 0.5Hz

### %Regulation
2% against input voltage and load variation

### Battery charger
Bi-directional Inverter/Charger

### Indications
Inverter ON
Grid ON
Array ON
Inverter under Voltage /
TENDER INTERNAL ELECTRICAL

Over Voltage
Inverter Overload
Inverter over Temperature
Battery Low

Enclosure
IP 30 (For indoor application)

Weight / Dimension
The details of the inverter will be provided in the specification / user manual

8. DC Distribution Board (DCDB)

Solar array side breaker and battery side breaker shall be housed in enclosure. These can also be housed within the PCU to save space.

AC Distribution Board (ACDB)

· An ACDB shall be provided in between PCU and load/grid interface
· It shall have 32 A MCB of suitable rating for connection and disconnection of PCU from load.
· It shall have 6 A x 5 nos. MCB’s to supply power to the loads

9. Cables and accessories

All the cables shall be supplied conforming to IS 1554 / 694 Part 1 of 1988 & shall be of 650 V/ 1.1 kV grade as per requirement. Only polyethylene copper cables shall be used. The size of the cables between array interconnections, array to junction boxes, junction boxes to PCU etc. shall be so selected to keep the voltage drop and losses to the minimum.

Cables shall be of either CCI/Universal/ Finolex make. Scope of the work also includes cable laying – including in trenches -, back-filling and restoration of excavated areas to original state.

The bidder shall supply installation accessories, which are required to install and successfully commission the power plant.

10. Earthing and lightning protection

Earthing: The array structure of the PV yard shall be grounded properly using adequate number of earthing kits. All metal casing / shielding of the plant shall be thoroughly grounded to ensure safety of the power plant. Earth resistance readings for each site must be measured by a qualified and licensed electrical contractor and submitted. Resistance values shall conform to either CCOE stipulations or that of IEE regulations.

Lightning:

The SPV Power Plant shall be provided with lightning & over voltage protection. The main aim in this protection shall be to reduce the over voltage to a tolerable value before it reaches the PV or other sub system components. The source of over voltage can be lightning, atmosphere disturbances etc.

Metal oxide variastors shall be provided inside the Array Junction Boxes. In addition suitable MOV’s (Metal Oxide Variastors) also shall be provided in the Inverter to protect the inverter from over voltage.

11. Control room

The bidder shall give the details of array layout and control room layout along with the offer. The room shall be provided to meet the space requirement to house PCU, Distribution Boards.