AN ISO 9001 & 14001 COMPANY

TENDER DOCUMENT

TENDER No: NRO/CON/696/660

FOR

BALANCE WORK OF SUPPLY, INSTALLATION, TESTING & COMMISSIONING OF TWO NO. 11/0.433KV INDOOR ELECTRIC SUBSTATION (ESS-1&2), THREE NO. OUTDOOR TYPE 11/0.433KV COMPACT SUB-STATION (CSS-1, 2 &3) AND OTHER ASSOCIATED EXTERNAL ELECTRICAL WORKS FOR THE PERMANENT CAMPUS OF THE CENTRAL UNIVERSITY OF JAMMU (CUJ) AT VILLAGE BAGLA, DISTT. SAMBA (J&K)

VOLUME – II

ADDITIONAL CONDITIONS OF CONTRACT,

TECHNICAL SPECIFICATIONS &

DRAWINGS

PROJECT MANAGEMENT CONSULTANT:

ENGINEERING PROJECTS (INDIA) LIMITED

(A GOVT. OF INDIA ENTERPRISE)
Northern Regional office
2ND Floor, CORE-3, SCOPE COMPLEX, 7–LODHI ROAD,
NEW DELHI – 110003.

TEL. NO: 011- 24361666
FAX NO: 011- 24363426
E-Mail: nrommd@engineeringprojects.com
## INDEX

### ADDITIONAL CONDITIONS OF CONTRACT (ACC)

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Clause No.</th>
<th>Description</th>
<th>Page No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>2</td>
<td>Introduction</td>
<td>1</td>
</tr>
<tr>
<td>2.</td>
<td>3</td>
<td>Approach to worksite</td>
<td>1</td>
</tr>
<tr>
<td>3.</td>
<td>4</td>
<td>Site Visit</td>
<td>2</td>
</tr>
<tr>
<td>4.</td>
<td>5</td>
<td>Scope of work</td>
<td>2</td>
</tr>
<tr>
<td>5.</td>
<td>6</td>
<td>Water and Power</td>
<td>5</td>
</tr>
<tr>
<td>6.</td>
<td>7</td>
<td>Qualification of tenderers</td>
<td>5</td>
</tr>
<tr>
<td>7.</td>
<td>8</td>
<td>Disqualification</td>
<td>5</td>
</tr>
<tr>
<td>8.</td>
<td>9</td>
<td>Modified Clause No. 1.0 of ITT- (Mode of submission)</td>
<td>6</td>
</tr>
<tr>
<td>9.</td>
<td>10</td>
<td>Drawings</td>
<td>6</td>
</tr>
<tr>
<td>10.</td>
<td>11</td>
<td>Specification &amp; Quality Assurance</td>
<td>7</td>
</tr>
<tr>
<td>11.</td>
<td>12</td>
<td>Modified Clause No. 6.0 set of tender documents of GCC.</td>
<td>8</td>
</tr>
<tr>
<td>12.</td>
<td>13</td>
<td>Inspection &amp; Testing</td>
<td>8</td>
</tr>
<tr>
<td>13.</td>
<td>14</td>
<td>Sub Standard Material</td>
<td>9</td>
</tr>
<tr>
<td>14.</td>
<td>15</td>
<td>Variation in taxes, duties, levies and imposition of new taxes</td>
<td>9</td>
</tr>
<tr>
<td>15.</td>
<td>16</td>
<td>Payment terms</td>
<td>10</td>
</tr>
<tr>
<td>16.</td>
<td>17</td>
<td>Completion Schedule</td>
<td>10</td>
</tr>
<tr>
<td>17.</td>
<td>18</td>
<td>Final bill</td>
<td>11</td>
</tr>
<tr>
<td>18.</td>
<td>19</td>
<td>Dispatch of material to site.</td>
<td>11</td>
</tr>
<tr>
<td>19.</td>
<td>20</td>
<td>Road permit</td>
<td>11</td>
</tr>
<tr>
<td>20.</td>
<td>22</td>
<td>Mobilization Advance</td>
<td>11</td>
</tr>
<tr>
<td>21.</td>
<td>23</td>
<td>Modified Clause no. 69.0 (iv) of GCC – (Alteration in specifications)</td>
<td>12</td>
</tr>
<tr>
<td>22.</td>
<td>24</td>
<td>Modified Clause no. 72.1 of GCC – (Compensation for Delay)</td>
<td>12</td>
</tr>
<tr>
<td>23.</td>
<td>25</td>
<td>Modified Clause no. 72.4.1 of GCC – (Time essence of Contract &amp; Ext. for delay)</td>
<td>12</td>
</tr>
<tr>
<td>24.</td>
<td>26</td>
<td>Plant and Machinery</td>
<td>13</td>
</tr>
<tr>
<td>25.</td>
<td>27</td>
<td>Tools and Tackles</td>
<td>13</td>
</tr>
<tr>
<td>26.</td>
<td>28</td>
<td>Concreting, Centering and Shuttering</td>
<td>14</td>
</tr>
<tr>
<td>27.</td>
<td>29</td>
<td>Free issue of available material at project site</td>
<td>14</td>
</tr>
<tr>
<td>28.</td>
<td>30</td>
<td>Project Meetings</td>
<td>14</td>
</tr>
<tr>
<td>29.</td>
<td>31</td>
<td>Recording of measurement of work done</td>
<td>14</td>
</tr>
<tr>
<td>30.</td>
<td>32</td>
<td>Work Subject to Audit</td>
<td>15</td>
</tr>
<tr>
<td>31.</td>
<td>33</td>
<td>False Statement</td>
<td>15</td>
</tr>
<tr>
<td>32.</td>
<td>34</td>
<td>Guarantee</td>
<td>15</td>
</tr>
<tr>
<td>33.</td>
<td>35</td>
<td>Insurance under workmen compensation act</td>
<td>16</td>
</tr>
<tr>
<td>34.</td>
<td>36</td>
<td>Insurance of works</td>
<td>16</td>
</tr>
<tr>
<td>35.</td>
<td>37</td>
<td>Indemnity Against Patent Rights</td>
<td>16</td>
</tr>
<tr>
<td>36.</td>
<td>38</td>
<td>Clause no. 35.0 of GCC stands deleted – (Secured Advance against Non- Perishable materials)</td>
<td>16</td>
</tr>
<tr>
<td>37.</td>
<td>39</td>
<td>Permits and Inspections</td>
<td>17</td>
</tr>
<tr>
<td>38.</td>
<td>40</td>
<td>Licenses</td>
<td>17</td>
</tr>
<tr>
<td>39.</td>
<td>43</td>
<td>Site Engineer of contractor</td>
<td>17</td>
</tr>
<tr>
<td>40.</td>
<td>44</td>
<td>Licensed Electrician</td>
<td>18</td>
</tr>
<tr>
<td>41.</td>
<td>45</td>
<td>Completion and taking over</td>
<td>18</td>
</tr>
<tr>
<td>42.</td>
<td>46</td>
<td>Statutory Approvals</td>
<td>18</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>43.</td>
<td>47</td>
<td>Safety and Security arrangements</td>
<td></td>
</tr>
<tr>
<td>44.</td>
<td>50</td>
<td>Housekeeping</td>
<td></td>
</tr>
<tr>
<td>45.</td>
<td>51</td>
<td>ISO Compliance</td>
<td></td>
</tr>
<tr>
<td>46.</td>
<td>52</td>
<td>Sign Boards</td>
<td></td>
</tr>
<tr>
<td>47.</td>
<td>54</td>
<td>Modification of Arbitration’s Clause No. 76.0 of GCC</td>
<td></td>
</tr>
<tr>
<td>48.</td>
<td>55</td>
<td>Clause no. 28.3 of GCC is deleted</td>
<td></td>
</tr>
<tr>
<td>49.</td>
<td>56</td>
<td>Preservation of Tree / Vegetation</td>
<td></td>
</tr>
<tr>
<td>50.</td>
<td>57</td>
<td>General Condition of “GRIHA” requirement.</td>
<td></td>
</tr>
<tr>
<td>51.</td>
<td>58</td>
<td>Requirements of GRIHA</td>
<td></td>
</tr>
<tr>
<td>52.</td>
<td>59</td>
<td>Facilities to be provided at site for labour welfare</td>
<td></td>
</tr>
</tbody>
</table>
1.0 The following Additional Conditions of Contract shall be read in conjunction with General Conditions/Special Condition of Contract. If there are any provisions in these Additional Conditions of Contract, which are at variance with the provisions of General Conditions/Special Condition of Contract, the provisions in these Additional Conditions of Contract shall take precedence.

2.0 INTRODUCTION

The Central University of Jammu (CUJ) has been established by an Act of Parliament in the year 2009. In order to create one of India’s leading Universities, the CUJ has contemplated to develop the campus equipped with modern infrastructure with latest facilities in the emerging educational needs. The site allotted for the establishment of Central University of Jammu is semi-mountainous, undulating and is surrounded by dense bushes and forest cover. The proposed site measuring approx. 610 acres is located at village Bagla, Distt. Samba (J&K) at approx. 25 km from Jammu & around 8 km from Rayna Morh on Jammu – Pathankot Highway (NH1A). The permanent Campus of CUJ shall be developed in 3 phases each of 5 years. The first phase of the permanent campus will have Institutional, Residential Buildings and external development work, Road Network conforming to the norms of the green building technologies “Green Rating for Integrated Habitat Assessment” (GRIHA) for large development rating certification (5-star). Plot of 2 Nos. electric Sub-station (ESS) each of approx. area of 495 sq. mtr. and site of other work in this tender are located in said CUJ campus.

The presently administrative office of Central University of Jammu is functioning from the Academic Block (erstwhile DDE Building), CUJ Campus, village Bagla, Distt. Samba (J&K).

FEATURES / DETAILS OF PLOT OF CUJ CAMPUS AREA.

i) One overhead electrical L.T. Line within the plot area.

ii) Trees within the land.

iii) National Highway (NH1A) popularly known as Jammu to Pathankot highway is at around 8 km (Rayna Morh) from the plot boundary of university.

iv) Jammu – Pathankot railway track is at around 6 km from plot boundary.

v) Plot is presently surrounded by Village Bagla&Suchani and farms.

vi) 5mtr. (Approx) wide approach road from National Highway (Rayna Morh) to village Mandal through University site is existing.

3.0 APPROACHES TO WORKSITE

Approach road to work site are available for movement of men, materials, machineries, other equipment etc. required for carrying out the work under this contract.

All drainage of works area and all weather truckable haulage roads as required by the contractor shall be maintained during the construction period by the contractor at his own cost.
4.0 SITE VISIT

Before bidding, the bidder, at his responsibilities, risk and expenses, should visit the site to ascertain local site conditions such as the working & other constraints at site, approach road to the site, availability of electricity & water at site, applicability of taxes, duties and Entry taxes etc and satisfy himself as to the conditions prevalent at the site.

The bidder shall be deemed to have inspected the site, its surrounding and acquainted itself with the nature of the ground, accessibility of the site and full extent and nature of all operations necessary for the full and proper execution of the contract.

The contractor is expected to visit the site as per clause No. 2 of GCC. The contractor shall be deemed to have full knowledge of site, whether he inspects it or not and no extra charges/ claims etc. consequent upon any misunderstanding or otherwise shall be allowed.

5.0 SCOPE OF WORK INCLUDED IN THE CONTRACT

The brief scope of work included in this tender shall include (but not be limited to) balance work of Supply, Installation, Testing & Commissioning, inspection, delivery at site, comprising Electrical substation work, HT/LT Power cable, transformers, LT Panel board, LT Breaker, Bus Ducts, Capacitor bank, DG sets, Earthing, balance civil, Plumbing & Fire-fighting Work, overall completion & handing over of two no. 11/0.433KV Indoor Substation (ESS-1&2), three no. Compact type substation (CSS-1,2,3) and other Associated External Electrical work and any other services not covered above but required in totality for overall completion of work as per the direction of PMC/ CUJ for Permanent campus of Central University of Jammu (CUJ) at Village Bagla, Distt. Samba (J&K), consisting of the following major work:

5.1 11KV Cable from 33/11KV Substation to various Substation for forming H.T. Ring including termination.

5.2 Electrical Substation Works at each of Substation No. 1 & 2 and consisting of following.

5.2.1 11KV VCB Panel Board.

5.2.2 11KV Cable from 11KV VCB Panel Board to transformer including termination.

5.2.3 Distribution Transformers (Oil type) with OLTC.

5.2.4 Main L.T. Panel (Normal Supply), Main L.T. Panel (Essential Supply) and Capacitor Panels.

5.2.5 Bus duct for connection between Transformer to Main L.T. Panel (Normal Supply).

5.2.6 Cables / Busduct for connection between following
- Main L.T. Panel (Normal Supply) to Main L.T. Panel (Essential Supply).
- Main L.T. Panel (Normal Supply) to Capacitor Panel.
5.3 Electrical Power cables for power distribution from sub-station Main L.T. Panel (Normal Supply) and Main L.T. Panel (Essential Supply) to various Building / Blocks and services.

5.3.1 Substation No. 1

- Main L.T. Panel (Normal Supply) to MLT Panel (Distance Education Building)
- Main L.T. Panel (Normal Supply) to HVAC Plant Panel (Distance Education Building)
- Main L.T. Panel (Essential Supply) to EMLT Panel (Distance Education Building)
- Main L.T. Panel (Essential Supply) to ESDB – Substation No. 1 (ESDB - SS1)
- Main L.T. Panel (Normal Supply) to MLT Panel (Admin Block)
- Main L.T. Panel (Normal Supply) to HVAC Plant Panel (Admin Block)
- Main L.T. Panel (Essential Supply) to EMLT Panel (Admin Block)
- Main L.T. Panel (Normal Supply) to Capacitor Panels (Substation No. 1)
- External street lighting.

5.3.2 Substation No. 2

- Main L.T. Panel (Normal Supply) to MLT Panel I & II (School of Basic applied science)
- Main L.T. Panel (Normal Supply) to HVAC Plant Panel (School of Basic applied science)
- Main L.T. Panel (Essential Supply) to EMLT Panel I & II (School of Basic applied science)
- Main L.T. Panel (Normal Supply) to Capacitor Panels (Substation No. 2)
- Main L.T. Panel (Essential Supply) to ESDB – Substation No. 2 (ESDB - SS2)
- External street lighting.

5.4 Earthing of Electrical Substation equipment like H.T. Panel Board, Transformer, Main L.T. Panel (Normal Supply), Main L.T. Panel (Essential Supply) Capacitor Panel, Bus Ducts, ESDB (Substation), Feeder pillars and any other Electrical Panel etc., Neutral earthing of Transformers. Earthing shall include for Earth electrode, Earth conductor etc. complete in all respects.

5.5 Package Type Compact substations (CSS) for Residential Quarter / Blocks

5.5.1 Package / compact type substation consisting of 11KV Transformer L.T.& H.T Breaker Panel and other associated Accessories & Instrument, Panels etc.

5.5.2 L.T. Distribution Feeder Pillars.

5.5.4 Earthing of Package / Compact type substations and L.T. Distribution Feeder Pillars complete with Earth electrode / Earth conductor etc. complete in all respect. Earthing shall be for body earthing of noncurrent carrying metal equipment (LT & HT) and for neutral earthing of Transformers.

5.6 DG Set Works

5.6.1 DG Set (Silent type) with Engine, Alternation, Control Panel etc. complete in all respect mounted on base frame. Silent type DG Set shall also have acoustic enclosure / housing conforming to CPCB norms.

5.6.2 DG exhaust system complete with silencers, exhaust piping duly insulated and cladded and suitably supported with MS Angles, channels etc. complete as required. DG Set shall be complete with AMF Panel.

5.6.3 L.T. Cables / Bus duct from DG Set to AMF Panel.

5.6.4 DG Fuel Handling system consisting of Fuel piping from day fuel tank to DG Set (Diesel Engine) complete with valve, strainers etc. as required.

5.6.5 Earthing of DG Sets (Body earthing and neutral earthing) with Earth Electrode, earth conductor etc. complete in all respect.

5.7 External Lighting

5.7.1 External Lighting Works shall include Feeder Pillar etc. complete in all respect.

5.7.2 Scope of work shall include supply, installation, testing & commissioning of electrical feeder pillar for street lighting system installation as described above.

It is not the intent to specify completely here in all aspects of design and constructional features of equipments and details of the work to be carried out, nevertheless, the equipment and work shall conform in all respects to high standards of Engineering, design and workmanship and shall be capable of performing in continuous commercial operation in a manner acceptable to the owner who will interpret the meaning of the specifications and drawings and shall have right to reject or accept any work or material which in his assessment is not complete to meet the requirement of these specifications and or applicable codes and standards mentioned elsewhere in these specifications.

5.8 Unless and otherwise mentioned in the tender documents, the following works shall be done by the contractor, and therefore their cost shall be deemed to be included in their tendered cost:

i) Foundations for equipments and components where required, including foundation bolts except foundation for DG Sets, Transformer and Package Type Compact Substations, which will be separately payable.

ii) Cutting and making good all damages caused during installation and restoring the same to their original finish.

iii) Sealing of all floor openings provided by him for pipes and cables, from fire safety point of view, after laying of the same.

iv) Painting at site of all exposed metal surfaces of the installation other than pre-painted items like fittings, fans, switchgear/distribution gear items,
cubicle switch board etc. and erection should be rectified to the satisfaction of the Engineer-in-charge.

5.9 All sundry fittings, assemblies, accessories, hardware items, foundation bolts, termination lugs for electrical connections as required, and all other sundry items which are useful and necessary for proper assembly and efficient working of the various components shall be arranged by contractor at their own cost.

5.10 Any other services required in totality for overall completion of work as per the direction of PMC/ CUJ for permanent campus of Central University of Jammu consistent with CPWD Specifications and other conditions specified (Vol-IIB), BOQ and elsewhere are deemed to be included in the scope of work.

5.11 GRIHA: CUJ intends to develop Green campus and aim to obtain “Green Rating for Integrated Habitat Assessment” (GRIHA) for large development rating certification (5-star) for the proposed facilities included in the project. Bidder to familiarize himself with the requirement and note that all requirements of “GRIHA” pertaining to construction for achieving the above targeted rating. No extra payment shall be made on this account.

6.0 WATER AND POWER (ELECTRICITY)

Contractor has to make his own arrangement at his own cost for construction Water & Power at site in accordance with clause no 44.0 of GCC.

7.0 QUALIFICATION OF TENDERERS

To be eligible for this tender the bidders should fulfill the requirements for eligibility as mentioned in the Notice Inviting Tender (NIT) and should submit detailed data and credentials set out in Clause No. 19.0 of ITT at page no.-5 (Vol-I) of the tender. The bidders are required to fulfill all the eligibility criteria as stipulated in NIT documents and elsewhere in the Tender documents. The price bid of only those bidders who fulfill the eligibility criteria as per evaluation of EPI shall be opened. The decision of EPI/ CUJ in this regard shall be final & binding on the bidders.

8.0 DISQUALIFICATION

The bidders may note that they are liable to be disqualified and not considered for the opening of Price Bid if;

a) Representation in the forms, statements and attachments submitted in the pre-qualification document are proved to be incorrect, false and misleading.

b) They have record of poor performance during the past 10 years such as abandoning the work, rescinding of contract for which the reasons are attributable to the non-performance of the contractor, inordinate delay in completion, consistent history of litigation / arbitration awarded against the contractor or any of its constituents or financial failures due to bankruptcy etc. in their ongoing / past projects.
c) They have submitted incompletely filled in formats without attaching certified supporting documents and credentials to establish their eligibility to participate in the tender.

d) If the bidders attempt to influence any member of the selection committee.

EPI reserves its right to take appropriate action including disqualification of bidder (s) as may be deemed fit and proper by EPI at any time without giving any notice to the contractor in this regard. The decision of EPI in the matter of disqualification shall be final and binding on the bidders.

EPI reserves the right to independently verify the performance of the bidder from the existing owners / users / owners’ Consultants. In case any execution of work/ Project is found to be performing unsatisfactorily, EPI reserves the right to reject the tender and price bid of such bidder shall not be opened, even if the bidder is meeting the technical and other qualifying requirements.

In such circumstances the bidder shall have no claim on EPI of whatsoever nature.

➢ Bidder’s specific attention is drawn to above clauses.

9.0 Clause no 1.0 of Instructions to Tenders i.e Mode of submission of tender is through e-bids only. Hence clause no. 1 of ITT is deleted.

➢ Kindly refer “Special Instructions to bidders for e-tendering” for downloading & uploading of tender documents as per NIT.

10.0 DRAWINGS

a) Before filling in the tender, the tenderer will have to check up all drawings and schedule of quantities and will have to get the immediate clarification from EPI on any point that he feels is vague or uncertain. No claim for damages or compensation will be entertained on this account, in future.

Figured dimensions are in all cases to be followed and in no case should they be scaled. Large scale details take precedence over small scale drawing, in case of the discrepancy; the contractor is to ask for clarification before proceeding with the work.

b) The drawings attached to the tender documents provide a general idea about the work to be performed under the scope of this contract. These are preliminary drawings for tender purpose only and are by no means the final/ GFC drawings and may not be showing the full range of the work under the scope. The details given in the tender drawings are tentative and likely to be changed / modified during the detailed engineering.

c) The work has to be executed according to “Good for Construction” drawings issued by Engineer-in-charge with addition and modifications made from time to time as and when required and approved by Engineer-in-charge. The drawing shall be progressively released to site before the start of the corresponding work.
Before the commencement of any item of work, the contractor shall correlate all the relevant architectural, structural and services drawings issued for the work and satisfy himself that the information available there from is complete and unambiguous. The discrepancy, if any, shall be brought to the notice of Engineer-In-Charge before the execution of work. The contractor alone shall be responsible for any loss or damage occurring by the commencement of work on the basis of any erroneous and / or incomplete information. Nothing extra shall be paid on this account.

d) The successful tenderer on receiving the letter of intent shall furnish the design & detailed / shop drawing for specialized work within the time schedule mentioned elsewhere.

All the drawings/documents shall be submitted in six sets (hard copies) and two sets soft copies for approval/reference/record of EPI/CUJ.

11.0 SPECIFICATIONS AND QUALITY ASSURANCE

a) The work under the contract shall be carried out in accordance with the schedule of items of work, the particular specifications drawings forming part of this tender document, and the general conditions and other provisions of the tender.

b) The work in general shall be carried out as per latest CPWD specifications New Delhi for Electrical Work (updated with correction slips issued upto last date of submission of tender)

c) For items not covered under latest CPWD specification for Electrical Works, specifications and in particular specification or nomenclature of the individual item as above, the work shall be done as per latest relevant BIS codes of practice.

d) In case, specifications are not covered under para (b) & (c) above the work shall be carried out as per the provisions of technical specifications given in Vol. II.

e) In case of non availability of any specification in the above paras or any overlapping provisions, non-clarity on any issue, applicability of particular provision out of above, shall be decided by Engineer-in-Charge whose decision shall be final & binding on the contractor.

f) The contractor is responsible for executing and completing the work in accordance with the specified standards and specifications and as per requirements of GRIHA- 5 star ratings. Construction quality control is intended to provide a comprehensive common and consistent framework of quality control which is comprised of two main elements.

• Testing
• Inspection

g) The contractor shall be responsible for the types of test to be carried out, frequency of testing and stage of testing as directed by Engineer-in-charge or as stipulated in Indian Standards / CPWD Specifications for relevant works.
The cost of all these tests shall deem to be included in the item/percentage rates quoted by the contractor.

All test samples should be preserved, with proper identification, test log reference, test date and other applicable information. These samples must be stored on site by the contractor. In addition to tests performed on site, the contractor is responsible for specialized tests which are performed at approved laboratories and for factory inspections and tests performed by manufactured or third party inspection agency during the manufacturing of various materials and after receipt of material at project site, to be incorporated in the works. The contractor shall be responsible for stipulated quality of materials received at project site.

h) The contractor shall be responsible for obtaining all approvals from EPI/Client with regard to quality of materials & work mentioned and measurements etc for the work.

12.0 Clause no 6.0 SET OF TENDER DOCUMENTS of GCC stands modified as under.

The following documents will complete a set of Tender Documents.

A) VOLUME I :

   a) Notice Inviting Tender (NIT)
   b) Instructions to tenderers & General Conditions of Contract (ITT & GCC)
   c) Instructions to Bidders for e-Tendering
   d) Letter of Undertaking,
   e) Form of tender,
   f) Memorandum

B) VOLUME II :

   a) Additional Conditions of Contract (ACC)
   c) Technical Specifications (TS)
   d) Tender Drawings

C) VOLUME III :

   a) Financial Bid (Schedule of Quantity / Price-Bid)

13.0 INSPECTION AND TESTING

13.1 TEST CERTIFICATE

All manufacturer’s certificates of test showing that the all equipments/ materials have been tested in accordance with the requirements of the relevant standard specification and the copy of the test certificate as well as standard shall be supplied free of cost to EPI/CUJ.
14.0 SUB STANDARD MATERIAL

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

Any material / item / fitting / fixtures rejected by EPI / CUJ shall be removed from the site within 48 hours of issue of instructions to this effect by EPI. Failing this, the EPI shall have the rights to get these removed and the contractor shall have no claim whatsoever in this regard.

15.0 TAXES & DUTIES.

Clause no 13.0 of GCC is amended to the extent as stated under:

a) The Bidder must be registered with GST in J&K state and should have valid GST number. In case the bidder does not have valid GST registration number, the same shall be obtained by the successful bidder within one month from the date of LOI or before release of 1st R/A bill whichever is earlier.

b) The Bidder must submit as an compliances of GST Act, the invoices in GST compliant format failing which the GST amount including interest and penalty if any shall be recovered/ adjusted by EPI without any prior notice from the next invoices or available dues with EPI.

c) The Bidders are requested to update/ upload the GST/Taxes data periodically so as to avail ITC credit by EPI failing which it shall be recovered / adjusted by EPI without any prior notice from the next invoices or available dues with EPI.

d) Rates to be quoted in this tender inclusive of all taxes & duties and GST etc. Taxes are to be disclosed separately in Price Bid /BOQ.

e) Bidder while quoting the rates in the tender must also consider the ITC credit applicable for the works, if any.

f) Price bid formats shall indicate “inclusive of all taxes and duties including GST.

In addition to the price bid format, an Annexure to indicate the “breakup of cost and levies such as GST and other taxes” considered in the quoted prices shall be annexed. This Annexure shall have breakup of all taxes/ duties relevant to the contract.

In case of any reduction in rate of GST or other taxes in future or the project getting exemption status prior to the last date of bid submission or afterwards, the sub-contractor shall pass on the benefit to EPIL immediately, failing which EPIL shall have the right to recover the differential amount from the amounts due to the sub-Bidder. Further, in case of any increase in rate of GST or other taxes in future or the project losing exemption status prior to last date of bid submission or afterwards, the said increase of taxes shall be paid / reimbursed to the sub-contractor, subject to the condition that the client reimburses the said increased taxes to EPIL."
16.0 Payment Terms

Subject to statutory deduction which EPI might be entitled to make under the contract, the contractor shall receive payment of contract value as follows:

16.01

60% of the contract value pro-rata (item wise) shall be paid on delivery of equipment/material at site after due inspection by EPI or Inspection Agency appointed by EPI. The equipment / material shall be maintained in safe custody by the contracting agency at his own cost till the time of erection / installation.

16.02

25% of the contract value pro-rata (item wise) shall be paid on successful completion of erection/ installation of the Equipments/Materials.

16.03

10% of contract value pro-rata (item wise) shall be paid on successful commissioning / energizing, trial run for entire work and uninterrupted power supply to load for a period of 30 days and handing over to ultimate client.

16.04

5% of the contract value pro-rata (item wise) shall be paid on completion of defect liability period of 12 months.

17.0 COMPLETION SCHEDULE

<table>
<thead>
<tr>
<th>Sl. No.</th>
<th>Period from the date of Start</th>
<th>Description of work to be completed during the period specified under column no. 2 (Milestone)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>From the date of start to end of 1st month.</td>
<td>Submission of GA drawings / Documents /Procurement schedule of Supply Items.</td>
</tr>
<tr>
<td>2</td>
<td>From the start of 2nd month upto the end of 3rd month</td>
<td>Approval of materials &amp; placing of order for supply.</td>
</tr>
<tr>
<td>3</td>
<td>From the start of 3rd month upto the end of 4th month</td>
<td>Arrival of equipment/ material at site.</td>
</tr>
<tr>
<td>4</td>
<td>From the date of start of 2nd month upto the end of 5th month</td>
<td>Completion of Civil works required at site and Installation of Equipment/Materials at site. All these items shall be inspected by EPI before dispatch.</td>
</tr>
<tr>
<td>5</td>
<td>From the start of 6th month upto the end of 6th month.</td>
<td>Testing &amp; Commissioning of System and handing over.</td>
</tr>
</tbody>
</table>

Entire work should be completed & handed over within a period of six (06) months from the date of LOI.

Page 10 of 21
18.0 **FINAL BILL**

The final bill will be submitted by the contractor within 90 days from the date of acceptance of completion of work accompanied by the following documents.

a) Interim Completion certificate issued by the Engineer-in-charge specifying the handing over of the work including list of inventories (fittings & fixtures).

b) Computerized stage wise payment schedule.

c) No claim certificate by the contractor.

d) No claim certificate from the sub agencies / venders engaged by the contractor.

e) ‘As built’ drawings.

f) Periodical services and measurement books.

g) Drawings for layout of underground cables and details showing location of sluice valves, electric cable joints etc.

h) All operation and maintenance manuals.

i) All statutory approvals from various state / central govt. local bodies, if required for completion & handling over of the work as included in scope of contractor.

j) Manufacture’s guarantee of various machines / equipments installed as part of works.

19.0 For dispatch of materials to site, equipment manufacturer / supplier shall mark consignee as a self A/c Central University of Jammu (CUJ) through Engineering Projects (India) Ltd (EPI).

20.0 **ROAD PERMIT**

Road permit for transportation of goods across state border shall not be issued by CUJ / EPI and will have to be arranged by contractor on his own. Transit Insurance of the equipment shall be arranged by the contractor. Nothing extra shall be paid on this account.

21.0 Invoice should be raised by Contractor in the name of Engineering Projects (India) Ltd., at Project Office : Campus of Central university of Jammu, Village Rahya-Suchani(Bagla), Distt. Samba - 1811432 (J&K) on account of CUJ, Jammu with copy to EPI-PMD, NRO, New Delhi.

22.0 Clause No. 8.0 of GCC (MOBILIZATION ADVANCE) stands deleted.

- No mobilization advance shall be given.
23.0 THE CLAUSE NO. 69.0 (IV) - “ALTERATION IN SPECIFICATIONS” OF GCC STANDS MODIFIED AS UNDER

If the rates for the altered, additional or substituted work cannot be determined in the manner specified in sub-clauses 69 (i) to (iii) of GCC, then the Contractor shall, within 7 days of the date of receipt of order to carry out the work, inform the Engineer-in-Charge the rates which he intends to charge for such class of work, supported by analysis of the rate or rates claimed, and the Engineer-in-Charge shall determine the rate or rates on the basis of prevailing market rates of the material, Labour, T&P etc. plus 15% (Fifteen percent) to cover the Contractors supervision, overheads and profit and pay the Contractor accordingly. The opinion of the Engineer-in-Charge as to the current market rates of materials and quantum of labour involved per unit of measurements will be final and binding on the Contractor. However, the Engineer-in-Charge, by notice in writing, will be at liberty to cancel his order to carry out such class of work and arrange to carry it out in such manner, as he may consider advisable. But under no circumstances, the Contractor shall suspend the work on the plea of non-settlement of rates of items falling under the clause.

24.0 THE CLAUSE NO.72.1 (COMPENSATION FOR DELAY) OF GCC SHALL BE REPLACED AS UNDER

The Contractor shall ensure adequate progress during the execution of work according to the detailed Bar Chart / PERT chart so that the activities are completed in the period allowed in the completion schedule as given at S. No. 17.0 of ACC.

However, the Contractor shall also maintain monthly progress strictly in accordance with bar chart and / or detailed time schedule that will be worked out on the basis of completion schedule for various stages mentioned at clause no. 17.0 of ACC. If the Contractor fails to maintain the above progress or to complete the work corresponding to S. No. 1 to 5 of completion schedule as given at clause no. 17.0 of ACC and clear the site on or before the contract or extended date of completion, he shall without prejudice to any other right or remedy of the EPI on account of such breach, pay as agreed compensation and not as penalty at the rate of half percent (1/2 %) per every week of delay of the entire value of contract.

The total amount of compensation payable by the contractor for delay in completion of the work corresponding to S.No.1 to 5 of completion schedule as per clause no. 17.0 of ACC shall not exceed 10% of the total contract value as awarded.

25.0 CLAUSE NO. 72.4.1 (TIME ESSENCE OF CONTRACT & EXTENSION FOR DELAY) OF GCC STANDS MODIFIED AS UNDER:

As the completion time is the essence of the contract, Agency may require additional resources, men & machinery, which has to be considered while quoting.

Within 10 (Ten) days of date of Letter of Intent, the contractor shall submit a Time and Progress Chart (CPM/PERT/Quantified Bar Chart) and get it approved by the Engineer-in-Charge. The Chart shall be prepared in direct relation to the time stated in the contract documents for completion of items / scope of the works. It shall indicate the forecast (mile stones) of the dates of commencement and completion of various items trades, sections of the work and may be amended as necessary by agreement between the Engineer-in-Charge and the Contractor within the limitations of time
imposed in the contract documents, to ensure good progress during the execution of the work. The approval by the Engineer-in-Charge of such programme including modifications made by the Engineer-in-Charge in the said programme shall not relieve the contractor of any of his duties or responsibilities under the contract. This is without prejudice to the right of Engineer-in-Charge to take action against the contractor as per terms and conditions of the agreement.

The physical report including photographs shall be submitted by the contractor on the prescribed format & the intervals (not later than a month) as decided by the Engineer-in-Charge. The compensation for delay as per clause 72.1 (revised as per ACC) shall be leviable in case the required progress is not achieved to meet the time deadlines of the completion period for execution of the complete work as per scope of work.

In case entire work is completed within the total time period of completion or extended period of completion allowed, the compensation for delay due to not achieving progress at intermediates stage, if any, shall be refunded without any interest charges.

26.0 PLANT AND MACHINERY

All plant & machinery required for execution of work shall have to be arranged by the contractor at his own cost nothing extra shall be paid on this account. The contractor has to deploy all the required equipment to complete all the works within stipulated specifications and time period as per contract documents.

Contractor will not be allowed to take out any plant & machinery from the site without permission of EPI.

Any other equipment for site test as outlined in CPWD Specification and as directed by the Engineer–in–charge.

In the event of breakdown of any equipment the contractor should immediately mobilize replacement of the said equipment.

27.0 TOOLS & TACKLES

All Tools & Tackles required for completion of work shall be arranged by contractor at their own cost nothing extra shall be paid on this account. A list of minimum required Tools & Tackles are given below.

<table>
<thead>
<tr>
<th>Sl.No.</th>
<th>Description of Item</th>
<th>Qty. in No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Motorised Megger - 5 KV</td>
<td>02</td>
</tr>
<tr>
<td>2.</td>
<td>LT Megger – 1.1 KV</td>
<td>02</td>
</tr>
<tr>
<td>3.</td>
<td>Earth Megger</td>
<td>02</td>
</tr>
<tr>
<td>4.</td>
<td>Multi meter</td>
<td>02</td>
</tr>
<tr>
<td>5.</td>
<td>Secondary Injection Test Set</td>
<td>02</td>
</tr>
<tr>
<td>6.</td>
<td>Hipot Test Set</td>
<td>02</td>
</tr>
<tr>
<td>7.</td>
<td>Oil Filter Machine</td>
<td>02</td>
</tr>
<tr>
<td>8.</td>
<td>Electrician Tools Set</td>
<td>Lot</td>
</tr>
<tr>
<td>9.</td>
<td>Crimping Tools (upto 600 sq. mm)</td>
<td>03</td>
</tr>
<tr>
<td>10.</td>
<td>Tong Tester (clamp on meter)</td>
<td>02</td>
</tr>
<tr>
<td>11.</td>
<td>Lifting Jack (Hydraulic)</td>
<td>02</td>
</tr>
<tr>
<td>12.</td>
<td>Discharge Road</td>
<td>As required</td>
</tr>
</tbody>
</table>
Contractor must have valid license of appropriate class acceptable in state of Jammu & Kashmir. The contractor shall also be responsible at his own cost for obtaining all statutory clearance including Electrical inspector’s approval from the concerned authorities of government.

28.0 CONCRETING, CENTERING & SHUTTERING

Minor civil work wherever applicable shall be as per the latest standard CPWD specifications. The samples of the aggregate, sand & other materials shall have to be got approved by Engineer-in-charge prior to its use.

29.0 FREE ISSUE OF AVAILABLE MATERIAL AT PROJECT SITE

Some quantity of electric cable of various sizes and MS street light poles (4 & 6 mtr high) are available at site, which shall have to be utilized by the successful bidder as per requirement. Said cable & MS street light poles shall be made available to the successful bidder free of cost and account for the same shall have to be submitted by the bidder. Custody of Said cables & poles shall be given to successful bidder before commencement of work at site, watch & ward and accounting of the same till final reconciliation/ accounting shall be the responsibility of the successful bidder. The bidder should quote their rate accordingly.

30.0 PROJECT MEETINGS

The contractor shall be available / associate with EPI in meetings with Client / Architect / Consultant/ Govt. authorities for its portion of work at their own cost. The contractor shall furnish all information and clarifications as and when required by EPI / CUJ.

Site meeting shall be held at regular intervals and in addition to other meeting required by EPI / CUJ. The contractor shall nominate / provide responsible member of his organization, who shall be authorized to commit and bind the contractor to any agreement reached during said meeting.

31.0 RECORDING OF MEASUREMENT OF WORK DONE

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

All measurement of all items having financial value shall be entered in Measurement Book and / or level field book so that a complete record is obtained of all works perform under the contract.

All measurements and levels shall be taken jointly by EPI and by the contractor or his authorized representative atleast once in a month during the progress of the work and such measurements shall be signed and dated by EPI and the contractor in token of their acceptance. If the contractor objects to any of the measurements recorded, a note shall be made to that effect with reason and signed by both the parties.

If the contractor or his authorized representative does not remain present at the time of measurements after the contractor has been given a notice three (3) days in advance or fails to countersign or to record objection within a week from the date of the
measurements recorded in his absence by EPI / CUJ, the measurements shall be
deemed be accepted by the contractor.

The contractor shall, without extra charge, provide all assistance with every appliance
labour and other things necessary for measurements and recording levels.

EPI / CUJ may cause to check the measurement recorded jointly or otherwise as
aforesaid and all provisions stipulated herein above shall be applicable to such
checking of measurement or levels.

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

All work to be measured as per latest IS Standards / CPWD Manuals with upto date
corrections.

32.0 WORK SUBJECT TO AUDIT

The work executed by the contractor shall be subject to audit and quality control
checks from Quality Control Division & Technical audit of EPI / CUJ, inspecting agency
of the Client and Chief Technical Examiner of Central Vigilance Commission, Govt. of
India. In the eventuality of any defect / sub standard works as brought out in the report
or noticed otherwise at any time during execution, maintenance period etc, the same
shall be made good by the contractor without any extra cost. In case the contractor
fails to rectify the defected / sub standard work within the time period stipulated by EPI
/ CUJ, necessary action as deemed fit shall be taken by EPI / CUJ and decision of EPI
/ CUJ shall be final and binding on the contractor.

33.0 FALSE STATEMENT

In case, at a later stage, it is found that the contractor has submitted incorrect, false
details and credentials resulting in apprehensions on the capabilities of contractor with
regard to quality & timely completion of works, financial capabilities etc. EPI / CUJ can
terminate this agreement solely at their option. In this eventuality the contractor shall
be liable for the losses suffered by EPI / CUJ and further contractor shall have no
claim on EPI / CUJ, whatsoever.

34.0 GUARANTEE

The contractor shall guarantee that all the materials and workmanship of works
executed by him, under these specifications shall be new and first class in every
respect. He will rectify any defect within 24 hours, which may develop within 12
months from the date of handing over of the entire work without any extra cost to EPI
/ CUJ.

All materials/work shall be guaranteed for a period of 12 months from the date of
taking over the installation by CUJ / EPI, against unsatisfactory performance and
workmanship or material. In case it is felt by CUJ / EPI that undue delay is being
caused by the contractor for rectifying the defects, the same will be got done by CUJ/
EPI at the risk and cost of the contractor. The decision of the Engineer-In-Charge in this regard shall be final.

The contractor shall also guarantee the performance of individual equipment.

35.0 Clause ’18.0’ (Insurance under WORKMEN COMPENSATION ACT) at page 22 of General Conditions of Contract (GCC) shall be replaced and read as under:

INSURANCE UNDER WORKMEN COMPENSATION ACT:

Contractor is required to take insurance cover under the workmen compensation Act, 1923 amended from time to time from an approved insurance company and pay premium charges thereof. Wherever required by EPI, the contractor shall produce the policy or the policies of Insurance and the receipt of payment of current premium. In the event of an accident, any workmen employed by the contractor for execution of the works, suffers an injury or death and is to be compensated under the provisions subsection (1) of section 12, of the workmen’s Compensation Act, 1923 by the contractor and if the contractor fails to compensate, the EPI / CUJ shall be entitled to recover from the contractor the amount of the compensation so paid, without prejudice to the rights of the EPI / CUJ under section 12, sub-section (2), of the said Act.

EPI / CUJ shall be at liberty to recover such amount or any part thereof by deducting it from the security deposit or from any sum due to the Contractor whether under this contract or otherwise. EPI / CUJ shall not be bound to contest any claim made against it under sub-section (1) Section 12, of the said Act, except security for all cost for which EPI / CUJ might become liable in consequence of contesting such claim.

36.0 INSURANCE OF WORKS

The Insurance coverage as stipulated in General Conditions of Contract (GCC) clause no. 17 (Insurance of works), clause no. 18 (Insurance under WCA) and clause no. 19 (Third Party Insurance) shall be in the joint name of CUJ, EPI and the Contractor for the contract period and 12 months after Successful completion / handling over of work. The Insurance coverage shall be on the total value of work awarded to contractor by EPI.

However, other contents of these clauses shall remain unchanged.

37.0 INDEMNITY AGAINST PATENT RIGHTS

The following Para shall be added to clause No. 20.0 of General Conditions of Contract as under:

“The Indemnity against Patent rights shall be in the Joint Name of CUJ and EPI”.

38.0 CLAUSE NO. 35.0 OF GCC (SECURED ADVANCE AGAINST NON-PERISHABLE MATERIALS) STANDS DELETED.

“No secured advance on any type of material shall be given.”
39.0 PERMITS AND INSPECTIONS

The contractor shall obtain all necessary permits from local bodies, provincial or central authorities and shall make arrangement for inspection and tests etc. as required at his own cost.

The contractor shall have to make his own arrangements for getting the permission for plying trucks or any Plant & Equipment for execution of works from the Police Department/ Govt. authorities at his own cost. No excuse as to delay in work due to non-availability of permission shall be entertained.

40.0 LICENSES

The contractor shall arrange for obtaining the license and clearances for the operation. (If required) from the local authorities and statutory bodies at his own cost & nothing extra shall be payable. Certification of various equipments / installations from statutory bodies other agencies as required as per technical specifications, shall be arranged by contractor at his own cost before handing over.

41.0 The contractor shall be bound to sign the site order book as and when required by Engineer-In-Charge at Site and carry out compliance of instruction promptly to the satisfaction of Engineer-In-Charge.

42.0 Bill of Quantities shall be read in conjunction with the specifications and requirement described in tender documents, Instructions to tenderers, General conditions of contract, Additional conditions of contract, Technical specifications, Drawings, Schedules, and Annexure & Addendum etc. to tender document.

General directions and description of work and materials are not necessarily repeated or summarized in the Bill of quantities. Reference to the relevant sections of the contract document shall be made by the contractor before entering rates or prices against each item in the Bill of Quantities.

43.0 SITE ENGINEERS OF CONTRACTOR

The Contractor shall employ at his cost the adequate number of technical staff during the execution of this work depending upon the requirement of work. For this purpose the number of staff to be deployed, their qualification, experience as decided by EPI shall be final and binding on Contractor. The Contractor shall not be entitled for any extra payment in this regard. The technical staff should be deployed on full time basis & available at Site, whenever required by EPI to take instructions.

However, Minimum qualifications and experience required for principal technical rep. and other minimum technical staff other than supervisor are given below:

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Qualification</th>
<th>No.</th>
<th>Minimum Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Graduate Electrical Engineer / Engineer – As a Principal Technical Representative/ Project-in-charge</td>
<td>1</td>
<td>Atleast 10-15 year experience in execution of electrical work for reputed institutional/ residential building project, involving external electrical &amp; substation work, installation of DG sets etc</td>
</tr>
<tr>
<td>No.</td>
<td>Position</td>
<td>Experience Required</td>
<td></td>
</tr>
<tr>
<td>-----</td>
<td>----------------------------------------------</td>
<td>--------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>Graduate Engineer (Electrical)</td>
<td>Atleast 5-8 years experience in QA/QC work of inspection, testing, commissioning of equipments and maintenance of records of electrical work, execution of Electrical work &amp; installation, testing &amp; commissioning of external electrical system and safety of work/ workman.</td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>Graduate/ Diploma Engineer (Civil)</td>
<td>Minimum 5 years experience in execution of foundation work of electrical equipments/ external electrical work of institutional/ residential building at site.</td>
<td></td>
</tr>
</tbody>
</table>

If Contractor fails to deploy minimum Technical staff as mentioned above, recovery on account of non-deployment of each Technical staff shall be made from subsequent RA Bills as under:

a) Graduate Engineer @ Rs. 80,000.00 (Rupees eighty thousand only) per month.

b) Diploma Holder @ Rs. 50,000.00 (Rupees fifty thousand only) per month.

44.0 LICENSED ELECTRICIAN

The electrical works shall be executed only through licensed electrician and the agency shall have to submit the valid license of electricians before starting the work.

45.0 COMPLETION AND TAKING OVER

As soon as the project is finally completed, the contractor shall inform EPI and EPI shall in turn inform to Central University of Jammu (CUJ). CUJ shall nominate a committee / officers for checking / verifications of completed work as per the scope of work for final taking over the project.

46.0 STATUTORY APPROVALS

It will be the sole responsibility of contractor to obtain all statutory approvals and completion clearance from the all relevant statutory bodies for all other services as included in the scope of contract etc. from the concerned department as required within the stipulated time frame. Liaison work on behalf of EPI with the local bodies will also have to be done by the contractor. Nothing extra shall be payable to contractor on this account. No claim whatsoever in this regard shall be entertained.

47.0 SAFETY & SECURITY ARRANGEMENTS

The contractor shall make his own necessary safety & security arrangements of his manpower, plant & equipment, material etc at site including as mentioned in GCC and indemnify EPI against any consequence of accident at site.

Nothing extra shall be admissible on account of this and no compensation shall be paid by client/ EPI, in case the contractor’s personnel suffer body injury, loss of life or any damage caused to the plant & machinery etc of the contractor.
48.0 EPI is awarding agency in respect of this Contract on behalf of CUJ. In case M/s EPI cease to be PMC, the right and responsibility etc. of EPI in the Contract shall get transferred to CUJ or their nominated agency shall operate this Contract.

49.0 Deduction (non-refundable) at the rate of 1% or at the rates applicable from time to time in the state of J&K from gross amount of each running bill and from final dues of contractor shall be made towards provision for workers “Welfare Cess Act 1996”.

50.0 HOUSEKEEPING

Contractor will be responsible to arrange day to day housekeeping as required at site as per instruction of Engineer in charge.

51.0 ISO COMPLIANCE


52.0 SIGN BOARD/ SIGNAGE

Contractor will arrange necessary pre-caution boards etc. required for during execution of work for safety purpose at their own cost.

53.0 The Contractor shall furnish details whether they are covered under micro, small and Medium Enterprise Development Act 2006. If yes, clearly indicate under which category they are covered along with documentary evidence. This information is required to be furnished along with the bid.

54.0 MODIFICATION OF ARBITRATION’S CLAUSE NO. 76.0 OF GCC

54.1 Clause no. 76.1 (Arbitration) of GCC stands deleted.

There shall be no Arbitration Clause for this Contract except between Central Public Sector Undertakings inter se / Government of India Departments/ Ministries as mentioned in the Clause No. 76.2 below:-

54.2 CLAUSE NO. 76.2 OF GCC: ARBITRATION BETWEEN CENTRAL PUBLIC SECTOR ENTERPRISES INTER SE / GOVERNMENT OF INDIA DEPARTMENTS /MINISTRIES

I) In the event of any dispute or difference relating to the interpretation and application of the provisions of the contract, such dispute or difference shall be referred by either party to the arbitration as per the instructions (Office Memorandum / Circulars) issued by Govt. of India from time to time with regard to arbitration between one Government Department and another one Government Department and a Public Sector Enterprise and Public Sector Enterprise inter se.

II) Subject to any amendment that may be carried out by the Government of India from time to time, the procedure to be followed in the arbitration shall be as is contained in D.O. No. DPE/4/(10)/2001-PMA-GL-I dated 22.01.2004 of Department of Public
Enterprises, Ministry of Heavy Industries and Public Enterprises, Govt. of India or any modification issued in this regard.

54.3 CLAUSE NO.76.3 (JURISDICTION) OF GCC STANDS MODIFIED AS UNDER:

The courts in Delhi/ New Delhi alone will have jurisdiction to deal with matters arising from the contract, to the exclusion of all other courts.

55.0 Clause No. 28.3 of GCC (FURNISHED OFFICE ACCOMODATION & MOBILITY AND COMMUNICATION) stands deleted.

56.0 PRESERVATION OF TREE / VEGETATION

Existing trees and other forms of vegetation are to be preserved by avoiding disturbance / damage due to construction activities. All existing vegetation should be marked on the site survey plan. The tree survey must be carried out and data must be recorded before starting construction activities. Adequate fencing to avoid disturbance / damages to trees / other vegetation is to be provided.

57.0 GENERAL CONDITION OF “GRIHA” REQUIREMENT FOR CUJ PROJECT

The CUJ intends to develop green complex & obtain “GOLD” rating of “GRIHA” for the proposed facilities included in the project. Bidder is required to familiarize with the requirements of “GRIHA - 5 Star rating”/ Green building technology for construction work for achieving targeted rating and nothing extra shall be paid on this account.

The contractor shall develop and implement spill prevention plan and erosion & sedimentation control plan and adopt proper staging during construction in line with “GRIHA” requirement and as per the instructions of Engineer – in – Charge. The contractor shall also adopt necessary measures for proper stabilization of soil in line with “GRIHA” requirements.

The project shall generate the least amount of waste possible and assimilate those processes that ensure the generation of waste as little as possible due to error, poor planning, breakage, mishandling, contamination or other defects shall be deployed.

The contractor shall designate specific areas as per directions of Engineer – in – Charge at construction site for segregated or mingled collection of recycled materials as consistent with requirements for acceptance by designated facilities.

58.0 REQUIREMENTS OF “GRIHA”

- Handling of materials & men by ensuring that the ground profile is least disturbed.
- Develop and implement spill prevention plan and erosion & sedimentation control plan.
- Segregation & proper record keeping of “disposal of all construction waste materials like rocks, empty cement bags, plastic containers, scrap steel, sanitary waste” etc.
• Proper housekeeping at site.
• Ensuring efficient use of water during construction.
• Minimizing air pollution during construction and arranging suitable water.
• Sprinkling arrangement at site.
• Control on erosion of soil during construction, construction of sedimentation tank and implement spill prevention plan.
• Implementation of HSE (Health, Safety and Environment) procedures & policies effectively.
• Ensuring proper staging / scaffolding during construction.
• Effective implementation of labour welfare measures / policies including well ventilated and hygienic labour camps with adequate lighting, water supply & sanitary arrangements.
• Submission of monthly report detailing compliance to the “GRIHA” norms and attaching the data and photographs.

59.0 FACILITIES TO BE PROVIDED AT SITE FOR LABOUR WELFARE

All facilities to be provided him at site for fulfilling all GRIHA & statuary labour welfare schemes are included in contractor’s scope which shall include the following but not limited to the same.

• Separate provision / rooms for First Aid Centre & Reset room and for the safety officer, safety supervisors and other personnel to be engaged by the contractor for H.S.E aspects of the project.
• Erecting sufficient numbers of Urinals, WC’s, drinking water, water supply and sanitary arrangements to the supervisory personnel and workmen engaged by them.
• Canteen facility to workmen engaged by the contractor.
• Treatment of waste from contractor’s toilets to meet the requirements of “GRIHA”.

Page 21 of 21
TECHNICAL SPECIFICATIONS

FOR

Balance Work of Supply, Installation, Testing & Commissioning of Two No. 11/0.433KV Indoor Electric Substation (ESS-1 & 2), Three No. Outdoor Type 11/0.433KV Compact Sub-Station (CSS-1,2&3) And other Associated External Electrical Works

OF

CENTRAL UNIVERSITY OF JAMMU

AT

VILLAGE BAGLA, DISTT. SAMBA (J&K)
TECHNICAL SPECIFICATIONS

WORK: BALANCE WORK OF SUPPLY, INSTALLATION, TESTING & COMMISSIONING OF TWO NO. 11/0.433KV INDOOR ELECTRIC SUBSTATION (ESS-1&2), THREE NO. OUTDOOR TYPE 11/0.433KV COMPACT SUB-STATION (CSS-1, 2 & 3) AND OTHER ASSOCIATED EXTERNAL ELECTRICAL WORKS FOR THE PERMANENT CAMPUS OF THE CENTRAL UNIVERSITY OF JAMMU (CUJ) AT VILLAGE BAGLA, DISTT. SAMBA (J&K).

1.0 GENERAL

1.1 The work under the contract shall be carried out in accordance with the schedule of items of work, the particular specifications drawings forming part of this tender document, and the general conditions and other provisions of the tender.

1.2 The work in general shall be carried out as per latest CPWD specifications New Delhi for Electrical & Civil Works unless otherwise specified in the nomenclature of the individual item or in the particular specifications of concerned items of works.

1.3 For items not covered under latest CPWD specification, for (Electrical & Civil Works) and in particular specification or nomenclature of the individual item as above, the work shall be done as per latest relevant BIS codes of practice.

1.4 In case of non-availability of any specification in the above paras or any overlapping provisions, non-clarity on any issue, applicability of particular provision out of above, shall be decided by Engineer-in-Charge whose decision shall be final & binding on the contractor.

1.5 The contractor is responsible for executing and completing the work in accordance with the specified standards and specification and as per requirements of GRIHA V ratings. Execution of Electrical quality control is intended to provide a comprehensive common and consistent framework of quality control which is comprised of two main elements.
- Testing
- Inspection

1.6 The contractor shall be responsible for the types of test to be carried out, frequency of testing and stage of testing as directed by Engineer-in-charge or as stipulated in Indian Standards CPWD Specifications for electrical and civil works. The cost of all these tests shall deemed to be included in the item rates quoted by the contractor.

All test samples should be preserved, with proper identification, test log reference, test date and other applicable information. These samples must be stored on site by the contractor. In addition to tests performed on site, the contractor is responsible for specialized tests which are performed by manufacturers or third parties during the manufacturing of various materials and equipment components, to be incorporated in the works.

1.7 The Substation works & DG Set Works shall be carried out in accordance with Indian Standard Code of Practice for Electrical Wiring Installation IS: 732-1989 and IS: 2274-1963. Electrical Installation work shall also be in conformity with National Electrical Code with up to date amendments. All Electrical work shall be carried out in accordance with the provision of Indian Electricity Act 1910 & Indian Electricity Rules 1956 amended up to date. The work shall also conform to Indian Standard Code of Practice for the type of work involved. It shall also be in conformity with regulations and requirements of the Local Electricity Supply Authority and Fire Insurance regulations so far as these become applicable to the installation. Electrical work shall be carried out as per following CPWD general Specifications for Electrical Works.

<table>
<thead>
<tr>
<th>Part I</th>
<th>Internal Work</th>
<th>2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part II</td>
<td>External Work</td>
<td>1994</td>
</tr>
<tr>
<td>Part IV</td>
<td>Substation Work</td>
<td>2013</td>
</tr>
</tbody>
</table>

Tech. Spécification - 2

1.8 Wherever this Tender Specifications call for a higher standard of material and or workmanship than those required by any of the above mentioned regulations and specifications then the particular specifications given here under shall take precedence over the said regulations and standards.

1.9 The work shall be executed and measured as per the dimensions given in the Bill of Quantities. Drawings, Designs, Specifications etc. The abbreviations used shall mean as under :-

//
" - Inch (25.4mm)

" - Foot (12 inches or 30.48 cms)

Sq.Ft. - Square Feet

Sq.Mt (M²) - Square Metre.

Cu. Ft. - Cubic Feet.

Cum (M³) - Cubic Metre.

Kg. - Kilograms (Equivalent to 1000 gms)

T.(M.T.) - Tonne (Equivalent to 1000 Kgs.)

No. - Numbers.

Cm. - Centimetre.

M or R.M. - Metre or Running Metre.

2.0 11KV VACUUM CIRCUIT BREAKER PANEL BOARD

2.1 GENERAL

Vacuum Circuit Breaker shall be incorporated in H.T. Panel wherever specified. VCB’s shall conform to IEC 298 and 694 IS 3427, BS 5227 and VDE 0670, part 6 as well as the regulations mentioned therein. VCB’s shall be suitable for operation on 11KV, 3 phase, 50Hz, AC supply.

2.2 TYPE AND CONSTRUCTION

2.2.1 The metal clad panel shall be fully extensible and compartmentalised to give.

a. Circuit Breaker Compartment

b. Busbar Compartment

c. CT and Cable Compartment

2.2.2 The compartments shall be safe to touch and compartments thus formed shall be dust proof & vermin proof. A light test is to be conducted after assembly by placing lights in different compartments of 11 KV and no light should come out from compartment. A separate metering chamber for fixing the necessary instrumentation metering and protective equipment shall be mounted on the top and bottom of the panel at the front.

2.2.3 The VCB shall consist of three air insulated poles incorporating mechanism of interrupters. The body of interrupters shall be made of nickel chromium steel supported on insulators made out of metalised aluminium oxide. The contacts shall be of chromium copper and butt shaped.

2.2.4 Vacuum circuit breaker shall be mounted on truck or a carriage mechanism. In case of truck mechanism, the breaker shall be on a trolley while in a carriage mechanism, shall be separate door and it shall be possible to perform all operations with front door closed. The drawout carriage shall have two position for the circuit breaker viz isolated/test & service position. Busbars shall be insulated type made of high conductivity copper supported on moulded
monobloc designed to withstand full short circuit currents and shall be provided all along the length of the H.T. board.

2.2.5 It shall be horizontal isolation, horizontal drawout type, or vertical isolation horizontal drawout fully interlocked, with dust and vermin proof construction, suitable for indoor installation. The panel shall be supplied with the manufacturer’s test certificates.

2.2.6 Certificates with date of manufacture and shall be complete in all respects as per details in the schedule of quantities. The steel work should have undergone a rigorous rust proofing process comprising alkaline degreasing, decaling in dilute sulphuric acid and recognised phosphating process and shall then be given powder coating (Electrostatic) paint of manufacturer’s standard shade.

2.2.7 The switchgear constructions shall be such that the operating personnel are not endangered by breaker operation and internal explosions, and the front of the panel shall be specially designed to withstand these. Pressure relief flaps shall be provided for safely venting out gases produced inside the high voltage compartment, busbar compartment and termination compartment. These flaps shall be vented upwards and cannot be opened from outside. These relief flaps shall be of such construction as not to permit ingress of dust/water in harmful quantities under normal working conditions. Enclosure shall be constructed with sheet steel of at least 2.0mm thickness. It shall have a rigid, smooth, leveled, flawless finish.

2.2.8 Total height of the H.T. Panel board shall be max. 2700mm approximately and width 620mm (approx.). On the incoming breaker panel, a 100VA burden and Class 0.5 accuracy potential transformer 11KV\(\sqrt{3}\)/110V\(\sqrt{3}\) with LT fuses shall be provided. These shall be three single-phase PTs cast resin insulated type. Adequate space at the rear of the panel shall be provided for termination of power & control cables. The panel shall be provided with suitable terminating arrangement for termination of cables.

2.2.9 The making contact arms (upper & lower) of the circuit breaker shall be encased in polypropylene tubes. Penetration type bushings shall be provided in the busbars & cable compartment for the fixed contacts.

2.2.10 Safety shutters shall be provided to cover up the fixed high voltage contacts on busbar and cable sides when the carriage is moved to Isolated/Disconnected position. The shutters shall move automatically with the movement of the drawout carriage. It shall, however, be possible to open the shutters of busbars side and cable side individually.

2.2.11 Mechanically operated circuit breaker auxiliary switches of minimum 4 NO + 4 NC ways, shall be provided for control and indication purposes. Control wiring shall be done by using 1.5 sq.mm, 1.1KV grade stranded copper PVC insulated cable. All control fuses shall be HRC link type.

2.2.12 Terminal blocks shall be clamp type suitable for connection of only 2 wires per terminal and shall be 650 V grade. The L.T. control circuit shall be routine tested to withstand 2.0KV for one minute.

2.2.13 Busbar compartment shall be provided at the rear. Electrolytic copper busbars shall be of rectangular cross section and insulated. Busbars shall be supported properly by cast epoxy resin insulators so as to withstand thermal and dynamic stresses during system short circuits. Busbars shall be provided with necessary colour coding for phases indication. The busbars shall be designed to withstand a temperature rise of 60 deg. C above and ambient temperature of 45 deg. C.

2.2.14 **SURGE SUPPRESSORS**

11 KV Surge suppressors are to be provided as below;

- Incomer :- Incoming side cables side
Outgoing : Outgoing side cables side

2.3 BUSBAR AND INSULATORS

All busbars and jumper connections shall be of electrolytic copper conforming to relevant IS standards. They shall be adequately supported on epoxy insulators to withstand electrical and mechanical stresses due to specified short circuit currents. Busbar cross section shall be uniform throughout the length of switchboard.

Contact surface at all joints shall be properly cleaned and No-oxide grease applied to ensure an efficient and trouble free connections. All bolted joints shall have necessary washers for maintaining adequate contact pressure. All connection hardware shall have high corrosion resistance.

Busbar insulators shall be of track-resistance, high strength, non-hygroscopic, non-combustible type & shall be suitable to withstand stresses due to over voltages and short circuit current. Busbar shall be supported on the insulator such that the conductor expansion and contraction are allowed without straining the insulators. The temperatures of the busbars and all other equipments, when carrying the rated of relevant Indian Standards, duly considering the specified ambient temperature.

2.4 EARTHING AND PROTECTIVE EARTHING

Copper earthing bus shall be provided. It shall be bolted/ welded to the framework of each panel. The earth bus shall have sufficient cross time fault currents to earth without exceeding the allowable temperature rise. Suitable arrangement shall be provided at each end of the earth for bolting Owner’s earthing conductors and earth bus shall run inside at the back of the panel for entire length. Facilities shall be provided for integral earthing of busbars & feeder circuit.

2.5 METERING AND PROTECTION

The VCB Panel Board shall be provided with epoxy resin current transformers for metering and protection. The CT’s shall conform in all respects to IS 2705-1964 Part-I, II and III. These shall have accuracy class of 0.5 / 1.0 for metering of 5P10 for protection. Potential transformers shall be epoxy cast resin type & conform to specifications of IS : 3156-1965 Part-I, II & III and shall be class-0.5. Ammeter and voltmeter to be installed on panel shall be of digital type. Electronic type digital energy analyser having parameter of KW, KWH power factor, frequency etc. with 30 days memory shall be provided. All meters shall be tested for 2000V for 1 minute and shall be 96mm square pattern. flush mounting type with necessary selector switches. Necessary indicating lamps of low voltage type with built in resistors shall be provided (maximum wattage 2.5W).

2.6 OPERATING MECHANISM

Vacuum Circuit Breaker shall be equipped with motorised spring charge. These operating mechanisms shall be of the stored energy type. In the closed state of the breaker, the energy stored in the springs shall be suitable for O-C-O duty.

2.7 INTERLOCKING AND SAFETY ARRANGEMENT

Vacuum Circuit Breaker shall be provided with the following safety and interlocking arrangements:

i. The drawout carriage cannot be moved from either test/disconnected to service position or vice versa, when the circuit breaker is ‘On’.

ii. The circuit breaker cannot be switched ‘ON’ when the carriage is in any position between test & service position.
iii. The front door of the panel cannot be opened when the breaker is in service position or in an intermediated position.

iv. The low voltage plug & socket cannot be disconnected in any position except test/isolated position.

v. The door cannot be closed unless the LV plug has been fitted.

vi. It shall be possible to mechanically close and trip the circuit breaker through push buttons with the circuit breaker in service position and the door closed.

vii. Individual explosion vents shall be provided for breaker, busbar, cable chambers on the top of the panel to let out the gases under pressure generated during an unlikely event of a fault inside the panel.

viii. Circuit Breaker & sheet metal enclosure shall be fully earthed.

ix. Self locking shutters shall be provided which close automatically and shall be interlocked with the movement of the drawout carriage mechanism.

2.8 RATING

The rating of the vacuum circuit breaker shall be as per the drawings and schedule of quantities. The rated/breaking capacity of the breaker shall be 350 MVA (18.37 KA RMS) at 11 KV. The rated making capacity shall be as per the relevant standards.

2.9 ACCESSORIES

Circuit Breakers shall be provided with the following accessories.

i. Auxiliary Switch with minimum 4 NO + 4 NC auxiliary contacts.

ii. Tripping Coil

iii. Mechanical Operation Counter

iv. Spring Charging Handle

2.10 ADDITIONAL ACCESSORIES

The loose items to be supplied with the 11KV VCB Panel Board shall comprise of the following:

a. Instruction Book.


c. Reaching in/out handle.

d. Handle for spring charging mechanism.

e. Foundation bolts.

f. Busbar Earthing.

2.11 MOUNTING

Vacuum Circuit Breakers shall be mounted as per manufacturers standard practice.

2.12 AUXILIARY SUPPLY

a. The tripping shall be at 110 Volt D.C. through a power pack unit. Each breaker (VCB) shall be provided with separate power pack unit.

b. Space heater, closing, indication & other auxiliary supply requirement shall be at 230 V AC. Necessary termination arrangement complete with isolating switch, control fuse & link shall be provided at one place in the panel for receiving the Incoming/Outgoing cables. A control transformer of 1 KVA capacity 11/0.415/230 volts shall be provided along with incomer breaker of HT Panel Board for providing auxiliary supply 230 Volts.
2.13 TESTS

2.13.1 FACTORY TESTS

The circuit breaker panel shall be subjected to routine tests at manufacturers works in accordance with the details specified in the relevant IS specifications. These shall however necessarily comprise of the following.

a. Power frequency voltage test on the main power circuit.

b. Verification of the correct wiring/Functional Test.

c. Dielectric test at 1.5KV on the control circuit. Apart form above, the vendor shall submit the routine test certificates for the following equipment.
   i. Circuit Breakers
   ii. Current Transformers
   iii. Voltage Transformers

The vendor shall submit the type test certificate for following alongwith the offer.

a. Temperature rise test.

b. Impulse & power frequency voltage test

c. Short time current test on circuit breaker.

2.13.2 SITE TEST

2.13.2.1 GENERAL

1. Verification for completion of equipment, physical damage/ deformities.
2. Alignment of panel, interconnection of busbars & tightness of bolts & connection etc.
3. Interconnection of panel earth busbar with plant earthing grid.
4. Inter panel wiring between transport sections.
5. Cleanliness of insulators and general Cleaniness of panel to remove traces of dust, water etc.

2.13.2.2 CIRCUIT BREAKER & PANEL

1. Check for free movement of circuit breaker, lubrication of moving part & other parts as per manufacturers manual.
3. Meggar before the Hi Pot test.
4. H.T. Test - Hi Pot test (Power frequency withstand test for one minute at 28KV RMS). At site Hi Pot test is carried out at 80% of 28KV RMS value.
5. Meggar after the Hi Pot test.
6. CT/PT ratio/polarity primary injection test.
7. Secondary injection test on relays to practical characteristics.

Note: Clause No. 4 & 6 – These tests can be conducted at the Factory. If these are conducted at factory satisfactorily, these need not be conducted at site.

2.13.3 These tests as per the clauses above will be witnessed by the Architect / Project Managers (PMC) / Engineer-In-Charge at the works for which necessary information has to be given in advance to the Architect / Project Managers (PMC) / Engineer-In-Charge.

-0-0-0-
3.0 **11KV OIL TYPE DISTRIBUTION TRANSFORMER (OUTDOOR TYPE WITH ON LOAD TAP CHANGER & RTCC PANEL)**

3.1 **GENERAL**

The transformer shall be double wound core type, oil naturally cooled suitable for Indoor installation. The transformer shall be designed and manufactured as per IS 2026-1977 with upto date amendments and Transformer shall be selected, Installed & Maintained as per IS Code of Practice IS 10028 (Part I) - 1985 with upto date amendments and having no load voltage ratio as 11000/433V. Rating of Transformer shall be as per BOQ item.

3.2 **SPECIFICATION**

a) **Standard**

   Unless otherwise stated below, transformer & transformer oil, shall conform to IS 2026 & 335 respectively.

b) **Climatic Conditions Affecting Operations**

   Minimum Temperature - 5 degree C.

   Maximum Temperature + 50 degree C.

c) **System of Supply**

   11kv 3 phase, 50 Hz system.

d) **No Load Ratio**

   11000/433 volts.

e) **KVA Rating**

   Transformer shall be suitable for continuous rating as stated in BOQ and on drawings.

f) **Type**

   Indoor

g) **Winding**

   The transformer shall be copper wound.

h) **Core**

   The magnetic core shall be made up of cold rolled grain oriented low loss steel stampings.

i) **Cooling**

   Natural oil cooling by means of pressed/round tubes around transformer tank (ONAN).

j) **Frequency**

   50Hz plus minus 3%

k) **Rated Voltage**

   Transformer shall operate at its rated KVA at any voltage plus minus 10% of rated voltage of that particular tap.

l) **Vector Group**

   Corresponding to the vector symbols Dyn-11.

m) **Connections**

   H.V. side of transformer shall be provided with cable box suitable for 3 core 240Sq.mm XLPE cable. Indoor heat shrinkable termination kit shall be used for termination of HV Cable. MV side of transformer shall be suitable for Bus Trunking / Bus Duct connection arrangement.
n) **Tapping**
ON load tap changing arrangement on 11kv side. The range for circuit taps which shall be provided on HV side shall be plus 5% to minus 15% in steps of 1.25%.

o) **Temperature Rise**
The transformer shall conform to the requirements of temperature rise specified in IS 2026 (Part II) 1977. Continuously rated for full load, temperature rise not to exceed 50 degree C by thermometer in oil (55 degree C by resistance).

p) **Insulation Levels**
The insulation level shall be in accordance with IS : 2026 (Part III) 1977.

q) **Terminal Markings, Tappings & Connections**
The terminal marking, tappings & connections shall be in accordance with IS 2026 (Part IV) 1977.

r) **Requirement with regards to ability to withstand short circuit**
As per IS : 2026 (Part I) 1977.

s) **Impedance Voltage**
As per table 3 of IS : 2026 (Part I) 1977.

t) **Tap changing switch**
An externally hand operated on load tap changing switch with handle and a position indicating plate & locking device.

v) **Parallel Operation**
Transformer shall be suitable for parallel operation with similar unit of same rates.

### 3.3 FITTINGS
The followings accessories and fittings shall be provided with the transformer.

(i). **Lifting Lugs** : The arrangement of lifting the active part of the transformer along with the cover of the tank by means of lifting lugs without disturbing the connections. Also complete transformer lifting lugs shall be provided.

(ii). **Rollers** : The transformer to be provided with 4 Nos. rollers fitted on cross channels to facilitate the movement of transformer.

(iii). **Oil Conservator** : The transformer to be provided with a conservator with welded end plates. It is to be bolted to the cover and can be dismounted for purposes of transport. It has to be provided with oil level gauge with marking for minimum level and an oil filling hole with a cap which can be used for filtering of oil. For draining purposes a plug is to be provided. A connection pipe between the conservator and main tank is to be provided, which projects inside the conservator.

(iv). **Air Release Valve** : An Air release valve shall be provided on top of the tank cover to facilitate the release of the entrapped air while filling of oil.

(v). **Breather** : The transformer shall be provided with an indicating dehydrating silicagel breather of sufficient capacity.

(vi). **Drain Valve With Plug** : The transformer to be provided with drain valve with plug at the bottom of the tank.

(vii). **Diagram And Rating Plate** : One diagram and rating plate indicating the details of transformer connection, diagram vector group, tap changing diagram etc.

(viii). **Thermometer** : Dial type thermometer (100mm dia) with maximum set pointer 75 degree C.
(ix). **Explosion Vent**: Explosion Vent or pressure relief device shall be provided of sufficient size of rapid release of any pressure that may be generated within the tank and which might result in damage to the equipment. The device shall operate at a static pressure less than the hydraulic test pressure for transformer tank.

(x). **Filter Valve**: Filter valve on the top of the tank.

(xi). **Bucholtz**: Oil & gas actuated relay equipment shall conform to IS 3637-1966 (amended upto date) and shall be double float type having contacts which close following oil surge or under incipient fault condition. Bucholtz relay shall have contacts for alarm and trip.

(xii). **Winding Temperature Indicator**: Winding temperature indicator with electrical contract for alarm and trip.

(xiii). **Oil Temperature Indicator**: Oil temperature indicator with alarm & trip contacts.

(xiv). **Marshalling Box**: The transformer shall be provided with suitable size marshalling box to terminate the control cables of thermometer and bucholtz relay. Control cabling between bucholtz relay / Marshalling box to H.T. Panel shall deemed to be including in quoted rate of Transformer.

(xv). **Transformer Oil**: First filling of oil.

(xvi). **Earthing**: Two separate earthing terminals are to be provided at the sides of the tank on both sides for earthing.

### 3.4 Instrumentation Manual

The successful bidder shall submit three copies of manual of complete instructions for the installations, operation, maintenance and repair, circuit diagrams, foundation and trenching details shall be provided with the transformer.

### 3.5 Shop Drawings

Manufacturer shall prepare and furnish shop drawings for the approval by the Architect / Project Managers (PMC) / Engineer-in-Charge before commencing fabrication/manufacture of the equipment. Shop drawings shall be based on requirement laid down in the specification. The manufacture of equipment shall be commence only after the shop drawings have been approved in writing by the Architect / Consultant / Project Managers (PMC). Transformer shall be manufactured as per approved specification of Local Supply Authority.

### 3.6 Installations

(i). The transformer shall be installed as per installation manual of the transformer supplier and conforming to Indian Standard IS 10028 (Part-II) 1981 with up to date amendments.

(ii). The transformer is to be erected on suitable cement concrete foundation / flooring. The transformer supplied shall be lifted by all lifting lugs for the purpose of avoiding imbalance in transit.

(iii). The transformer wheels shall be locked by suitable locking arrangement to avoid accidental movement of the transformer.

(iv). The transformer cable end boxes shall be sealed to prevent absorption of moisture.

(v). Dehydration at all the stages upto the handing over to the Owner shall be done by the contractor free of cost.

(vi). The transformer neutral earthing and body earthing shall be done as shown on the drawing and shall conform to Indian Standard IS : 3043-1987 with up to date amendment.

(vii). Two earths shall be provided for body earthing and two earths for neutral earthing. Copper shall be used for neutral earthing.
3.7 **Factory Tests**

The transformer shall be subjected to test as laid down in IS 2026 (Part-I) 1977 at the factory/manufacturing unit prior to despatch of the transformer to the site. All original test certificate shall be furnished.

3.8 **Test at Site**

Prior to commissioning of the transformer the following tests shall be performed.

(i). Insulation resistance of the winding between phases and earth of H.V. and M.V. Side.

(ii). Winding resistance of all the winding on all tap positions shall be taken.

(iii). Di-electric strength of transformer oil shall be checked in accordance with IS 335-1963. Incase the test is not satisfactory, the oil shall be filtered till proper dielectric strength of oil is obtained. A certificate for the same shall be given to Owner.

Contractor / Manufacturer shall give sufficient advance information about the test schedule to enable the Project Managers to appoint his representative.

3.9 **High Speed Resistor ON Load Tap Changer**

3.9.1 **General**

High speed resistor On-Load-Tap Changer shall be provided with the transformer wherever specified. The high speed, resistor, OLTC shall be for rated voltage upto 11KV, rating current of 100 Amp, 3 phase, 17 step conforming to IS 8468-1977 complete with AVR & RTCC panel.

3.9.2 **Type And Construction**

OLTC shall be a compact unit for use with three phase distribution and substation transformer. It shall be completely self contained and designed to bolt directly to a part flange on the transformer.

The assembly comprises of:

(a). Tank

(b). Selector Switch

(c). Driving Mechanism

(d). Barrier Board

(e). Local Control Gear

(f). Control Cable Terminations

(g). AVR & RTCC Panel

3.9.3 **Tank**

The complete tap changer shall be housed in a single tank of welded sheet steel construction. The tank shall be divided into two separate compartments to house the selector switch, Driving Mechanism and Local Control Gear. Access to the compartments shall be made easy by means of removable covers and a weatherproof door. Anti-condensation heater shall be provided in the compartment which houses driving mechanism and control gear.

3.9.4 **Selector Switch**

The three phase of the tap-changer shall be adequately spaced for full interphase insulation but mounted as a common assembly using vertical synthetic resin bonded insulating boards, each carrying a circle of fixed contacts. Insulating rods and tubes shall be used for the horizontal spacing of the phases and the fixed contacts shall be connected via the barrier board to appropriate tappings in the transformer winding. Each phase shall have a single rotary contact support ring with sliding contact take off connection. This ring carries separately insulated spring loaded snap connected by a
non inductive resistance unit accommodated on the contact carrier. One main moving contact shall be connected directly to the centre boss take off point, the second, transition moving contact shall be connected to the resistor. The three contact support rings shall be attached to the central insulating drive shaft, which rotates in self aligning ball bearings in the two outer phase boards. This centre shaft shall be of glass reinforced synthetic resin construction. Access to the selector switch shall be via removable cover on the top of the tank.

3.9.5 Drive Mechanism

Operation of the selector switch shaft shall be by means of a stored energy spring device having a positive snap-action for rotating the moving contacts quickly through the angle required for each tap change. The driving mechanism compartment shall be external to the oil filled switch tank. The rotary drive from the driving mechanism to the selector switch shall passes through a frictionless positive oil-tight gland. The angular movement of selector switch shaft shall be controlled by an indexing wheel which shall positively locked by the periphery of the operating cam except during the actual time of tap-change operation. The operating cam shall be freely mounted on its shafts, rotation being imparted to it by means of tension springs attached radially between the operating camhub and the periphery of a concentric spring carrying gear wheel. The spring carrying gear wheel shall be rotated by a driving motor through cam. When the drive pin on the operating cam enters the slot in the indexing wheel the lock shall disengaged but rotation shall be prevented by the locking arm pawl engaging in another slot of indexing wheel. The spring carrying gear wheel continuous to rotate thus charging the springs. When sufficient energy has been stored a trip pin on the gear wheel shall lift the locking arm restraining the indexing wheel and the spring energy shall be released to move the tap selector switch one position, the cam locking coming in operation, accurately controlling the angular movement.

The operation of the selector switch shall be thus positively assured and shall be dependent only upon the quick release of the spring energy. It shall be thus independent of the motor drive. The tap changing sequence shall now complete and the driving motor shall brought to rest by the resetting of auxiliary switches and mechanical friction device. For protective purpose automatic declutching by shear pins shall be incorporated in the drive. The mechanism shall be provided with the auxiliary switches necessary for its operation. A step by step switch for position indication shall also be fitted and additional paralleling & out of step switches provided. A tap change mechanical counter, mechanical tap position indicator, mechanical end stops and electrical limit switch shall be provided. A detachable handle for hand operation shall also be provided. The fitting of this handle shall automatically disconnects the motor drive shaft by the operation of a simply spring loaded dog clutch and at the same time isolates the electrical control supply.

3.9.6 Barrier Board

The connections from the transformer winding shall be taken through an insulating terminal barrier board, which shall be supplied loose for clamping to the transformer port flange. Thus the transformer shall be treated and filled with oil before the tap changer is fitted. This arrangement allows the tap selector switch contacts to be inspected or the complete tap changer to be handled separately without disturbing the oil level in the transformer.

3.9.7 Local Control Gear

The motor reversing contactors and associated local control gear shall be housed in the same compartment as the driving mechanism with a common hinged weatherproof door. Weatherproof local control switches when required shall be mounted in an accessible position below the door.

3.9.8 Operating Mechanism

An impulse is received, either from a remote control panel or from a local manual operation switch, which energises the appropriate raise/lower contactor to initiate a tap changer in the required direction. The contactor when energised seals itself via its own contact and the driving motor commences to run. At a predetermined point a directional sequence switch closes, taking over the holding duties of the contactor whose original self-hold circuit shall be isolated. At the completion
of the tap change the directional sequence switch opens and de-energises the driving motor. This arrangement ensures that a short period initiating pulse shall be accepted by the control gear.

3.9.9 Control Cable Termination
A detachable undrilled gland plate and the terminal station for all external connections shall be provided in the driving mechanism compartment of the tap-changer.

3.9.10 Automatic Voltage Regulator
Solid state Automatic Voltage Regulator shall be provided for regulation of the secondary voltage of power transformer with on load tap changer (OLTC). The band width control shall allow the dead band to be set in terms of upper (LOWER VOLTS) and lower (RAISE VOLTS) voltage limits around a particular nominal value with a specified sensitivity. AVR shall be provided with time delay control to allow the regulator to respond only to voltage fluctuations lasting for period greater than a selected time delay. Where the voltage correction requires more than one tap change, the time delay shall be reinitiated before further tap changes. Regulation shall reset automatically after voltage correction. Solid state lamps (LED) shall be provided to indicate voltage outside the preset limits & control relay operation.

3.9.11 RTCC Panel
RTCC Panel shall be provided to operate OLTC from Control Room located in Substation. RTCC shall be provided with main switch, a sequence selector switch. RTCC shall be provided with lower push button & raise push button, tap change in progress & complete, A.C. supply ON/OFF lamp indicator & AVR relay operated indication. Cubicle panel shall be totally enclosed, floor mounting and fabricated with a framed structure with rolled/folded sheet steel channel section of minimum 2mm thickness. All sheet steel work forming the exterior of RTCC panel shall be smoothly finished and all steel work used in construction of RTCC panel shall undergone a rigorous metal treatment process consisting of effective cleaning by hot alkaline degreasing solution followed by cold water rinsing, pickling in dilute sulphuric acid to remove scales and rust formation, a recognized phosphating process, passivating in deoxalite to retain & augment the effects of phosphating, drying with compressed air and dust free atmosphere, primer coating with two coats of highly corrosion resistant primer applied under strictly controlled conditions and finished coat of stoving synthetic enameled paint of grey colour.

4.0 PACKAGE/COMPACT TYPE SUBSTATION

4.1 CODE & STANDARDS:
4.1.1 All equipment and material shall be designed manufactured and tested in accordance with the latest applicable Indian Standard / IEC standard.

4.1.2 The electrical installation shall meet the requirement of Indian Electricity Rules as amended upto date relevant IS code of practice and Indian electricity act.

4.1.3 The Package type Substation offered shall in general comply with the latest issues including amendments of the following standards but not restricted to it.

<table>
<thead>
<tr>
<th>Title</th>
<th>Indian Standards</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Voltage Low Voltage Pre-Fabricated Substation</td>
<td>IEC:62271-202</td>
</tr>
<tr>
<td>11 kV Switchgear cubicles</td>
<td>IS:13118, IS:3427, IEC:60694, IEC:60298</td>
</tr>
<tr>
<td>Code of practice for selection, installation and maintenance of</td>
<td>IS:10118</td>
</tr>
<tr>
<td>Switchgear</td>
<td></td>
</tr>
<tr>
<td>Ring main unit 11KV Grade</td>
<td>IS:9920, IEC: 60265</td>
</tr>
<tr>
<td>Distribution Transformer</td>
<td>IS: 2026</td>
</tr>
</tbody>
</table>
Colour for ready mix paints | IS:5
---|---
Enamel synthetic, exterior a) Undercoating, b) finishing | IS:2932
Indian Electricity Rules | 1956
Indian Electricity Act | 1910

4.2 DESIGN CRITERIA

4.2.1 Package Substation consisting of **11KV SF6 insulated Non-Ext compact switchgear with VCB + Transformer + L.T. Switchgear** with all connection accessories, fitting & auxiliary equipment in an Enclosure to supply Low-voltage energy from high-voltage system as detailed in this specification. The complete unit shall be installed on a substation plinth (base) as **Outdoor Substation**. 11KV VCB controls incoming-outgoing feeder cables of the 11KV distribution system. The Vacuum Circuit Breaker shall be used to control and isolate the 11kV/433V Distribution transformer. The transformer L.T. side shall be connected to L.T. switchgear. The connection cables to consumer shall be taken out from the L.T. switchgear.

4.2.2 The prefabricated package type substation shall be designed for a) Compactness, b) fast installation, c) maintenance free operation, d) safety for worker/operator & public.

4.2.3 The Switchgear and component thereof shall be capable of withstanding the mechanical and thermal stresses of short circuit listed in ratings and requirements clause without any damage or deterioration of the materials.

4.2.4 For continuous operation at specified ratings temperature rise of the various switchgear components shall be limited to permissible values stipulated in the relevant standard and / or this specification.

4.2.5 **Service Conditions:**

4.2.5.1 The equipment offered shall be suitable for continuous satisfactory operation in tropical area of Installation.

**Enclosure:** The Enclosure, High Voltage switchgear-control gear, Low Voltage switchgear-control gear & Transformer of the package type substation shall be designed to be used under **normal outdoor service condition** as mentioned. The enclosure should take minimum space for the installation including the space required for approaching various doors & equipment. The enclosure construction shall be such that it fully protects ingress of rain water & rusting. For this purpose, construction without welded joint is preferred.

4.3 SPECIFIC REQUIREMENT

The main components of a prefabricated package type substation are Transformer, High-voltage switchgear-control gear, Low-voltage switchgear-control gear, corresponding interconnections (cable, flexible, busbars) & auxiliary equipment. The components shall be enclosed, by either common enclosure or by an assembly of enclosure. All the components shall comply with their relevant IS/IEC standards.

4.3.1 **Ratings:**
<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated Voltage / Operating Voltage</td>
<td>kV rms</td>
<td>11</td>
</tr>
<tr>
<td>Rated frequency &amp; Number of phases</td>
<td>Hz &amp; nos.</td>
<td>50 &amp; 3</td>
</tr>
<tr>
<td>Rated maximum power of substation</td>
<td>Kva</td>
<td>630KVA, 500KVA, 400KVA &amp; 315KVA</td>
</tr>
</tbody>
</table>

**HV Insulation Level**

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated withstand voltage at power frequency of 50 Hz</td>
<td>kV rms</td>
<td>28</td>
</tr>
<tr>
<td>Rated Impulse withstand Voltage</td>
<td>kV peak</td>
<td>75</td>
</tr>
</tbody>
</table>

**HV Network & Busbar**

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated current</td>
<td>Amp</td>
<td>200Amp</td>
</tr>
<tr>
<td>Rated short time withstand current</td>
<td>kA rms/ 3sec</td>
<td>21</td>
</tr>
<tr>
<td>Making capacity for switch-disconnector &amp; earthing switches</td>
<td>kA peak</td>
<td>52kA</td>
</tr>
<tr>
<td>Breaking capacity of Isolators (rated full load)</td>
<td>A</td>
<td>630Amp</td>
</tr>
</tbody>
</table>

**LV Network**

| Description                                                                 |                      | As per the requirement      |

4.3.2 **Outdoor enclosure:**

4.3.2.1 The enclosure shall be made of Galvanised Sheet Steel tropicalised to Indian weather conditions.

4.3.2.2 The metal base shall ensure rigidity for easy transport & installation.

4.3.2.3 The structure of the substation shall be capable of supporting the gross weight of all the equipment & the roof of the substation compartment shall be designed to support adequate loads.

4.3.2.4 The protection degree of the Enclosure shall be **IP:23D** for Proper / adequate ventilation aperture shall be provided for natural ventilation by way of Louvers etc.

4.3.2.5 The doors shall be provided with proper interlocking arrangement for safety of operator.

4.3.2.6 The H.V. & L.V. outgoing of the transformer are to be connected to Breaker of HT Panel Board & incomer of the L.V.

4.3.3 **Internal Fault**: Failure within the package type substation due either to a defect, an exceptional service condition or mal-operation may initiate an internal arc. Such an event may lead to the risk of injury, if persons are present. It is desirable that the highest practicable degree of protection to persons shall be provided.

4.3.4 **Covers & Doors**: Covers & doors are part of the enclosure. When they are closed, they shall provide the degree of protection specified for the enclosure. Ventilation openings shall be so arranged or shielded that same degree of protection as specified for enclosure is obtained. Additional wire mesh may be used with proper Danger board for safety of the operator. All covers,
doors or roof shall be provided with locking facility or it shall not be possible to open or remove them before doors used for normal operation have been opened. The doors shall open outward at an angle of at least 90° & be equipped with a device able to maintain them in an open position.

4.3.5 **Earthing** : All metallic components shall be earthed to a common earthing point. It shall be terminated by an adequate terminal intended for connection to the earth system of the installation, by way of flexible jumpers/strips & Lug arrangement. The continuity of the earth system shall be ensured taking into account the thermal & mechanical stresses caused by the current it may have to carry. The components to be connected to the earth system shall include:

a) The enclosure of Package type / prefabricated substation,
b) The enclosure of High voltage switchgear & control gear from the terminal provided for the purpose,
c) The metal screen & the high voltage cable earth conductor,
d) The transformer tank or metal frame of transformer,
e) The frame &/or enclosure of low voltage switchgear,

4.3.6 Package type substation enclosure has internal lighting activated by associated switch for HV, Transformer & LV compartments separately.

4.3.7 **Labels** : Labels for warning, manufacturer’s operating instructions etc. & those according to local standards & regulations shall be durable & clearly legible.

4.3.8 **Cleaning & Painting** :

a) The paints shall be carefully selected to withstand tropical heat rain. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling.
b) Special care shall be taken by the manufacturer to ensure against rusting of nuts, bolts and fittings during operation. All bushings and current carrying parts shall be cleaned properly after final painting.
c) The Fabrication process shall ensure that there are no sharp edges on GI sheet used.

4.3.9 **11KV SF-6 insulated VCB Panel Board** : The requirement of 11KV HT Panel is as under.

4.3.9.1 SF6 insulated VCB Breakers complete with operating mechanism suitable for load breaking fault making with cable box accessible from the front.

The above breakers, Busbars should be mounted inside a robotically welded sealed for life, stainless steel tank of 3mm thick sheet metal. The tank should be filled with SF6 gas at adequate pressure. The degree of protection for gas tank should be IP67.

4.3.9.2 The VCB is required to control 11 kV/433 volts distribution Transformer of following rating and relay settings shall be selected accordingly.

- 630KVA / 500KVA / 400KVA / 315KVA Transformer.

4.3.9.3 **General Finish** : Totally enclosed, metal clad, vermin and dust proof suitable for tropical climate use as detailed in the specification.

4.3.9.4 **Breaking & Making Capacity** : Breaker shall be capable of having rupturing capacity of minimum 21KA (350 MVA at 11KV has 18.37KA breaking capacity) symmetrical at 11000 volts three phase.

4.3.9.5 **Busbar** : Switchgear shall be complete with all connection, bus-bars etc. Copper bus bars continuous rating shall be 800 Amps. The bus bars should be fully encapsulated by SF6 gas inside the steel tank.

4.3.10 **Switchgear**:

4.3.10.1 The **VCB pressure details shall be submitted with the Tender document**. Sealed for life, the enclosure shall meet the “sealed pressure system” criteria in accordance with IEC:298 (a system
for which no handling of gas is required throughout service life of approximate 20 years.) There shall be no requirement to ‘top up’ the SF6 gas. In addition, manufacturer shall confirm that maximum leakage rate is lower than 0.1% per year. It shall provide full insulation, making the switchgear insensitive to the environment. Thus assembled, the active parts of the switchgear unit shall be maintenance free.

4.3.10.2 The switchgear & switchboard shall be designed so that the position of different devices is visible to the operator on the front of the switchboard & operation is visible as well. The switchboard shall be designed so as to prevent access to all live parts during operation without the use of tools.

4.3.10.3 11 KV VCB Panel Board should be tested for internal arc fault test.

4.3.11 VCB:

4.3.11.1 The Unit shall consist 630A Tee-off spring assisted, three pole VCB circuit breaker, with integral fault making/ dead breaking earth switch. The function shall be naturally interlocked to prevent the main & earth switch from being switched ‘ON’ at the same time & the CB not allowed to trip in ‘Earth On’ position. The selection of the main/earth switch lever on the panel, which is allowed to move only if the main or earth switches in the off position. The lever shall be able to pad locked in either the main or earth position.

4.3.11.2 The manual operation of the circuit breaker shall not have an effect of the trip spring. This should only be discharged under a fault (electrical) trip condition; the following manual reset operation should recharge the trip spring & reset the CB mechanism in ‘main off’ position.

4.3.11.3 Protection:

Protection Relays: The CB shall be fitted with microprocessor based self powered relay inside the front cover to avoid any tampering.

4.3.12 Cable Box:

4.3.12.1 Every VCB shall be provided with suitable and identical cable boxes for connecting 3 core, 11kV cable from vertically below. The cable boxes shall be so located at convenient height to facilitate easy cable jointing work. The height available for cable termination should be minimum 500mm The Cable termination shall be done by Heat shrinkable Termination method so adequate clearances shall be maintained between phases for Termination. Access to all the cables should be possible form the front of HT Panel Board.

4.3.12.2 Locking Arrangement: Suitable padlocking arrangements shall be provided as stated below.

   a) CB manual operating handle in the “OFF” position.
   b) Each feeder Panel operating handles in ‘Closed’ ‘Open’ or ‘Earth’ position.
   c) Each VCB operating handle in ‘Closed’, ‘Open’, or ‘Earth’ position.

4.3.13 Ratings:

<table>
<thead>
<tr>
<th>1.3.6.1 Switchgear Data</th>
</tr>
</thead>
<tbody>
<tr>
<td>a) Type</td>
</tr>
<tr>
<td>VCB in SF-6 Tank</td>
</tr>
<tr>
<td>b) Number of phases</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>c) Voltage</td>
</tr>
<tr>
<td>11000V</td>
</tr>
<tr>
<td>d) Rated Frequency</td>
</tr>
<tr>
<td>50 Hz</td>
</tr>
<tr>
<td>e) Rated Current</td>
</tr>
<tr>
<td>200 Amp (Breaker)</td>
</tr>
<tr>
<td>f) Short Circuit rating</td>
</tr>
</tbody>
</table>

---

Tech. Spécification - 17
i) Breaking  
Minimum 21 KA (350 MVA) at 11 KV

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>ii) Short time withstand for 3 Sec.</td>
<td>Minimum 21 KA</td>
</tr>
<tr>
<td>iii) Rated S/c making</td>
<td>52 kA peak for Breaker</td>
</tr>
<tr>
<td>g) Short duration power freq.</td>
<td>28 kV</td>
</tr>
<tr>
<td>h) Insulation Level</td>
<td>95 KV peak</td>
</tr>
<tr>
<td>i) System earthing</td>
<td>Solidly earthed at substation</td>
</tr>
</tbody>
</table>

4.3.14 **Tests For 11 KV HT Panel Board**: Each type of 11kV Switchgear shall be completely assembled, wired, adjusted and tested at the factory as per the relevant standards i.e. IS:9920, IS:3427, IS:13118, IEC:265, IEC:298 and during manufacturing and on completion

4.3.15 **Routine Tests**: The tests shall include but not necessarily limited to the following:

a) Operation under simulated service condition to ensure accuracy of wiring, correctness of control scheme and proper functioning of the equipment.

b) All wiring and current carrying part shall be given appropriate High Voltage test.

4.3.16 **Distribution Transformer (Oil Filled Transformer)**

4.3.16.1 **Requirement**: 11000/433 Volt Oil immersed, **630KVA to 315KVA** ONAN cooled suitable for installation at outdoor in Enclosure for ground mounting. The transformer should be hermetically sealed & should be with corrugated wall design

4.3.16.2 **Voltage Ratio**: No load voltage 11000/433 volts within tolerance as stipulated in IS:2026.

4.3.16.3 **Rating**: The transformer shall have a continuous rating as specified at any of the specified tapping position and with the maximum temperature rise specified.

4.3.16.4 **Temperature Rise**: The maximum temperature rise at the specified maximum continuous output shall not exceed 40°C by thermometer in the hottest portion of the oil or 50°C measured by resistance of winding above ambient temperature, not exceeding 40°C daily average or 50°C maximum.

4.3.16.5 **Type of Load**: The transformer shall be suitable for carrying load within temperature rise indicated in the Indian Standard specification IS:6600 ‘Guide for loading of oil immersed Transformer’.

4.3.16.6 **Overloads**: The transformers shall be suitable for carrying overload within temperature rise indicated in IS:6600 ‘Guide for Loading of oil immersed Transformer’.

4.3.16.7 **Connections**: H.V. Delta and L.V Star connected with neutral brought out on the secondary side for connection to earth; Vector group DYn11 of IS:2026.

4.3.16.8 **Tapping**:

a) Each transformer shall be provided with **Rotary type tap switch** so as to provided for a voltage adjustment on H.V. from +5% to –5% of rated voltage of 11000 volts in 4 equal steps (5 position) to obtain rated voltage of 433 volts on LV side. The tapping shall be provided for following voltage ratios at no load.

b) Each transformer shall be provided with adjustable **tapping Links** such as to provided for a voltage adjustment on H.V. from +5% to –5% of rated voltage of 11000 volts in 4 equal steps (5 position) to obtain rated voltage of 433 volts on LV side. The tapping shall be suitable to change on H.V. side by links provided for this purpose.
4.3.16.9 **Cleaning & Painting:**

a) All steel surfaces shall be thoroughly cleaned by sand blasting or chemical agents, as required to produce a smooth surface free of scales, grease and rust.

b) The internal surfaces in contact with insulating oil shall be painted with heat resistant insulation paint which shall not react & be soluble in the insulating liquid used.

c) The external Surfaces, after cleaning, shall be given two coats of high quality epoxy based rust resisting primer as per IS:2074 followed by filler coats.

d) The transformer shall be furnished with coats of weather resisting battleship gray epoxy based enamel paint as per IS:2932 specially recommended for transformer use.

e) The paints shall be carefully selected to withstand tropical heat rain, effect of proximity to the sea etc. The paint shall not scale off or crinkle or be removed by abrasion due to normal handling.

f) Special care shall be taken by the manufacturer to ensure against rusting of nuts, bolts and fittings during operation. All bushings and current carrying parts shall be cleaned properly after final painting.

4.3.16.10 Both H.V. and L.V. bushings shall have creepage corresponding to **very heavily polluted atmosphere**.

4.3.16.11 **Oil:** New transformer oil used shall be according to IS:335.

4.3.16.12 **Phase Marking & Danger Plate:** Phase markings in fluorescent paint on small non-corrodbile metallic tags shall be permanently fixed for H.V. and L.V sides. Phase markings tags shall be properly fixed with proper alignment. Danger plates shall be provided on the H.V & LV sides, mentioning the Corresponding Voltages.

4.3.16.13 **Core:** The core shall be constructed from high grade, cold rolled, non-ageing, low loss, high permeability, grain oriented, cold-rolled grain oriented silicon steel laminations. The transformer shall be so designed as to have minimum humming noise. The percentage harmonic potentials with the maximum flux density under any conditions shall be such that capacitors connected in the system shall not be overloaded.

4.3.16.14 The core and coil assembly shall be securely fixed in position so that no shifting or deformation occurs during movement of transformer. The core and coil assembly shall be capable of withstanding without injury, the thermal and mechanical effects of short circuit at the terminals of any winding as per IS:2026.

4.3.16.15 **Impedance Volts:** The Percentage impedance value at 75 Deg. C at any tap shall be 5% subject to tolerance as specified in IS:2026. The value of the impedance volts at each tapping over the specified range shall be specified in the bid.

4.3.16.16 **Regulation:** The regulation at 75°C at full load at unity and 0.8 power factor subject to the usual tolerance as per IS:2026 shall be specified in the bid.

4.3.16.17 **Power Freq. High Voltage & Insulation Level (Impulse voltage):** The distribution transformer shall be designed so that they are capable of withstanding high voltage & impulse voltages as per IS:2026 and as given below:

   a) Impulse Voltage for 11kV winding: 75 kV (1.2/50 Microsecond wave shape).
   b) High Voltage : 28kV rms.

4.3.16.18 **RATINGS (Summary) :**

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Application</th>
<th>630 KVA to 315 KVA Corrugated Tank</th>
</tr>
</thead>
<tbody>
<tr>
<td>(i)</td>
<td>Service</td>
<td>Outdoor in an Enclosure, Distribution Transformer</td>
</tr>
<tr>
<td>(ii)</td>
<td>Type</td>
<td>Oil immersed corrugated tank</td>
</tr>
<tr>
<td>S. No.</td>
<td>Application</td>
<td>630 KVA to 315 KVA Corrugated Tank</td>
</tr>
<tr>
<td>--------</td>
<td>-----------------------------------------</td>
<td>------------------------------------</td>
</tr>
<tr>
<td>(iii)</td>
<td>Cooling system</td>
<td>ONAN</td>
</tr>
<tr>
<td>(iv)</td>
<td>No. of Phases</td>
<td>3</td>
</tr>
<tr>
<td>(v)</td>
<td>No. of winding per phase</td>
<td>2</td>
</tr>
<tr>
<td>(vi)</td>
<td>Rated output (MVA) With ANAN cooling</td>
<td>630 KVA to 315 KVA</td>
</tr>
<tr>
<td>(vii)</td>
<td>Rated voltage in KV (Line to Line)</td>
<td>HV-11 kV, LV-0.433 kV</td>
</tr>
<tr>
<td>(viii)</td>
<td>Rated frequency</td>
<td>50 Hz</td>
</tr>
<tr>
<td>(ix)</td>
<td>Temperature rise above 40°C</td>
<td></td>
</tr>
<tr>
<td>a)</td>
<td>In winding by resistance</td>
<td>50°C or above</td>
</tr>
<tr>
<td>b)</td>
<td>In Oil by thermometer</td>
<td>40°C or above</td>
</tr>
<tr>
<td>(x)</td>
<td>Insulation level</td>
<td></td>
</tr>
<tr>
<td>a)</td>
<td>H.V. Power Freq. KV rms</td>
<td>28 kV</td>
</tr>
<tr>
<td>b)</td>
<td>H.V. (kVpeak ) Impulse</td>
<td>75 kV</td>
</tr>
<tr>
<td>c)</td>
<td>L.V. (kV)</td>
<td>-</td>
</tr>
<tr>
<td>(xi)</td>
<td>Vector Group</td>
<td>Dyn11</td>
</tr>
<tr>
<td>(xii)</td>
<td>Parallel operation</td>
<td>Yes</td>
</tr>
<tr>
<td>(xiii)</td>
<td>Type of taps provided</td>
<td>Off Load full capacity</td>
</tr>
<tr>
<td>a)</td>
<td>Taps provided on</td>
<td>H.V. winding</td>
</tr>
<tr>
<td>b)</td>
<td>Range of taps</td>
<td>+5% to -5% in steps of 2.5%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(4 steps, 5 position)</td>
</tr>
<tr>
<td>c)</td>
<td>Method of Tap Change control</td>
<td>Rotary Switch</td>
</tr>
<tr>
<td>d)</td>
<td>Manual load</td>
<td>Yes ‘Off Circuit’</td>
</tr>
<tr>
<td>(xiv)</td>
<td>Percentage impedance at 75 Deg. C</td>
<td>5% with tolerance</td>
</tr>
<tr>
<td>(xv)</td>
<td>System earthing</td>
<td></td>
</tr>
<tr>
<td>a)</td>
<td>H.V.</td>
<td>Solidly earthed</td>
</tr>
<tr>
<td>b)</td>
<td>L.V.</td>
<td>Solidly earthed</td>
</tr>
<tr>
<td>(xvi)</td>
<td>Terminal arrangement</td>
<td></td>
</tr>
<tr>
<td>a)</td>
<td>H.V.</td>
<td>From H.V. Bushing on Top.</td>
</tr>
<tr>
<td>b)</td>
<td>L.V.</td>
<td>From L.V. Bushing on Top.</td>
</tr>
<tr>
<td>c)</td>
<td>L.V. Neutral</td>
<td>From L.V. Neutral Bushing on Top.</td>
</tr>
<tr>
<td>(xvii)</td>
<td>Transformer-bushing voltage class</td>
<td></td>
</tr>
<tr>
<td>a)</td>
<td>H.V. (kV)</td>
<td>12 kV class</td>
</tr>
<tr>
<td>b)</td>
<td>L.V. (kV)</td>
<td>1.1kV class</td>
</tr>
<tr>
<td>(xviii)</td>
<td>System fault level</td>
<td></td>
</tr>
<tr>
<td>a)</td>
<td>H.V. side</td>
<td>350 MVA (11 kV)</td>
</tr>
<tr>
<td>b)</td>
<td>L.V. side</td>
<td>-</td>
</tr>
<tr>
<td>(xix)</td>
<td>Short circuit withstand capability duration</td>
<td>3 sec.</td>
</tr>
<tr>
<td>(xx)</td>
<td>L.T. side C.T. ratings</td>
<td></td>
</tr>
<tr>
<td>a)</td>
<td>Current Ratio</td>
<td>1250/5 Amps &amp; 500/5 Amps</td>
</tr>
<tr>
<td>b)</td>
<td>Class of Accuracy</td>
<td>1</td>
</tr>
<tr>
<td>c)</td>
<td>Burden</td>
<td>5 VA</td>
</tr>
<tr>
<td>d)</td>
<td>Type</td>
<td>ring type</td>
</tr>
</tbody>
</table>
4.3.16.19  **Fittings & Accessories For Corrugated Tank Transformer:**

The following accessories conforming to IS:3639 shall be provided for 11kV / 0.433kV, distribution transformer.

a) Two earthing terminals with copper lugs. The lugs shall be provided in such a way that they shall not obstruct the movements of rollers. The earthing continuity for all the connected equipments shall be properly done.

b) Two lifting lugs for complete transformer as well as enclosure.

c) Off circuit tapping switch shall be rotary type, 3 pole gang operated, top mounting draw out type only. Tap switch shall be suitable for rated current considering 20% overloading & operating voltage. Switch shall be provided with externally operating hand wheel handle with indicator and locking device, with direction changing facility and locking arrangement.

d) **Rating plate and diagram plate** of durable non-corroding metal giving information as required under IS:2026. Rating plate shall also include Transformer Actual % Z, No-Load Loss & Full-Load Loss at 75°C along with details like Purchase Order Number, date. The name plate marking shall be done with fluorescent colour. Each equipment shall carry individual name-plate with proper instructions & affixed with screws.

4.3.17  **LT Switchgear:**

4.3.17.1  **System:**

a) **Declared voltage** :- 3 Phase,400V (±6%) 50 Hz,

b) **Neutral** :- Solidly earthed at substation.

4.3.17.2  **General finish:** - Tropical, totally enclosed, metal-clad, weather-proof, vermin and dust proof.

4.3.17.3  **Enclosure**: Type of enclosure shall be able to provide the degree of protection IP:54 .

4.3.17.4  **Circuit Ways:**

As per the requirement given in the specifications / schedule of requirement.

4.3.17.5  **Construction** :

a) The terminals shall be of sufficient mechanical strength and shall provide adequate electrical contact for the appropriate size of cable used. They shall be capable of receiving appropriate size of Aluminum conductors. They shall be provided with stainless steel nut bolts, plane washers and spring washers for cable connection.

b) The enclosure shall be of sheet steel of 2mm CRC sheet steel, dust vermin proof, duly powder coated and wired as per standard engineering practice and CPRI tested.

c) No contact pressure shall be transmitted through insulating material & the gripping of the conductor shall take place between metal faces.

4.3.18  **Earthing** :

4.3.18.1  Earthing arrangement shall be provided for earthing each cable, PVC cable gland, neutral busbar, chassis and frame work of the cubicle with separate earthing terminals at two ends. The main earthing terminals shall be suitably marked. The earthing terminals shall be of adequate size, protected against corrosion, and readily accessible. These shall be identified by means of sign marked in a legible manner on or adjacent to terminals.

4.3.18.2  Neutral bus bar strip shall be connected to Earthing terminal with help of copper strip of suitable capacity & nut-bolt arrangement.

4.3.19  **Accessories:** The following accessories shall be supplied duly mounted.

One incandescent lamp (with necessary fuse) to illuminate the fuse board internally.

4.3.20  **LT Switchgear**

Specification/Selection of Air Circuit Breaker and Moulded Case Circuit Breakers:-
1) Upto 100Amp MCCBs shall be used of 25kA Short Ckt. Current and should be Thermal Magnetic.

2) Above 100Amp and below 250Amp MCCBs shall be used of 35kA short Ckt. Current and should be Thermal Magnetic.

3) From 250Amp to 630Amp MCCBs shall be used of minimum 35kA short Ckt. Current and should be microprocessor based.

<table>
<thead>
<tr>
<th>Rating of MCCB</th>
<th>Electrical Endurance</th>
<th>Mechanical Endurance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upto 160 A</td>
<td>7000 Opns</td>
<td>25000 Opns</td>
</tr>
<tr>
<td>Above 160 A</td>
<td>4000 Opns</td>
<td>15000 Opns</td>
</tr>
</tbody>
</table>

**Frame Size**

The MCCB shall have the following Frame Size:

a) Upto 160 A. Rating 160 A Frame
b) From 160 A. to 250 A. 250 A Frame
c) From 250 A. to 400 A. 400 A Frame
d) From 400 A. to 630 A. 630 A Frame

For thermal magnetic protection the O/L adjustment should be 75%-100% and for microprocessor-based release the adjustment should be 40%-100% and S/c for 2 to 12 times.

4) From 800A onwards ACBs shall be used of 50kA(Icu=Ics) with Thermal Magnetic (TM) based overload, short circuit and earth fault protection.

<table>
<thead>
<tr>
<th>Rating of ACB</th>
<th>Electrical Endurance</th>
<th>Mechanical Endurance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Upto 1600 A</td>
<td>10000 Opns</td>
<td>200000Opns</td>
</tr>
<tr>
<td>2000-4000A</td>
<td>5000 Opns</td>
<td>15000 Opns</td>
</tr>
</tbody>
</table>

The air circuit-breakers (ACB’s) used in low-voltage installations shall be designed, built and tested in compliance with the standards of the IEC 947-2 & EN 60947,

• The ACB’s shall have a rated operating voltage of up to 690 V (50/60Hz)
• The rated insulation voltage shall be equal to or greater than 1000 V.
• The rated impulse withstand voltage shall be equal to 12 kV; the device can be used for every installation category in this way, in compliance with the international standards CEI IEC 664-1

**Setting range of protection release**

a) Overload protection shall have adjustable setting from 40% to 100% of the ACBs rated.

b) Current in steps of 10% and adjustable time setting from 3-18m sec.

c) Short circuit protection shall have adjustable current setting from 100% to 1000% of the overload setting and adjustable time delay setting for fault discrimination from 50-500 m sec.

d) E/F protection if specified will have adjustable current setting from 40% to 100% of ACB rated current and adjustable time setting from 100-800m sec. It shall be possible to charge the release setting on load.

e) There should not be any defeat facility of overload protection.
4.3.21 TYPE/Routine Test on Package Type Substation:

4.3.21.1 Type Tests for the Package Type Substation:

The offered package type substation should be fully type tested as per the IEC-1330.

4.3.21.2 Routine Tests: The routine tests shall be made on each complete prefabricated substation.

a) Voltage tests on auxiliary circuit.

b) Functional test.

c) Verification of complete wiring.

4.3.21.3 Test Witness: Routine test shall be performed in presence of Owner’s representative if so desired by the Owner. The Vendor shall give at least fifteen (15) days advance notice of the date when the tests are to be carried out.

4.3.21.4 Test Certificates:

4.3.21.4.1 Test report for the test mentioned under Type tests clause shall be submitted along with offer.

4.3.21.4.2 Certified reports of all the tests carried out at the works shall be furnished in three (3) copies for approval of the Owner.

5.0 Main L.T. Panel

5.1 General

This specification of Main L.T. Panel shall be applicable for Main L.T. Panel (Normal Supply) and Main L.T. Panel (Essential Supply) of all Substations.

Main L.T. Panel shall be indoor type, metal clad, floor mounted, free standing, totally enclosed, extensible type, air insulated, cubicle type for use on 415 Volts, 3 phase, 50 cycles system with a fault level withstand of 50 KA RMS symmetrical. Main L.T. Panel (Essential Supply) shall be provided with PLC for load management. PLC shall check load on various bus section. PLC shall also give command to Main L.T. Panel (Essential Supply) incomer breakers to open and closed and also for buscoupler switching. PLC shall also provide interlocking of incomer breakers and buscoupler. PLC shall provide signal to AMF Panel for load status and AMF shall give command to DG Sets to auto start / auto stop depending upon load status and requirement. All hardware and software required to ensure above operation of Main L.T. Panel (Essential Supply) shall deemed to be included in the cost, wether these items are listed out or not in the BOQ item.

5.2 Standards

The equipment shall be designed to conform to the requirements of:

i. IS : 8623- Factory Built Assemblies of switchgear and controlgear.

ii. IS : 4237- General requirements for switchgear and control gear for voltages not exceeding 1000 volts.

iii. IS : 2147- Degree of protection provided by enclosures for low voltage switchgear and controlgear.

iv. IS : 375- Marking and arrangement of busbars.

Individual equipment housed in the Main L.T. Panels shall conform to the following IS Specification.

i. Air Circuit Breakers/ Moulded Case Circuit Breaker - IS: 13947 (Part-II) & IEC 947 (2).

ii. Fuse switch and switch fuse units - IS: 13947 (Part-3) & IEC 947 (3).

iii. HRC fuse links - IS: 13703

iv. Current Transformers - IS: 2705
5.3 CONSTRUCTION

Main L.T. Panels shall be:-

i. Of metal enclosed, indoor, floor mounted, free standing construction, extensible type.

ii. Made up of the requisite vertical sections, which when coupled together shall form continuous dead front switchboards.

iii. Provide dust and damp protection, the degree of protection being not less than IP 54 to IS : 2147.

iv. Be readily extensible on both sides by the addition of vertical sections after removal of the end covers.

Main L.T. Panel shall be constructed only of materials capable of withstanding the mechanical, electrical and thermal stresses, as the effects of humidity, which are likely to be encountered in normal service.

Each vertical section shall comprise of:

i. A front-framed structure of rolled/folded sheet steel channel section, of minimum 2mm thickness, rigidly bolted together. This structure shall house the components contributing to the major weight of the equipment, such as circuit breaker cassettes, fuse switch units, and main horizontal busbars, vertical risers and other front mounted accessories.

The structure shall be mounted on a rigid base frame of folded sheet steel of minimum 2 mm thickness and 100 mm height or MS channel of 100mm x 50mm x 5mm thick. The design shall ensure that the weight of the components is adequately supported without deformation or loss of alignment during transit or during operation.

ii. A rear cable chamber housing the cable end connections, and power/control cable terminations. The design shall ensure generous availability of space for ease of 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.

iii. A cover plate at the top of the vertical section, provided with a ventilating hood where necessary. Any aperture for ventilation shall be covered with a perforated sheet having less than 1 mm diameter perforations to prevent entry of vermin.

iv. Front and rear doors fitted with dust excluding neoprene gaskets with fasteners designed to ensure proper compression of the gaskets. When covers are provided in place of doors, generous overlap shall be assured between sheet steel surfaces with closely spaced fasteners to preclude the entry of dust.

v. All doors shall be lockable mounted lock.

vi. Gland plate shall be 3mm thick.

The height of the panels should not be more than 2400 mm. The total depth of the panel should be adequate to cater to proper cabling space and should not be less than 1350mm. Operating handle not higher than 1800mm and not lower than 350mm.
Doors and covers shall be of minimum 2mm thick sheet steel. Sheet steel shrouds and partitions shall be of minimum 2mm thickness. All sheet panels shall be smoothly finished, levelled and free from flaws. The corners should be rounded.

The apparatus and circuits in the power control centres shall be so arranged as to facilitate their operation and maintenance and at the same time to ensure the necessary degree of safety.

Apparatus forming part of the Main L.T. Panel shall have the following minimum clearances.

i. Between phases - 32mm
ii. Between phases and neutral - 26mm
iii. Between phases and earth - 26mm
iv. Between neutral and earth - 26mm

When, for any reason, the above clearances are not available, suitable insulation shall be provided. Clearances shall be maintained during normal service conditions.

Creepage distances shall comply to those specified in relevant standards.

All insulating material used in the construction of the equipment shall be of non-hygroscopic material, duly treated to withstand the effects of the high humidity, high temperature tropical ambient service conditions.

Functional units such as circuit breakers and fuse switches shall be arranged in multi-tier formation, except that not more than two air circuit breakers shall be housed in a single vertical section. Cable entry for various feeders shall be from the rear. Panel shall be suitable for termination of busduct for incoming breakers.

Metallic perforated barriers shall be provided within vertical sections and between adjacent sections to ensure prevention of accidental contact with:

i. Main busbars and vertical risers during operation, inspection or maintenance of functional units and front mounted accessories.
ii. Cable termination of one functional unit, when working on those of adjacent unit/units.

All doors/covers providing access to live power equipment/ circuits shall be provided with tool operated fasteners to prevent unauthorised access.

Provision shall also be made for permanently earthing the frames and other metal parts of the switchgear by two independent connections.

5.4 METAL TREATMENT & FINISH

All steel work used in the construction of the Electrical cubicle panels should have undergone a rigorous metal treatment process as follows:

i. Effective cleaning by hot alkaline degreasing solution followed by cold water rinsing to remove traces of alkaline solution.
ii. Pickling in dilute sulphuric acid to remove oxide scales & rust formation, if any, followed by cold water rinsing to remove traces of acidic solution.
iii. A recognised phosphating process to facilitate durable coating of the paint on the metal surfaces and also to prevent the spread of rusting in the event of the paint film being mechanically damaged. This again, shall be followed by hot water rinsing to remove traces of phosphate solution.
iv. Passivating in de-oxalite solution to retain and augment the effects of phosphating.
v. Drying with compressed air in a dust free atmosphere.

5.5 BUSBARS

The busbars shall be air insulated and made of high conductivity, high strength aluminium alloy complying with the requirement of grade E-9IE of IS-5082.

The busbars shall be suitable braced with non-hygroscopic SMC supports to provide a through fault withstand capacity of 50KA RMS symmetrical for one second and a peak short circuit withstand capacity of 105KA. The neutral as well as the earth bar should be capable of withstanding the above level. Ridges shall be provided on the SMC supports to prevent tracking between adjacent busbars. Large clearances and creepage distances shall be provided on the busbar system to minimize possibilities of fault.

The Main L.T. Panel shall be designed that the cables are not directly terminated on the terminals of breaker/switch fuse/fuse switch etc. but on cable termination links. Capacity of aluminium busbars shall be considered as 0.8Amp/sq.mm of cross section area of the busbar. The main busbars shall have continuous current rating throughout the length of L.T. Panel. The cross section of neutral busbars shall be same as that of phase busbar for busbars of capacity upto 200Amp; for higher capacity the neutral busbar shall not be less than half (50%) the cross section of that the phase busbars. The busbar system shall consist of main horizontal busbar and auxiliary vertical busbars run in busbar alley/chamber on either side in which the circuit could be arranged/connected with front access.

Connections from the main busbars to functional circuit shall be arranged and supported to withstand without any damage or deformation the thermal and dynamic stresses due to short circuit currents. Busbars to be colour coded with PVC sleeves.

5.6 MEDIUM VOLTAGE AIR CIRCUIT BREAKERS

5.6.1 GENERAL

Air circuit breakers shall be incorporated in Main L.T. Panel wherever specified. ACBs shall conform to IS : 13947 (Part-II) & IEC 60947-2 and their latest amendments and should be type tested and certified for compliance to Indian standards from CPRI / ERDA. Manufacturer shall submit test report for combined sequence tests from CPRI / ERDA. The breaker shall be suitable for isolation and shall be clearly indicated on front facia. ACBs shall be suitable for operation on 415 volts, 3 phase, 50Hz, AC supply. Rated insulation voltage (Ui : 1000 volts AC)

5.6.2 TYPE AND CONSTRUCTION

Air Circuit Breakers shall be of enclosed pattern, dead front type with ‘trip free’ operating mechanism. Air Circuit Breakers shall be of fixed type or withdrawable type with horizontal drawout carriage. The ACBs shall be strong and robust in construction with suitable arrangements for anchoring when in fully engaged or fully drawnout positions. The carriage or cradle on which the breaker is mounted shall be robust design made of fabricated steel, supported on rollers. Cradle shall also comprise of main and secondary separable contacts and all drawout mechanism in a completely fig welded assembly. There shall be no dependence upon the switchboard frame for any critical alignment. The withdrawal arrangement shall be such as to allow smooth and easy movement.

All the current carrying parts of the circuit breakers shall be silver plated, suitable arcing contacts shall be provided to protect the main contacts. The contacts shall be of spring-loaded design. The sequence of operation of the contacts shall be such that arcing contacts ‘make before’ and break after the main contacts. Arcing contacts shall be provided with efficient arc chutes on each pole and these shall be such suitable for being lifted out for inspection of main as well as arcing contacts. The contact tips and arc chutes shall be suitable for ready replacement. Self-aligning isolating contacts shall be provided. The design of the breaker shall be such that all the components are easily accessible to inspection, maintenance and replacement. Interphase barriers shall be provided to prevent flashover between phases.
5.6.3 OPERATING MECHANISM
Air Circuit breaker shall be provided with a quick-make, trip free operating mechanism, the operating mechanism shall be 'strain-free' spring operated. The operating handle shall be in front of the panel type. The design shall be such that the circuit breaker compartment door need not be opened while moving the breaker from completely connected, through test, into the disconnected position. Manually operated circuits breakers shall be provided with spring operated closing mechanism, which shall be independent of speed of manual operation. Electrical operated breakers shall have a motor wound spring charged closing mechanism. Breaker operation shall be independent of the motor, which shall be used solely for charging the closing spring. The operating mechanism shall be such that the breaker is at all times free to open immediately the trip coil is energised. Mechanical operation indicator shall be provided to show open and closed position of breaker. Electrically operated breakers shall be additionally provided with mechanical indication to show charged and discharged condition of charging spring.
Means shall be provided for slow closing and opening of the breaker for maintenance purposes and for manual charging and closing of electrically operating breakers during emergencies.

5.6.4 INTERLOCKING AND SAFETY ARRANGEMENT
Air Circuit Breakers shall be provided the following safety and interlocking arrangements:

i. It shall not be possible for breaker to be withdrawn when in “ON” position.

ii. It shall not be possible for the breaker to be switched on until it is either in fully inserted position or for testing purposes it is in fully isolated position.

iii. The breaker shall be capable of being racked into ‘testing’ ‘isolated’ and maintenance positions and kept locked in any of these positions.

iv. A safety catch to ensure that the movement of the breaker, as it is withdrawn is checked before it is completely out of the cubicle.

v. The operating mechanism shall provide for racking the breaker into connected, test and disconnected positions without operating compartment door. When cubicle door shall be open position, the breaker can be pulled out to a fourth position, maintenance, where free access shall be possible to all parts of the breaker.

5.6.5 RATING
The rating of the circuit breaker shall be as per the drawings and schedule of quantities. The rated/breaking capacity of the breakers shall be 50KA or higher for one (1) second at 415 volts. The rated making capacity shall be as per the relevant standard. ACBs shall have Ics = Icu = Icw for one second for short circuit capacity of not less than 50KA rms at 415 volt 50Hz etc.

5.6.6 ACCESSORIES
The incoming breaker shall be equipped with microprocessor release and the outgoing breaker shall be equipped with thermal magnetic or microprocessor releases to provide over current protection and short circuit protection. In addition to over current, earth fault release shall also be provided with the breaker. A multi tap current transformer shall be provided. The buscoupler breaker shall be provided without protection releases. The incoming & outgoing breaker shall be fitted with following accessories for control, signal and interlocking.

i. Earth fault release.

ii. Auxiliary contacts 6 NO + 6 NC, rated at 16Amp 415 volts 50Hz.

iii. Under voltage release with built in time delay of 3 ± 1 Sec. pickup at 80% & drop off from 35% to 65% (to be provided in incomer breaker of Transformers & DG).

iv. Shunt release for tripping the breaker remotely and shall be suitable for 240volt/ 415-volt 50Hz with range of operation from 10% to 130% of rated voltage.

v. Micro switch kit for separate indication of overload and short circuit.
vi. Micro switches shall be mounted on the cradle of drawout breaker to indicate the position of the breaker on the cradle.
   a. Kit for test/isolated indication.
   b. Kit for service position indication.
   c. Kit for shutter assembly.

vii. Accessories for following interlocking schemes shall be provided.
   a. Accessory kit for locking the breaker in isolated position. This kit is useful for interlocking scheme as well as keeping personal and equipment safe.
   b. Door interlock kit: Panel or cubicle door cannot be opened with the ACB in Test or Service position.
   c. Lockable trip push button.

5.6.7 MOUNTING
Circuit Breakers shall be mounted as per manufacturer’s standard practice.

5.6.8 TESTING
Testing of circuit breaker for routine & type tests shall be as per relevant IS Code. Test Certificates shall be submitted.

5.7 MOULDED CASE CIRCUIT BREAKERS

5.7.1 GENERAL
Moulded Case Circuit Breakers shall be incorporated in Electrical Panels wherever specified. MCCB’s shall conform to IS 13947-2 and/or IEC 60947-2 and shall have test certificate for breaking capacities from independent test authorities CRPI / ERDA. MCCB’s shall be suitable either for single phase AC 230 volts or three phase 415 volts. MCCB shall be with thermal magnetic release type. All MCCB of 250Amp and above rating shall have microprocessor release. Rated service breaking capacity should be equal to rated ultimate breaking capacity (Ics = Icu)

5.7.2 FRAME SIZES
The MCCB’s shall have the following frame sizes subject to meeting the fault level specified elsewhere.

i) Up to 100A rating .................. 100Amp frame.
ii) Above 100A to 200A ............... 200Amp frame.
iii) Above 200A to 250A ............... 250Amp frame.
iv) Above 250A to 400A ............... 400Amp frame.
v) Above 400A to 630A ............... 630Amp frame.

5.7.3 CONSTRUCTIONS

5.7.3.1 The MCCB cover and case shall be made of high strength heat treatment and flame retardant thermo-setting insulating material. Operating handle shall be of rotary type quick make/quick break, trip-free type. The operating handle for simultaneous operation and tripping of all the three phases.

5.7.3.2.1 Suitable fire extinguishing device shall be provided for each contact. Tripping unit shall be of thermomagnetic type provided in each pole and connected by a common trip bar such that tripping of any one pole operates all three poles to open simultaneously. MCCB shall be current limiting type with trip time of less than 10 millisecond under short circuit condition. MCCB shall be either 3 or 4 Poles as specified in BOQ. MCCB shall be line load reversible type. MCCB’s shall be site adjustable thermal release (80% to 100%) of rated current. Device shall have IDMT characteristics for sustained overload and short circuits. MCCB shall be current limiting type MCCB shall be provided with rotary handle.

5.7.3.3 Contacts trips shall be made of suitable are resistant, silver alloy for long electrical life. Terminals shall be of liberal design with adequate clearance.
RUPTURING CAPACITY

The Moulded Case Circuit Breaker shall have a service breaking capacity (Ics) of not less than 50KA RMS at 415 volts for Main L.T. Panels. MCCB for Sub Distribution Boards shall have service breaking capacity (Ics) of not less than 25 KA RMS at 415 Volts. Short circuit with stand capacity (Service breaking capacity) specified shall be for one second.

TESTING

Test certificate of the MCCB as per relevant Indian Standards (IS) shall be furnished.

POWER CONTACTORS :

5.8.1 The contactors shall comply with the requirements of IEC 60947-4-1 / IS 13947 – Part 4-1. Contactors for motor application should be of 3 Pole AC3 duty as specified in standards.

5.8.2 Main contacts of contactors shall be silver plated copper. Coil insulation should be of class H to withstand the higher temperature rise. Spare contact kits and spare coils replacement should be possible for the entire range for maintenance. The maintenance of contactors and replacement of spare kits should be possible with disturbing busbar / cable termination.

5.8.3 The contactor should be having front and rear parts are in thermoplastics for rugged construction. The contactor should confirm to glow wire tests as per IEC 60695-2-1 with superior quality of engineering grade plastic used for insulation purpose. Complete range should be suitable for AL termination.

5.8.4 Contactors should have the possibility of having finger proof structure safety feature.

THERMAL OVERLOAD RELAY :

5.9.1 Thermal Overload Relay used in the circuit with contactor shall be in conformity with IS : 842 part 2-1966 and it shall withstand insulation test to IS: 12083 part 2. The relay shall be provided with adjustable current settings and with a provision of sealing the same to make it tamper proof.

5.9.2 The relay shall have built in single phasing protection and over load protection as per IEC 947-part 4. The relay shall have in built NO & NC contact. The thermal over load relay shall be suitable for Copper / Aluminium termination, with a maximum permissible temperature rise of 65°C, at the terminals, with maximum ambient temperature of 45°C.

MEASURING INSTRUMENTS, METERING & PROTECTION

GENERAL

5.10.1 Direct reading electrical instruments shall be in conformity with IS 1248. The accuracy of direct reading shall be 1.0 for voltmeter and 1.0 for ammeters. Other type of instruments shall have accuracy of 1.5. The errors due to variations in temperature shall be limited to a minimum. The meter shall be suitable for continuous operation between-10 degree Centigrade to + 50 degree Centigrade. All meters shall be of flush mounting type of 96mm square or circular pattern. The meter shall be enclosed in a dust tight housing. The housing shall be of steel or phenolic mould. The design and manufacture of the meters shall ensure the prevention of fogging of instruments glass.

Instruments meters shall be sealed in such a way that access to the measuring element and to the accessories within the case shall not be possible without removal of the seal.

Suitable selector switches shall be provided for all ammeters and voltmeters intended to be used on three phase supply.

The specifications herein after laid down shall also cover all the meters, instrument and protective devices required for the electrical work. The ratings type and quantity of meters, instruments and protective devices shall be as per the schedule of quantities.

AMMETERS

Ammeters shall be digital type 7 segment LED display. Ammeter shall be suitable for accuracy class 1.0 and burden 0.5 VA approx. The ammeters shall be capable of carrying sustained overloads during fault conditions without damage or loss of accuracy.
5.10.3 VOLTMETERS
Voltmeter shall be digital type 7 segment LED display. Voltmeter shall be suitable for accuracy class 1.0 and burden 0.5 VA approx. The range for 3 phase voltmeters shall be 0 to 500 volts. The voltmeter shall be provided with protection fuse of suitable capacity.

5.10.4 CURRENT TRANSFORMERS
Current transformers shall be in conformity with IS: 2705 (Part I, II & III) in all respects. All current transformers used for medium voltage applications shall be rated for 1 kv. Current transformers shall have rated primary current, rated burden and class of accuracy as required. However, the rated secondary current shall be 5A unless otherwise specified. The acceptable minimum class of various applications shall be as given below:

- Measuring: Class 0.5 to 1.
- Protection: Class 5P10.

Current transformers shall be capable of withstanding without damage, magnetic and thermal stresses due to short circuit fault of 50KA on medium voltage system. Terminals of the current transformers shall be marked permanently for easy identification of poles. Separate CT shall be provided for measuring instruments and protection relays. Each C.T. shall be provided with rating plate.

Current transformers shall be mounted such that they are easily accessible for inspection, maintenance and replacement. The wiring for CT’s shall be copper conductor, PVC insulated wires with proper termination lugs and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

5.11 MISCELLANEOUS
Control switches shall be of the heavy-duty rotary type with escutcheon plates clearly marked to show the operating position. They shall be semi-flush mounting with only the front plate and operating handle projecting. Indicating lamps shall be of the filament type of low watt consumption, provided with series resistor where necessary, and with translucent lamps covers, bulbs & lenses shall be easily replaced from the front.

Push buttons shall be of the momentary contact, push to actuate type fitted with self-reset contacts & provided with integral escutcheon plates marked with its functions.

5.12 BATTERY & BATTERY CHARGER
A set of 24V DC power supply shall be provided for indication, relay operation etc. for Main L.T. Panel (Essential Supply). DC Power supply shall be sealed maintenance free batteries of 65 AH capacity. Suitable battery chargers shall also be provided to charge the battery to perform during mains failure. One set of 24V, 360 AH automotive battery with battery charger shall be provided for each DG Set & one set of 24V, 65AH SMF battery with battery charger for PLC.

5.13 CABLE TERMINATIONS
Cable entries and terminals shall be provided in the Main L.T. Panel to suit the number; type and size of aluminium conductor power cables and copper conductor control cable specified.

Provision shall be made for top or bottom entry of cables as required. Generous size of cabling chambers shall be provided, with the position of cable gland and terminals such that cables can be easily and safely terminated.

Barriers or shrouds shall be provided to permit safe working at the terminals of one circuit without accidentally touching that of another live circuit.

Cable risers shall be adequately supported to withstand the effects of rated short circuit currents without damage and without causing secondary faults.

5.14 LABELS
Labels shall be anodised aluminium with white engraving on black background shall be provided for each incoming and outgoing feeder of L.T. Panels.
5.15 TEST AT MANUFACTURES WORK
All routine tests specified in IS: 8623-1977 shall be carried out and test certificates produced to the Department.

5.15.1 TESTING AND COMMISSIONING
Commissioning checks and tests shall be included all wiring checks and checking up of connections. Primary/secondary injection tests for the relays adjustment/setting shall be done before commissioning in addition to routine meggar test. Checks and tests shall include the following.

a) Operation checks and lubrication of all moving parts.
b) Interlocking function check.
c) Insulation test: When measured with 500V meggar, the insulation resistance shall not be less than 100 mega ohms.
d) Trip tests & protection gear test.

5.16 LOAD MANAGEMENT WITH PLC
Load Management through Micro PLC to achieve auto opening and closing of incomer breakers, buscoupler switching, interlocking providing signal to AMF Panel for load status and AMF shall give command to DG Set to auto start / auto stop depending upon load status and requirement etc. and necessary hardware and software required to perform the operation shall be provided by the contractor including all control wiring and rates for the same shall deemed to be included in the quoted rate of the panel.

6.0 CAPACITOR BANK & PANEL

6.1 GENERAL
This specification covers requirements of Medium Voltage Capacitors and Control Panel to be used for power factor improvement of the electrical system and shall be a part of Main L.T. Panels. Automatic Power Factor Correction Panel shall function to improve power factor of the system in which it is connected. It shall improve power factor upto 0.99 from initial power factor of 0.70. Capacitor Panel shall have 10-15% of capacitor bank directly connected to ensure power factor remains within prescribed limit during low load demand period and / or night period.

6.2 CODES AND STANDARDS
The design, manufacture and performance of power capacitors and accessories shall comply with all currently applicable statutes, regulations and safety codes for power installation as prescribed in relevant IS codes and to requirement of Local Electricity Supply Authority to which the equipment shall be installed.

Unless otherwise specified the capacitor and control panel shall conform to following.

a. IS : 2834 - Shunt capacitors for power systems.
b. IS : 2147 - Degree of protection provided by enclosures for low voltage switchgear and controlgear.
c. IS : 4237 - General requirements for switchgear and controlgear for voltages not exceeding 1000V.
d. IS : 8623 - Specification for factory built assemblies of switchgear and controlgear (Upto 1000 volts).
e. IS : 2208 - HRC cartridge fuse links upto 650 volts.
f. IS : 4064 - Specification for Fuse Switch & Switch Fuse switchgear and controlgear.
g. IS : 2959 - AC contactors for voltage not exceeding 1000 volts.
6.3 CONSTRUCTIONAL FEATURE

a) Capacitor bank shall be suitable for operation on 415 volts 3 phase, 4 wire, 50c/s, solidly earthed AC supply system. The capacitor shall be connected to the 415 V Switchgear bus and shall be manually as well as automatically switched in and out in steps so as to correct the power factor to be required value depending on the actual KVAR requirement of bus.

b) The capacitor bank shall be complete with the required capacitor units with the supporting post insulators, sheet steel cubicles, busbars, connecting strips, foundation channels, fuses, corrosion proof rating plate etc. Capacitor shall be MPP type. Reactor shall be provided to counter for presence of harmonics in the system.

c) Each basic unit is to be built up with a number of elements. These elements should be wounded with high grade metallised poly propylene film. These metallised film capacitors should be self healing, having very low loss factor. Capacitor element to be completely sealed with epoxy resins to provide maximum humidity protection and highest insulation. The capacitor elements are to be given adequate outside insulation and should be put in all welded surface treated MS containers. These capacitors shall be impregnated with special grade of capacitor oil under high vacuum. The metal case shall be equipped with porcelain bushings to permit connection between power lines and active capacitors.

i. Externally each capacitor unit shall have two separate earthing points, name plate conforming to the requirements of IS-2834 (amended upto date), discharge resistances etc.

d) The capacitor bank may comprise suitable number of single phase self cooled hermetically sealed units in series parallel combination to achieve required KVAR rating. However, failure of one unit shall not create over voltage on other units connected in parallel to avoid failure of parallel units.

e) Each capacitor unit/bank shall be provided with directly connected continuously rated, low loss discharge device built into the unit to reduce the residual voltage to a safe value within the specified time as recommended in the relevant standard after the capacitor has been disconnected from the supply.

f) All capacitor shall be suitably protected against over current by means of suitable over current protection (other than fuses) which is adjusted to interrupt the circuit when the current exceeds the safe permissible limit. Capacitor units shall also be protected against the internal faults and the effected units/banks shall be automatically and immediately isolated in the event of such fault.

g) Each capacitor unit shall continuously operate at the following overload conditions separately.

i. Over voltage upto 10% of the rated RMS voltage.

ii. Over current upto 15% of the rated current.

iii. Maximum reactive output upto 30% over the rated reactive output.

h) Each capacitor unit shall be individually protected by HRC fuses with visual indication for operation.

6.4 CAPACITOR CONTROL PANEL

a) The control panel shall be indoor, cubicle type, floor mounted, dust and vermin proof conforming to degree of protection IP-54 excepting the enclosure enclosing capacitor bank which shall be of protection class IP-41.

b) Cubicle shall comprise rigid structural frame enclosed by 2mm thick cold rolled sheet steel, doors and covers shall also be from 2.0mm thick cold rolled sheet steel. Structural framework with foundation bolts etc. shall be provided at the bottom to mount control panel directly on concrete/floor/steel channel base. Fabrication metal treatment and painting of Capacitor Panel shall be as specified in clause 5.3 and 5.4 of this specification.

c) All doors, removable covers shall be gasketed all around preferably with neoprene gaskets.
d) The capacitors control panel shall, in general, comprise of the following and shall be housed in well ventilated panels. Capacitors and their control elements may be installed in different compartments of the same panel to minimize space requirement.

   i. Microprocessor based power factor correction relay.
   ii. Time delay and No-volt relays.
   iii. Protection fuses.
   iv. Capacitor duty contactors for individual capacitor bank.
   v. Change over switch for either automatic operation or manual operation with Push button control.
   vi. Visual indications for capacitor IN-OUT.

e) Switches shall be triple pole, air break AC-23 duty. The switch shall have a quick make, quick break mechanism operated by a suitable external handle complete with position indicator.

f) The Compartment door shall be interlocked mechanically with the switch so that the door cannot be opened unless the switch is in OFF position. Means shall be provided to releasing this interlock at any time.

g) Fuses shall be HRC, preferably link type, with a minimum interrupting capacity equal to the listed short circuit current. Fuses shall be complete with fuse base and fitting of such design as to permit easy and safe replacement of fuse element. Visible indication shall be provided on blowing of the fuse.

h) The Contactors shall be three pole, air break type designed for capacitor duty with non bouncing silver/silver alloy contacts. Each Contactor shall be provided with 2 NC & 2 NO auxiliary lamps contacts rated at 10 Amp. Indicating lamps shall be LED type. Lamp and lens shall be replaceable from front.

i) The main buses and connection shall be of high conductivity aluminium/aluminium alloy, sized for specified current ratings shall be limited to 105 degree centigrade and 100 degree centigrade for silver plated copper joints and aluminium joints respectively.

j) For all bus connections adequate contact pressure shall be ensured by means of two bolt connection with plain and spring washers and locknuts.

k) Busbars and connections shall be fully insulated for working voltage with adequate phase/ground clearance. Insulating colour coded PVC sleeves for busbars and shrouds for joints shall be provided. Shrouds for busbar and for joints shall be provided. Shrouds for busbar joints and tapping points shall be of two part epoxy resin cast/fibre glass moulded. Minimum clearance of 32mm is required between phases and 26mm between phase and earth irrespective of sleeve/shrouds provided for busbar. Insulating shrouds shall be of moulded type.

   i. Bus supports shall be non-hygroscopic type epoxy SMC with high creepage surface.

l) All buses and connections shall be supported and braced to withstand the stresses due to maximum short-circuit current and also to take care of any thermal expansion.

m) Busbars shall be colour coded for easy identification and so located that the sequence R-Y-B shall be from left to right, top to bottom or front to rear, when viewed from the front to panel assembly.

n) The horizontal busbar chamber shall be separate and totally enclosed.

o) Gland shall be minimum 3mm thick.

p) Screws of corrosion resistant material shall be furnished on all ventilating louvers to prevent the entry of insects.

q) All internal wiring inside the cubicle shall be carried out with 650 V grade, PVC insulated copper wires duly ferruled at either end. The power wiring above 100A shall be carried out with PVC insulated aluminium links.
r) Separate labels shall be provided for relay, instruments, switch, indicating lamp etc. Approval for the type of label shall be taken from the Engineer-in-charge.

s) Metal treatment, finish and painting shall be done as per the specification Para Ref. 5.4 of this tender.

t) Automatic control relay with necessary taps shall be provided.

6.5 TESTS

(a) Routine tests shall be carried out on assembled capacitors and control panel as per relevant Indian Standards.

(b) Type tests reports for similar capacitor units shall be submitted.

(c) Three (3) copies of type test and routine test certificates shall be submitted for Engineer-in-Charge approval before despatch of capacitor and control panel.

6.6 INSPECTION

(a) Visual inspection including witnessing routine tests shall be carried out by Engineer-in-Charge or his authorised representative.

(b) Contractor shall notify Engineer-in-Charge or his authorised representatives in writing at least fifteen (15) days prior to Contractor’s scheduled inspection test.

6.7 DRAWINGS AND INSTRUCTIONS MANUALS

(A). Contractor shall submit four copies of the following certified drawings after award of contract.

a. General arrangement of capacitor bank and control panel indicating main dimensions, type of mounting, locations of various devices etc. as foundation details.

b. Schematic diagram for automatic sequential switching with terminals and ferrules numbers.

c. Wiring diagram of control panel indicating terminal blocks and various apparatus.

d. Final list of components of control panel.

(B). Contractor shall submit four (4) copies of installation and maintenance manual.

(C). One print of each drawing shall be returned to Contractor after making all necessary corrections, changes and required specification. Contractor shall incorporate these and send within fifteen days five (5) prints of these each drawing shall be marked certified for record and use.

7.0 MAIN / SUB DISTRIBUTION BOARDS.

7.1 GENERAL

MDB / SDB & Meter Board shall be metal clad totally enclosed, rigid, floor mounting, air insulated, compartmentalized cubicle type Panel Board for use on 415 volts, three phases, 50 cycle system. Equipment shall be designed for operation in high ambient temperature and high humidity tropical atmospheric conditions.

7.2 STANDARDS

The equipment shall be designed to conform to the requirements of:

a) IS 8623 - Factory Built Assemblies of switchgear and controlgear.

b) IS 4237 - General requirements for switchgear and controlgear for voltage not exceeding 1000 volts.

c) IS 2147-Degrees of protection provided by enclosures for low voltage switchgear and controlgear.

d) IS 375 - Marking and arrangement of busbars.
7.2.1 Individual equipment housed in the MDB / SDB & Meter Boards shall conform to the following IS specifications:

b) Current Transformers - IS : 2705.
c) Indicating Instruments - IS : 1248.
d) Integrating Instruments - IS : 722.
e) HRC fuse links - IS : 13703 / IEC 269.

7.3. CONSTRUCTIONS

7.3.1 MAIN / SUB DISTRIBUTION BOARD

Main / Sub Distribution Boards shall be constructed only of materials capable of withstanding the mechanical, electrical and thermal stresses, as the effects of humidity, which are likely to be encountered in normal service.

Each vertical section shall comprise of:

a) A front framed structure of rolled/folded sheet steel channel section, of minimum 2mm thickness, rigidly bolted together. This structure shall house the components contributing to the major weight of the equipment, such as circuit breaker cassettes, fuse switch units, main horizontal busbars, vertical risers and other front mounted accessories.

b) The structure shall be mounted on a rigid base frame of folded sheet steel of minimum 2mm thickness and 100 mm height or 100 mm x 50mm x 5mm thick MS Channel. The design shall ensure that the weight of the components is adequately supported without deformation or loss of alignment during transit or during operation.

c) A side cable chamber in Main / Sub Distribution Boards for housing the cable end connections, and power/ control cable terminations. The design shall ensure generous availability of space for ease of 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.

d) A cover plate at the top of the vertical section, provided with a ventilating hood where necessary. Any aperture for ventilation shall be covered with a perforated sheet having less than 1 mm diameter perforations to prevent entry of vermin.

e) Front and rear doors fitted with dust excluding neoprene gaskets with fasteners designed to ensure proper compression of the gaskets. When covers are provided in place of doors, generous overlap shall be assured between sheet steel surfaces with closely spaced fasteners to preclude the entry of dust.

f) All doors shall be lockable mounted lock.

g) Gland plate shall be 3mm thick.

7.3.2 The height of the Main / Sub Distribution Boards should not be more than 2000mm. The total depth of the panel should be adequate to cater to proper cabling space and should not be less than 400mm. Operating handle not higher than 1800mm and not lower than 300mm from bottom of MDB / SDB / Meter Board.

7.3.3 Doors and covers shall be of minimum 2mm thick sheet steel. Sheet steel shrouds and partitions shall be of minimum 2mm thickness. All sheet panels shall be smoothly finished, levelled and free from flaws. The corners should be rounded.

7.3.4 The apparatus and circuits in the panel board shall be so arranged as to facilitate their operation and maintenance and at the same time to ensure the necessary degree of safety.

7.3.5 Apparatus forming part of the Main / Sub Distribution Boards & Meter Boards shall have the following minimum clearances.

i. Between phases - 32mm.
ii. Between phases and neutral - 26mm.
iii. Between phases and earth - 26mm.
iv. Between neutral and earth - 26mm.

7.3.6 When, for any reason, the above clearances are not available, suitable insulation shall be provided. Clearances shall be maintained during normal service conditions.

7.3.7 Creepage distances shall comply to those specified in relevant standards.

7.3.8 All insulating material used in the construction of the equipment shall be of non-hygroscopic material, duly treated to withstand the effects of the high humidity, high temperature tropical ambient service conditions.

7.3.9 Functional units such as circuit breakers and fuse switches shall be arranged in multi-tier formation, except that not more than two air circuit breakers shall be housed in a single vertical section. Cable entry for various feeders shall be from the rear / front. Panel board shall be suitable for termination of cable for incoming breakers.

7.3.10 Metallic/perforated barriers shall be provided within vertical sections and between adjacent sections to ensure prevention of accidental contact with:

i. Main busbars and vertical risers during operation, inspection or maintenance of functional units and front mounted accessories.

ii. Cable termination of one functional unit, when working on those of adjacent unit/units.

All doors/covers providing access to live power equipment/ circuits shall be provided with tool operated fasteners to prevent unauthorized access.

Provision shall also be made for permanently earthing the frames and other metal parts of the switchgear by two independent connections.

7.4 METAL TREATMENT AND FINISH.

All metal work used in the construction of the MDB / SDB & Meter Boards should have undergone a rigorous metal treatment process as follows.

i. Effective cleaning by hot alkaline degreasing solution followed by cold water rinsing to remove traces of alkaline solution.

ii. Picking in dilute sulphuric acid to remove oxide scales & rust formation, if any, followed by cold water rinsing to remove traces of acidic solution.

iii. A recognised phosphating process to facilitate durable coating of the paint on the metal surfaces and also to prevent the spread of rusting in the event of the paint film being mechanically damaged. This again, shall be followed by hot water rinsing to remove traces of phosphate solution.

iv. Passivating in de-oxalite solution to retain and augment the effects of phosphating.

v. Drying with compressed air in a dust free atmosphere.

vi. A finishing coat of powder coating of Siemens grey colour.

7.5 BUSBARS

7.5.1 The busbars shall be air insulated and made of high conductivity, high strength Aluminium complying with the requirement of grade 63401 WP.

7.5.2 The busbars shall be suitably braced with non-hygroscopic SMC supports to provide a through fault withstand capacity of maximum 50KA RMS symmetrical for one second and a peak short circuit with stand capacity of 105 KA.

7.5.3 The neutral as well as the earth bar should be capable of withstanding the above level. Ridges shall be provided on the SMC supports to prevent tracking between adjacent busbars. Large clearances and creepage distance shall be provided on the busbar system to minimize the possibility of fault. The main phase busbars shall have continues current rating throughout the length of the Panel. The cross section of neutral busbars shall be same as that of the phase busbar for busbars of capacity upto 200 Amp; for higher capacities, the neutral busbar shall not be less than half (50%) the cross section of that of the phase busbars. Connections from the main busbars to functional circuits shall be so arranged and supported to withstand without any damage.
or deformation the thermal and dynamic stresses due to short circuit currents. Busbars shall be colour coded with PVC heat shrinkable sleeves. All connectors of bus bars to busbars & outgoing termination arrangement is to be in Stainless steel non magnetic grade nut & bolts.

7.5.4 Capacity of aluminium busbars shall be considered as 0.8 Amp per sq.mm of cross section area of the busbars.

7.6 MOULDED CASE CIRCUIT BREAKERS

7.6.1 GENERAL

Moulded Case Circuit Breakers shall be incorporated in MDB / SDB & Meter Boards wherever specified. MCCB’s shall conform to IS 13947-2 and/or IEC 947-2 in all respects. MCCB’s shall be suitable either for single phase AC 230 volts or three phase 415 volts. MCCB shall be with thermo magnetic release type. All MCCB of 250Amp and above rating shall have microprocessor released.

7.6.2 FRAME SIZES

The MCCB’s shall have the following frame sizes subject to meeting the fault level specified elsewhere.

i) Up to 100Amp rating ............ 100Amp frame.
ii) Above 100Amp to 200Amp ............ 200Amp frame.
iii) Above 200Amp to 250Amp ............ 250Amp frame.
iv) Above 250Amp to 400Amp ............ 400Amp frame.
v) Above 400Amp to 630Amp ............ 630Amp frame.

7.6.3 CONSTRUCTIONS

The MCCB cover and case shall be made of high strength heat treatment and flame retardant thermo-setting insulating material. Operating handle shall be of rotary type quick make/quick break, trip-free type. The operating handle for simultaneous operation and tripping of all the three phases.

Suitable fire arc extinguishing device shall be provided for each contact. Tripping unit shall be of thermomagnetic type provided in each pole and connected by a common trip bar such that tripping of any one pole operates all three poles to open simultaneously. MCCB shall be line load reversible type. MCCB’s shall be site adjustable thermal release (80% to 100%) of rated current. Device shall have IDMT characteristics for sustained overload and short circuits. MCCB shall be current limiting type MCCB shall be provided with rotary handle.

Contacts tips shall be made of suitable arc resistant, silver alloy for long electrical life. Terminals shall be of liberal design with adequate clearance.

7.6.4 RUPTURING CAPACITY.

The Moulded Case Circuit Breaker shall have a minimum fault breaking capacity (Ics) of not less than 25 KA RMS at 415 volts for MDB / SDB & Meter Boards and / or higher capacity as specified in individual panel item.

7.6.5 TESTING.

Test certificate of the MCCB as per relevant Indian Standards (IS) shall be furnished.

7.7 MEASURING INSTRUMENTS, FOR METERING.

GENERAL

Direct reading electrical instruments shall be in conformity with IS 1248. The accuracy of direct reading shall be 1.0 for voltmeter and 1.0 for ammeters. Other type of instruments shall have accuracy of 1.5. The errors due to variations in temperature shall be limited to a minimum. The meter shall be suitable for continuous operation between-10 degree Centigrade to + 50 degree
Centigrade. All meters shall be of flush mounting type of 96mm square or circular pattern. The meter shall be enclosed in a dust tight housing. The housing shall be of steel or phenolic mould. The design and manufacture of the meters shall ensure the prevention of fogging of instruments glass. Instruments meters shall be sealed in such a way that access to the measuring element and to the accessories within the case shall not be possible without removal of the seal. The meters shall be provided with white dials and black scale markings.

The pointer shall be black in colour and shall have zero position adjustment device which could be operated from outside. The direction of deflection shall be from left to right.

Suitable selector switches shall be provided for all ammeters and voltmeters intended to be used on three phase supply.

The specifications herein after laid down shall also cover all the meters, instrument and protective devices required for the electrical work. The ratings type and quantity of meters, instruments and protective devices shall be as per the schedule of quantities.

7.8 DIGITAL AMMETERS

Ammeters shall be digital type 7 segment LED display. Ammeter shall be suitable for accuracy class 1.0 and burden 0.5 VA approx. The ammeters shall be capable of carrying sustained overloads during fault conditions without damage or loss of accuracy.

7.9 DIGITAL VOLTMETERS

Voltmeter shall be digital type 7 segment LED display. Voltmeter shall be suitable for accuracy class 1.0 and burden 0.5 VA approx. The range for 3 phase voltmeters shall be 0 to 500 volts. The voltmeter shall be provided with protection fuse of suitable capacity.

7.10 CURRENT TRANSFORMERS

7.10.1 Current transformers shall be in conformity with IS: 2705 (Part I, II & III) in all respects. All current transformers used for medium voltage applications shall be rated for 1kv. Current transformers shall have rated primary current, rated burden and class of accuracy as required. However, the rated secondary current shall be 5A unless otherwise specified. The acceptable minimum class of various applications shall be as given below:

- Measuring : Class 0.5 to 1.
- Protection : Class 5P10.

7.10.2 Current transformers shall be capable of withstanding without damage, magnetic and thermal stresses due to short circuit fault of 50KA on medium voltage system. Terminals of the current transformers shall be marked permanently for easy identification of poles. Separate CT shall be provided for measuring instruments and protection relays. Each C.T. shall be provided with rating plate.

7.10.3 Current transformers shall be mounted such that they are easily accessible for inspection, maintenance and replacement. The wiring for CT’s shall be copper conductor, PVC insulated wires with proper termination lugs and wiring shall be bunched with cable straps and fixed to the panel structure in a neat manner.

7.11 MISCELLANEOUS

Control switches shall be of the heavy-duty rotary type with escutcheon plates clearly marked to show the operating position. They shall be semi-flush mounting with only the front plate and operating handle projecting.

Indicating lamps shall be of the LED type, and with translucent lamps covers. Bulbs & lenses shall be easily replaced from the front.
Push buttons shall be on the momentary contact, push to actuate type fitted with self-reset contacts & provided with integral escutcheon plates marked with its functions.

7.12 **CABLE TERMINATIONS**

Cable entries and terminals shall be provided in the sub distribution boards to suit the number, type and size of aluminium conductor power cable and copper conductor control cable specified.

Provision shall be made for top or bottom entry of cables as required. Generous size of cabling chambers shall be provided, with the position of cable gland and terminals such that cables can be easily and safely terminated. Cable glands shall be double compression type, barriers or shrouds shall be provided to permit safe working at the terminals of one circuit without accidentally touching that of another live circuit.

Cable risers shall be adequately supported to withstand the effects of rated short circuit currents without damage and without causing secondary faults.

7.13 **CONTROL WIRING**

All control wirings shall be carried out with 1100/660V grade single core PVC cable conforming to IS 694/ IS 8130 having stranded copper conductors of minimum 1.5 sq.mm for potential circuits and 2.5 sq.mm for current transformer circuits. Wiring shall be neatly bunched, adequately supported and properly routed to allow for easy access and maintenance. Wiring shall be identified by numbering ferrules at each end. All control fuses shall be mounted in front of the panel and shall be easily accessible.

7.14 **TERMINAL BLOCKS**

Terminal blocks shall be 500 Volts grade of the stud type. Insulating barriers shall be provided between adjacent terminals. Terminals block shall have a minimum current rating of 10 Amps and shall be shrouded. Provisions shall be made for label inscriptions.

7.15 **LABELS**

Labels shall be of anodized aluminium, with white engraving on block background. They shall be properly secured with fasteners.

7.16 **TEST AT MANUFACTURES WORK**

All routine tests specified is IS : 8623-1977 shall be carried out and test certificates submitted to the Engineer-in-Charge.

7.16.1 **TESTING AND COMMISSIONING**

Commissioning checks and tests shall be included all wiring checks and checking up of connections. Primary/secondary injection tests for the relays adjustment/setting shall be done before commissioning in addition to routine meggar test. Checks and tests shall include the following:

- a) Operation checks and lubrication of all moving parts.
- b) Interlocking function check.
- c) **Insulation test**: When measured with 500V meggar, the insulation resistance shall not be less than 100 mega ohms.
- d) Trip tests & protection gear test.

7.17 **MINIATURE CIRCUIT BREAKER**

The MCB’s shall be of the completely moulded design suitable for operation at 240/415 Volts 50 Hz system.

The MCB’s shall have a rupturing capacity of 10 KA.
The MCB’s shall have inverse time delayed thermal overload and instantaneous magnetic short circuit protection.

Type test certificates from independent authorities shall be furnished.
8.0 BUS DUCT

8.1 GENERAL

Bus duct shall be supplied as per BOQ, specification & drawings. The Bus duct shall be of indoor/Outdoor type. Bus duct system air cooled (self cooled), non segregated type and shall be suitable for continuous current rating and shall have rupturing capacity of 36 MVA at 415 volts. Bus duct shall be suitable for short circuit withstand capacity of 50 KA. Manufacturer shall submit type test certificate of similar Bus duct from recognised test lab like CPRI or equivalent.

8.2 CONSTRUCTION

Bus duct shall consists of three phase and neutral busbars permanently positioned. Part of Bus duct outside the station building shall conform to degree of enclosure protection IP 54 while part of Bus duct inside the Substation building shall conform to degree of enclosure protection IP 42 with up to date amendments. Minimum thickness of sheet steel enclosure shall be of 2mm. The busbars shall be of high conductivity electrolytic quality aluminium conforming to relevant Indian Standards and shall be of sufficient cross section. Overall busbar cross section size shall not be less than the cross section based on 0.8 Amp / Sq.mm. and shall be as per Table VI of CPWD General specification for Electrical Works Part I – Internal-2013 and whichever is of higher cross section. The cross section of neutral busbar shall be same as that of phase busbar. Entire length of busbars shall be provided with colour coded PVC sleeves. Bus duct shall be natural cooled with inspections covers at suitable intervals. Busbars shall be supported with 12mm thick non hygroscopic insulating material at every 600mm but allowing busbar to expand on normal operation but restrict excessive movement under fault conditions. Expansion joints shall be provided in such a way that expansion and contraction does not have undue strain on the bus at the terminals at both ends.

The Bus duct arrangement shall have a common frame earth bar of sizes 2No. 32mm x 5mm of Aluminium for entire length suitably loop earthing various section. Two number of each terminals shall be provided for earthing connections. Frame earthing of Bus duct system shall be connected to two earthing terminals at Main L.T. Panels and Transformer ends.

8.3 Contractor shall submit the busbar sizing calculation for short circuit withstand capability and maximum temperature rise indicating the de-rating factors clearly for the approval of Employer/Engineer-In-Charge.

8.4 TESTS

8.4.1 FACTORY TESTS

Contractor / Supplier shall submit manufacturer copy of test certificates for Type test & original test certificates for Routine test & laid down in relevant IS.

8.4.2 SITE TESTS

Contractor / Supplier shall coordinate with erection Contractor for testing of Bus duct prior to commissioning and following tests shall be carried out at site and test results recorded.

i. Insulation resistance test with 500 volts megger. The insulation resistance shall be not less than 100 mega ohms. The testing shall be done as per IS 8084-1976 with up to date amendments.

ii. Earth continuity test.

9.0 CABLES

9.1 H.T. CABLES
9.1.1 CONSTRUCTION

All H.T. Cables shall be of 11 KV grade XLPE insulated & PVC sheathed flat steel wires (strips) armoured electrical purity aluminium conductor cables shall be manufactured & tested in accordance with IS : 7098 (Part II) 1985. H.T. Cable shall be earthed type. The conductor shall be made electrical purity aluminium wires and shall be of stranded construction and shall comply to IS 8130. High quality XLPE unfilled insulating compound shall be used for insulation. Insulation shall be carried out by extrusion process and shall be chemically cross linked in continuous vulcanisation process. Core screen shall consists of a layer of extruded semi-conducting compound. Additional insulation shield shall be provided with semi conducting and metallic tape shield over the extruded insulation shield. Inner and outer shielding with insulation shall have perfect bonding. Cores shall be stranded together with suitable non hygroscopic fillers in the interstices and provided with common covering of plastic tape wrapping. Armouring shall be applied over the inner sheath and shall comprise of flat steel wires (strips). Outer sheath shall be of tough, heat resistance PVC compound as per IS : 5831 and shall be extruded over the armouring. Cables shall be tested for type tested & routine tested in accordance with IS:7098 (Part II).

9.1.2 TERMINATION JOINTS

Terminal joints shall be carried out inside the cable end boxes fixed on the equipment. Cables shall be penciled with layers of black ampere tapes wrapped over the conductor and the insulations then the entire joint shall be wrapped in layers of ampere tapes upto the terminals, butted and lugged. Lugs shall be fitted by the means of bolts and nuts with the terminal studs. On the glands, armour of the cable shall be fixed by means of clamps which shall be grounded. Heat shrink cable termination kit shall be used for terminations.

9.1.3 INSTALLATION OF CABLES

Cables in the HT Rooms of the Sub-Station shall be laid in trenches. All cables shall be bent in radius not less than 15 times the diameter of cables or as prescribed by the manufacturer which ever is higher. Cable laying shall be carried out as per CPWD specifications.

9.2 L.T. CABLES

9.2.1 GENERAL

L.T. Cables shall be supplied, inspected, laid tested and commissioned in accordance with drawings, specifications, relevant Indian Standards specifications and cable manufacturer’s instructions. The cable shall be delivered at site in original drums with manufacturer’s name clearly written on the drums. The recommendations of the cable manufacturer with regard to jointing and sealing shall be strictly followed.

9.2.2 MATERIALS

L.T. Cables shall be XLPE insulated and PVC sheathed aluminium conductor armoured cables conforming to IS: 7098 (Part I)-1988. Cables shall be of 1100volt and with ISI certification mark. Conductor of power cables shall be made of electrical purity aluminium conforming to IS 8130-1984. All power cables shall be FR type

9.2.3 INSTALLATION OF CABLES

Cables shall be laid directly in ground, pipes, masonary ducts, on cable tray, surface of wall/ceiling etc. as indicated on drawings and/or as per the direction of Engineer-in-Charge. Cable laying shall be carried out as per CPWD specifications.

9.2.4 INSPECTION

All cables shall be inspected at site and checked for any damage during transit.

9.2.5 JOINTS IN CABLES

The Contractor shall take care to see that the cables received at site are apportioned to various locations in such a manner as to ensure maximum utilisation and avoiding of cable joints. This apportioning shall be got approved from Engineer-in-Charge before the cables are cut to lengths.
9.2.6 LAYING CABLES IN GROUND

Cable laying shall be as per IS: 1255-1983 with up to date amendments and as specifying. Cables shall be laid by skilled experienced workmen using adequate rollers to minimize stretching of the cables. The cable drums shall be placed on jacks before unwinding the cable. With great care it shall be unrolled on over wooden rollers placed in trenches at intervals not exceeding 2 metres. Cables shall be laid at depth of 0.75 metres below ground level. A cushion of sand total of 250mm shall be provided both above and below the cable, joint boxes and other accessories. Cable shall not be laid in the same trench or along side a water main.

The cable shall be laid in excavated trench over 80mm layer of sand cushion. The relative position of the cables, laid in the same trench shall preserved. At all changes in direction in horizontal and vertical planes, the cables shall be bent smooth with a radius of bent not less than 12 times the diameter of cables. Minimum 3 metre long loop shall be provided at both end of cable.

Distinguishing marks may be made on the cable ends for identifications of phases. Insulation, tapes of appropriate voltage and in red, yellow and blue colours shall be wrapped just below the sockets for phase identifications.

9.2.7 PROTECTION OF CABLES

The cables shall be protected by bricks laid on the top layer of the sand for the full length of underground cable. Where more than one cables is laid in the same trench, the bricks shall cover all the cables and shall project a minimum of approximately 80mm on either side of the cables. Cable under road crossings and any other places subject to heavy traffic, shall be protected by running them through Hume Pipes of suitable size.

9.2.8 EXCAVATION & BACK FILL

All excavation and back fill required for the installation of the cables shall be carried out by the Contractor in accordance with the drawings and requirements laid down elsewhere. Trenches shall be dug true to line and grades. Back fill for trenches shall be filled in layer not exceeding 150mm. Each layer shall be properly rammed and consolidated before laying the next layer.

The Contractor shall restore all surface, road ways, side walks, kerbs wall or the works cut by excavation to their original condition to the satisfaction of the Engineer-in-Charge.

9.2.9 LAYING OF CABLES ON CABLE TRAY/SURFACE OF WALL/CEILING

Cable shall be laid on perforated M.S. Cable tray. Cables shall be properly dressed before cable ties/clamps are fixed. Wherever cable tray is not proposed, cables shall be fixed on surface of wall or ceiling slab by suitable MS clamps/ saddles. Care shall be taken to avoid crossing of cable.

9.2.10 CABLES ON HANGERS OR RACKS

The Contractor shall provide and install all iron hangers racks or racks with die cast cleats with all fixings, rag bolts or girder clamps or other specialist fixing as required.

Where hangers or racks are to be fixed to wall sides, ceiling and other concrete structures, the Contractor shall be responsible for cutting away, fixing and grouting in rag bolts and making good.

The hangers or racks shall be designed to leave at least 25mm clearance between the cables and the face to which it is fixed. Multiple hangers shall have two or more fixing holes. All cables shall be saddled at not more than 150mm centres. These shall be designed to keep provision of some spare capacity for future development.

9.2.11 CABLES TAGS

Cable tags shall be made out of 2mm thick aluminium sheets, each tag 1-1/2 inch in dia with one hole of 2.5mm dia, 6mm below the periphery. Cable designations are to be punched with letter/number punches and the tags are to be tied inside the panels beyond the glanding as well as below the glands at cable entries. Trays tags are to be tied at all bends. On straight lengths, tags shall be provided at every 5 metres.

9.3 TESTING OF CABLES
Prior to installation burying of cables, following tests shall be carried out. Insulation test between phases, phase & neutral, phase & earth for each length of cable.

a. Before laying.
b. After laying.
c. After jointing.

On completion of cable laying work, the following tests shall be conducted in the presence of the Engineer in Charge.

a. Insulation Resistance Test (Sectional and overall).
b. Continuity Resistance Test.
c. Earth Test.

All tests shall be carried out in accordance with relevant Indian Standard code of practice and Indian Electricity Rules. The Contractor shall provide necessary instruments, equipments and labour for conducting the above tests & shall bear all expenses of conducting such tests.

10.0 CABLE TRAY

10.1 PERFORATED TYPE CABLE TRAY

The cable tray shall be fabricated out of slotted/perforated MS sheets as channel sections, single or double bended. The channel sections shall be supplied in convenient lengths and assembled at site to the desired lengths. These may be galvanised or painted as specified.

Typically, the dimensions, fabrication details etc. are shown in CPWD General Specification for Electrical Works Part-II-External.

The jointing between the sections shall be made with coupler plates of the same material and thickness as the channel section. Two coupler plates, each of minimum 200mm length, shall be bolted on each of the two sides of the channel section with 8mm dia round headed bolts, nuts and washers. In order to maintain proper earth continuity bond, the paint on the contact surface between the coupler plates and cable tray shall be scraped and removed before the installation.

The maximum permissible uniformly distributed load for various sizes of cable trays and for different supported span are as per Table-IV. The sizes shall be specified considering the same.

Factory fabricated bends, reducers, tee/cross junctions, etc. shall be provided as per good engineering practice. (Details are typically shown in figure-3) of CPWD General specifications of Electrical Work Part-II – 1994. The radius of bends, junctions etc. shall not be less than the minimum permissible radius of bending of the largest size of cable to be carried by the cable tray.

The entire tray (except in the case of galvanised type) and the suspenders shall be painted with two coats of red oxide primer paint after removing the dirt and rust, and finished with two coats of spray paint of approved make synthetic enamel paint.

10.2 LADDER TYPE CABLE TRAY

Ladder type cable tray shall be fabricated out of double bended channel section longitudinal members with single bended channel section rungs of cross members welded to the base of the longitudinal members at a centre to centre spacing of 250mm. The channel sections shall be supplied in convenient lengths and assembled at side to the desired lengths. These may be galvanised or painted to the desired lengths. Alternatively, where specified, the cable tray may be fabricated by two angle irons of 50mm x 50mm x 6mm as two longitudinal members, with crosses bracings between them by 50mm x 5mm flats welded/bolted to the angles at 1 m spacing.
Typically, the dimensions, fabrication details etc. are shown in CPWD General Specification for Electrical Works - Part II -External, 1994.

The jointing between the sections shall be made with coupler plates of the same material and thickness as the channel section. Two coupler plates, each of minimum 200mm length, shall be bolted on each of the two sides of the channel section with 8mm dia round headed bolts, nuts and washers. In order to maintain proper earth continuity bond, the paint on the contact surfaces between the coupler plates and cable tray shall be scraped and removed before the installation.

The maximum permissible uniformly distributed load for various sizes of cables trays and for different supported span are as per CPWD General Specification of Electrical Work Part II -1994. The sizes shall be specified considering the same.

The width of the cable tray shall be chosen so as to accommodate all the cable in one tier, plus 30 to 50% additional width for future expansion. This additional width shall be minimum 100mm. The overall width of one cable tray shall be limited to 900mm.

Factory fabricated bends, reducers, tee/cross junctions, etc. shall be provided as per good engineering practice. Details are typically shown in figure 3 of CPWD General Specification of Electrical Work Part II-1994. The radius of bends, junctions etc. shall not be less than the minimum permissible radius of bending of the largest size of cable to be carried by the cable tray.

The entire tray (except in the case of galvanised type) and the suspenders shall be painted with two coats of red oxide primer paint after removing the dirt and rust, and finished with two coats of spray paint of approved make synthetic enamel paint.

The cable tray shall be bonded to the earth Terminal of the switch bonds at both ends.

The cable trays shall be measured on unit length basis, along the center line of the cable tray, including bends, reducers, tees, cross joints, etc, and paid for accordingly.

The cable tray shall be suspended from the ceiling slab with the help of 10mm dia MS rounds or 25mm x 5mm flats at specified spacing as per of CPWD General Specification of Electrical Work Part II -1994. Flat type suspenders may be used for channels upto 450mm width bolted to cable trays. Round suspenders shall be threaded and bolted to the cable trays or to independent support angles 50mm x 50mm x 5mm at the bottom end as specified. These shall be grouted to the ceiling slab at the other end through an effective means, as approved by the Engineer, to take the weight of the cable tray with the cables.

11.0 DIESEL GENERATOR SET (SILENT TYPE)

11.1 General

DG Set shall consist of Diesel Engine coupled to alternator housed in an acoustic enclosure & conforming to CPCB norms. BHP of engine & alternator KVA rating shall be as per BOQ item. The Diesel Generator set shall consist of all accessories and control such as starting device, Lubricating arrangements, speed control, automatic control devices, protection gear, instrumentation etc. as required and specified herein after. The Diesel Generator set shall be factory assembled, factory tested, excise duty paid in all respects.

11.2 Diesel Engine

11.2.1 General
Diesel Engine shall be of heavy duty, robust construction, suitable for continuous duty. Emission for Diesel Engine shall be within prescribed emission limits as per CPCB norms dated 01/07/2004 and manufacturer shall be furnished certificate issued by approved agencies of CPCB.

11.2.2 Engine

The engine shall be of standard design of the original manufacturer. It should be 4 stroke cycles, radiator cooled, naturally aspirated / turbo charged (as per manufacturer standard), diesel engine developing suitable BHP. The engine shall be capable for delivering specified prime power rating at variable loads for P.F. of 0.8 lag with 10% overload available in excess of specified output for one hour in every 12 hours.

The speed governing mechanism shall be electronic type and should keep correct frequency for class A1–Governing at all possible operating conditions.

Starting shall be push button electric starting type by an axial type starter motor from a 24 volts lead acid battery.

A length of flexible exhaust pipe shall be supplied connected to the exhaust manifold. Silencer and exhaust piping from D.G. Set to silencer form part of the item of D.G. Set and deemed to be included in quoted rates. Silencers shall be hospital type. Piping from silencer onwards shall be measured as linear basis.

Dry type air filters shall be fitted.

11.2.3 Engine Details

<table>
<thead>
<tr>
<th>Type</th>
<th>Multi-cylinder Diesel.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method of starting</td>
<td>Electric Start.</td>
</tr>
<tr>
<td>Type of Cooling</td>
<td>Radiator type with Fan.</td>
</tr>
<tr>
<td>Type of Governor</td>
<td>Electronic Variable speed.</td>
</tr>
<tr>
<td>Type of fuel</td>
<td>High speed diesel.</td>
</tr>
<tr>
<td>Type of lubricating oil</td>
<td>Multi grade (as per IS : 13656-1993)</td>
</tr>
</tbody>
</table>

The above engine shall be equipped with the following:-

a. Fly wheel of suitable diameter and weight.
b. Fuel tank suitable for 990 ltrs. capacity with necessary piping and fuel gauge.
c. Fuel and lubricating oil filter.
d. Fuel injection equipment.
e. Air cleaner/filter.
f. Lubricating oil pump.
g. Flexible coupling.
h. Radiator with fan.
i. Governor electronic type as per standard design of approved manufacturer.
j. Turbo charged after cooled.
k. Fuel Hoses.
1. Batteries & battery charger.

m. Engine control panel.

Suitable stop device to stop the engine in case any of the controlled variables exceed the upper or lower limit (Temperatures of cooling water, pressure of lub oil & over speeding).

DG Set shall be provided with Power command control Panel (Cumin PCC 2100 or requirement) for microprocessor base governing, regulation, metering monitoring. Power command controller shall have feature of AMF.

Indicating panel of Engine shall be consisting of the following.

a) Water temperature indication.

b) Lub oil pressure gauge.

c) Lub oil temperature gauge.

d) Starting Switch with key.

e) RPM meter with hour meter (Techno-hour meter).

f) Battery charging ammeter.

g) Toggle switch.

h) Push button for starting.

i) Safety control indicator lamps.

Oil service tank with all accessories such as level indicator, manhole, valved inlet and outlet, air vent, drain plug, mounting pedestals etc.

11.2.4 Base and Mounting

11.2.4.1 Base

The D.G Set i.e. diesel engine and alternator, shall be mounted on a steel skid base. An oil and water drain block shall be provided on the base rail.

11.2.4.2 Mounting

The set will be mounted on spring loaded cushy-footing pads. Cushy footing pads shall be spring loaded Anti-vibration Mountings of GERB.

11.2.5 Performance of D.G Set

Voltage regulation : Plus or minus 2.5% from no load to full load and at power factor from 0.8 P.F. (lag) to unity with 1% speed regulation of the engine.

11.3 Alternator

11.3.1 General

Alternator shall be of salient pole, rotating field type and shall be self exciter suitable for 415 volts, 50Hz, AC 0.8 power factor and 1500 RPM. The alternator shall be of drip-proof construction. Alternators shall generally conform to IS: 4722 and BS 2613.

11.3.2 Frame

Frame shall be of cast iron construction, the feet and terminal box mounting being cast integral with the frame. A terminal box (adoptor) shall be used if required for proper termination of cables/bus duct.

11.3.3 Stator core

Stator core shall be built up to silicon steel laminations compressed hydraulically and rigidly supported by either cast iron or steel end rings. The core shall be designed for minimum reactance, low voltage wave form distortion and maximum efficiency, stator coils shall be of tropicalized mica or leatheriod. End windings shall be taped with fibre glass tape and the complete windings shall be
impregnated with varnish and spray finished with moisture protection varnish. Otherwise 100% epoxy impregnating with an overcoat of resilient insulating materials shall be carried out.

11.3.4 **End Frames**
The end frames shall be of well ribbed cast iron design. The end frames shall spigotted to the stator frame and secured by easily available set screws. Ventilation openings shall be cast into the vertical and bottom side face which shall be screen protected and drip proof.

11.3.5 **Bearings**
The bearings shall be of heavy duty prelubricated cartridge design ball or roller bearings. Single bearing alternators shall have self-aligning ball on roller bearing. The end frames of the rotor shall be removable (from stator) without disturbing the bearings.

11.3.6 **The Rotor**
The rotor shaft shall be turned either from a high tensile MS bar or from a MS forging. Field coils shall be wound with synthetic enamel covered or varnish bounded and glass cover copper strips of high conductivity. Poles shall be of bolt on type made of sheet steel of high premeability. The insulation between the pole and coil shall comprise of varnished fibre glass cloth backed mica around the body and thick insulating washers on the top and bottom of the coil. Coils shall be impregnated with resin and the complete rotor shall be spray finished with a moisture protection varnish suitable for tropical conditions. However 100% epoxy impregnation and an overcoat of resilient insulating material shall be preferable.

11.3.7 **Damper Windings**
Damper windings shall be provided to assist parallel operation of alternators. The damper bars of copper brazed to heavy copper and connectors shall be located in a semi closed circular slots situated in the pole faces.

11.3.8 **Type**
Alternator shall be brushless.

11.3.9 **Coupling**
Engine & alternator shall be directly coupled through a sturdy flexible coupling.

11.3.10 **Terminals**
Terminals shall be housed in a suitable cast iron box fixed on to the stator frame. The terminals shall have ample clearance between phases and between phases to earth and shall be readily accessible. The terminal shall be suitable for receiving suitable size of aluminium conductor XLPE insulated, PVC sheathed and steel armoured cables.

11.3.11 **Temperature Rise**
The alternator shall be suitable for temperature rise of 50 degree C above ambient and shall be capable of withstanding 10% overload for one hour continuously in 12 hours as per IS : 4722.

11.3.12 **Exciter - Voltage Regulators**
The exciter shall be over hung, rotating type without any bearing exciter of static type or semi conductor may be provided. Solid state voltage regulator with all accessories and relays shall be provided for proper voltage regulation.

11.3.13 **Balancing**
All the rotating part shall be dynamically balanced to ensure smooth vibration free running.

11.4 **AUTO - MAINS FAILURE PANEL (AMF PANEL)**

11.4.1 **General**
DG Set shall be provided with Auto – Mains Failure Panel (AMF Panel) for auto start, auto stop of DG Sets. AMF Panel shall be complete with contactor / Electrical operated Air Circuit Breaker
AMF Panel shall be equipped with suitable arrangement for auto changeover from grid to DG Set source and vice versa and shall be complete with all switchgears, timer contactors, relays etc. to ensure the functionality of the system.

11.4.2 Operations

a. The normal or mains source shall be constantly monitored by a main voltage monitor.

b. When main voltage fails or drops below 80% adjustable and selectable of the rated voltage, the automatic control system shall give a starting signal to the Generator Set.

c. As soon as the diesel generator set reaches its operating speed and attains its operating voltage, the load shall be transferred on to the generator set.

d. Upon the return of the normal source voltage of 90% of rated voltage for a minute the switch shall retransfer the load to the normal source.

e. The automatic control system shall reset itself and start the engine generator set upon the failure of the normal source.

f. In the event of failure of the diesel generator set due to faulty starting the normal Contactors/Switch shall get energised without any time delay on the restoration of the normal source.

g. If the diesel set fails to start and reach its operating speed in 25 second in three attempts, the set shall automatically be disconnected and locked in isolated position.

11.4.3 Protection, Instrumentation & Accessories

The automatic transfer facility shall be in addition to following for manual operation

11.4.4 Protection Gear

i. Solid Neutral.

ii. Adjustable time delay relays for transfer and retransfer of loads.

iii. Engine start/stop control relays, three attempt start facility & failure to start lockout.


v. Push buttons, start/stop/reset/test.

vi. Selector switch for engine control on/off.

vii. A bye pass arrangement in the control panel for isolating the control panel from main supply for carrying out maintenance, repairs to control panel.

11.4.5 Instrumentation.

i. AC voltmeters.

ii. AC ammeters.

iii. Frequency meter.

iv. KWH / Energy Analyser meter with protection fuses.

v. CT’s of specified ratio and burden.

vi. Signal lamp ‘Load on set’.

vii. Signal lamp (load on mains).

viii. Signal lamp (set fails to start).

ix. Audio visual system to indicate abnormalities in the standby system.

11.4.6 Accessories

i. Battery charging equipment and instruments for starting of the engine and controls energisation.
ii. Cable alley for incoming and outgoing cable with glands.

iii. Removable side panels for easy access and locking arrangement to prevent tempering.

11.5 **SPECIFICATION OF MATERIALS**

11.5.1 **Exhaust Silencer Piping.**

The exhaust silencer piping system shall be of heavy-duty MS pipes conforming to relevant IS code. Suitable length of flexible piping shall be used for connecting the exhaust piping to the engine as per the recommendations of the manufacturer. MS screwed flanges and bends shall be used as per site requirements.

DG Set exhaust pipe shall be legged with 80mm thick glass wool insulation. Cladding shall be done with 24 SWG aluminium sheet.

11.5.2 **Oil Piping.**

Oil piping shall be of MS suitable to withstand the pressure as recommended by manufacturer.

11.6 **Foundation.**

Suitable size 1:2:4 cement concrete foundations is to be casted by the Civil Contractor by referring approved manufacturer foundation drawing of DG Set for erection of DG Set. Foundation bolts etc. shall be provided by the D.G. Set Contractor.

11.7 **24 Volts DC Batteries**

24 volts batteries for each shall comprise of standard lead acid stationary batteries consisting of required cells of each 2 volts to have 180 AH / 360 AH capacity at twenty (20) hours rate of discharge. Battery cells shall conform to IS: 1651 with up-to-date amendments. The battery bank shall be provided with the following accessories.

(a) Battery stand.

(b) Set of connectors with ends take off suitable for connections.

(c) Cell insulators and stand insulators.

(d) Spring type hydrometer.

(e) Thermometer with specific gravity correction scale.

(f) Cell testing voltmeter.

(g) Set of tools consisting of spanners, rubber syringe, acid resisting funnel and acid resisting tube of 2 litres capacity - one set.

The batteries shall be supplied duly filled, charged and acid filled.

11.8 **Battery Charging Equipment**

Battery boost charger of suitable capacity intended to operate on single phase 230 volts, 50 cycles supply system and suitable for charging current. The battery boost charger shall be provided with the following accessories.

a. A.C. and D.C. “ON” and “OFF” switches with HRC fuses.

b. Indicating lamps for indicating mains “ON” and battery charging.

c. Ballast to give charging.

d. Single phase double wound (copper conductor) impregnated natural air cooled mains transformer for rectifier stack.

e. Rotary switch to give step control.

f. Single phase full wave bridge connected silicon rectifier stack.

g. Moving coil ammeter to indicate charging current.

h. Moving coil voltmeter with a selector switches to measure the battery/charger voltage.

i. Silicon blocking diodes connected to a suitable tap to maintain continuity of D.C. supply.
j. A.C. and D.C. contactors of suitable rating as required.

All the components for battery charger shall be adequately rated and housed in a well ventilated sheet steel cubicle with input and output terminals. Proper cables glands shall be provided for incoming and outgoing cables.

11.9 **Wiring**

a. All control cabling / wiring between D.G. Sets & Main L.T. Panel shall carried out with suitable size armoured copper cable.

b. The minimum size of wires outside the panel shall be 2.5 sq.mm copper conductor.

c. The minimum size of control cables inside the panel shall be 1.5 sq.mm copper. Control cables and connection shall form part of contract and deemed to be included in the cost.

d. All the wires and cables shall be suitable for 650/1100 volts.

11.10 **Painting**

The contractor shall paint all exposed metal parts of plant and equipment supplied by him. Painting shall be by application of two coats of synthetic enamel paint of approved colour. All piping shall be colour coded.

11.11 **Testing**

The Contractor shall give notice well in advance to the Project Manager / Engineer-in-charge before commencement of any site testing. All material like consumable stores, fuel, oil grease, lubricating oil etc. required for the trials shall be arranged by the Contractor.

11.11.1 **Factory Tests**

The factory tests shall incorporate the following and manufacturer’s test certificates to be submitted.

a. Routine tests.

b. High Voltage test.

c. Short circuit current test.

d. Instantaneous short circuit withstand test.

e. Insulation resistance test.

Contractor shall furnish type tests certificate for Engine and alternator. These tests shall be conducted as per the requirements of BS: 2613 or IS: 4722 and the original tests certificates shall be furnished.

11.11.2 **Site Tests**

After erection is completed following tests shall be conducted.

a. Insulation resistance of the generator.

b. Speed, No load voltage and full load voltage regulations.

c. Frequency on no-load, half load and full load.

The readings shall be observed with calibrated meters. Only one meter shall be used for the test. The readings shall be properly tabulated submitted in triplicate to Engineer-in-charge.

11.12 **TRIALS**

11.12.1 **Preliminary Trials**

After completion of erection of generating sets and before carrying out main trials. Preliminary trials shall be conducted in the presence of the Project Managers (PMC) / Engineer-in-Charge. Such trials shall include the checking and adjustments of all instrument relays, timers, interlocks and meters. Crank shaft alignment shall be checked when the engine is cold. Insulation resistance of stator, rotor and exciter windings reading recorded.

11.12.2 **Main Trials**
Main trial shall be for 6 hours. Continuous run at full load and including one hour at 110% of full load. Fuel & Lub Oil required for trial run shall be provided by the Contractor & shall deemed to be included in the quoted tender rates.

11.13 ACUSTIC ENCLOSURE

11.13.1 General

The enclosure shall be of compact sleek design conforming to international standard to provide insertion loss of 25 DBA as per the requirement of central pollution control board norms. The enclosure shall be fabricated using high grade cold rolled cold annealed (CRCA) sheet & steel members. High density sound absorption material shall be used to reduce the sound level. Sound level shall not be more than 75 dB(A) at a distance of one metre away from the set and DG Set supplier shall give an integral acoustic enclosure and the acoustic enclosure shall have approval from anyone of the agencies as listed / approved by CPCB. The enclosure shall be surface treated and powder coating painted to make it weather proof and suitable for outdoor application. The enclosure shall be provided with durable industrial locking system with doors duly gasketed.

11.13.2 Acoustic Insulation

High density resin bonded rock wool shall be provided on all six sides includes door, roof and base to absorb noise. The insulation shall be covered with fire proof acoustic material, light resin rock wool and shall be supported by perforated sheet. Sound attenuators/down stream silencers shall be provided at all openings for air inlet/outlet to facility free air flow but to absorb sound resulting in extremely low noise level. Detachable partitions shall be provided inside the enclosure to attain further noise attenuation of the engine.

11.13.3 Noise Suppressor

A suitably designed hospital type noise suppressor shall be provided to minimize the exhaust noise of the engine. Hospital type noise suppressor shall be placed outside the acoustic enclosure.

11.14 Exhaust System

11.14.1 Exhaust piping shall be of M.S. & shall be conforming to relevant IS. The runs forming part of factory assembly on the engine flexible connections upto exhaust silencer shall be exclusive of exhaust piping item. The work includes necessary cladding of exhaust pipe work using 50mm thick glass wool/mineral wool/rockwool, density not less than 46 kg/m sq. and aluminium cladding (0.80mm thick) for the complete portion. The exhaust pipe work includes necessary supports, foundation etc. to avoid any load & stress on turbo charger/exhaust piping. The exhaust pipe support structure shall be got approved from the Architect / Project Manager / Engineer – In Charge before execution.

a) Exhaust system should create minimum back pressure but not more than 2” of mercury (Hg) column.
b) Number of bends should be kept minimum and smooth bends should be used to minimize back pressure.
c) Pipe sleeve of larger dia should be used while passing the pipe through concrete wall & gap should be filled with felt lining.
d) Exhaust piping shall be lagged with asbestos rope along with aluminium sheet cladding from DG Set to top of the building.
e) Exhaust flexible shall have it’s free length when it is installed. For bigger engines, two flexible bellows can be used.
f) Bellow shall be provided in exhaust piping preferably at 10 metre internal.
g) Class B MS pipes and long bend/elbows should be used.
h) The exhaust outlet should be in the direction of prevailing winds and should not allow exhaust gases to enter air inlet/windows etc.
i) When tail end is horizontal, 45 Degree downward cut should be given at the end of the pipe to avoid rain water entry into exhaust piping.
11.14.2 Optimum Silencer Location: Location of the silencer in exhaust system has very definite influence on both reduction of noise and back pressure imposed on the system. The preferred silencer locations are given in the Table below, where L is length of the total exhaust system measured from exhaust manifold in metres. Please note that locating the silencer as per optimum silencer location is not mandatory. For high rise buildings, suitable arrangements may have to be provided in consultation with acoustic engineer.

**Optimum Location of Silencer (In metres)**

<table>
<thead>
<tr>
<th>Silencer Location</th>
<th>In-line Engine</th>
<th>‘V’ Engine</th>
</tr>
</thead>
<tbody>
<tr>
<td>Best</td>
<td>2L/5</td>
<td>(4L – 1.5)/5</td>
</tr>
<tr>
<td>Second best</td>
<td>4L/5</td>
<td>(2L – 4.5)/5</td>
</tr>
<tr>
<td>Worst Location of</td>
<td>L/5 or 3L/5 or</td>
<td>(3L – 10)/5 or at</td>
</tr>
<tr>
<td>Silencer</td>
<td>at tail end of</td>
<td>the tail end of</td>
</tr>
<tr>
<td></td>
<td>Exhaust piping</td>
<td>exhaust piping</td>
</tr>
</tbody>
</table>

11.14.3 Exhaust stack height: In order to dispose exhaust above building height, minimum exhaust stack height should be as follows :-

(a) For DG set:

\[ H = h + 0.2x \div \text{KVA} \]

Where  = Height of exhaust stack

\[ H = \text{height of building} \]

11.14.4 Care should be taken to ensure that no carbon particle emitted due to exhaust leakage enters and deposits on alternator windings and on open connection.

11.14.5 Support to Exhaust piping: Exhaust piping should be supported in such manner that the load of exhaust piping is not exerted to turbo charger.

11.15 **Air System**

It is preferable to provide vacuum indicator with all engines to indicate choked filter. Maximum air intake restrictions with clean and choked filters should be within prescribed limit as per OEM/manufacturer recommendation for the particular model of the engine. Gensets should be supplied with heavy duty air cleaners. (Heavy duty air cleaner should be used for installations in dusty or polluted surroundings.).

11.16 **Cooling System**

DG Set shall be water cooled radiator type with suitable capacity radiator & fan.

11.16.1 OEM shall provide acoustic enclosure of duly approved design from CPCB and shall ensure temperature rise within the acoustic enclosure does not exceed 5% to 7% (max.) on continuous operation of the DG set. OEM may provide forced air intake fan and / or forced exhaust fan as per OEM standard design. However it is OEM / contractors sole responsibility to ensure that the acoustic enclosure complies with CPCB norms for insertion loss and temperature within the acoustic enclosure conforms to the temperature requirement.

11.17 **Painting**

Enclosure shall be painted with weather proof, acid proof, heat resistant, powder coated paint shade as approved by the Architect / Consultant / Engineer-in-Charge after pretreatment for degreasing, derusting, pickling, phosphating and passivation.

11.18 **TEST ACCEPTANCE CRITERIA**
The Contractor shall be required to carry out any further tests/trials that the Architects / Consultants / Owners may desire to satisfy themselves that the Generator Sets and associated equipments fully comply with the conditions as set out in these Specifications.

All instruments, materials, load configurations and labour required for carrying out of the test shall be provided by the Contractor free of cost. Fuel required for testing and commissioning shall however be provided by Owners free of cost to the Contractor.

The Contractor shall give ample notice of the test to the Architects/Consultants/Owners.

11.19

**TECHNICAL DATA OF DG SET**

<table>
<thead>
<tr>
<th>S.NO.</th>
<th>PARTICULAR OF DETAILS</th>
<th>GUARANTEED DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>I.</td>
<td>DG SET</td>
<td></td>
</tr>
<tr>
<td>1.0</td>
<td>DIESEL ENGINE</td>
<td></td>
</tr>
<tr>
<td>1.1</td>
<td>Specifications to which it conforms.</td>
<td>:</td>
</tr>
<tr>
<td>1.2</td>
<td>Type &amp; Make</td>
<td>:</td>
</tr>
<tr>
<td>1.3</td>
<td>BHP Rating</td>
<td>:</td>
</tr>
<tr>
<td>1.4</td>
<td>Frequency</td>
<td>:</td>
</tr>
<tr>
<td>1.5</td>
<td>Method of Starting</td>
<td>:</td>
</tr>
<tr>
<td>1.6</td>
<td>Type of Cooling</td>
<td>:</td>
</tr>
<tr>
<td>1.7</td>
<td>Type of Governor</td>
<td>:</td>
</tr>
<tr>
<td>1.8</td>
<td>Type of fuel</td>
<td>:</td>
</tr>
<tr>
<td>1.9</td>
<td>Type of Lubricant Oil</td>
<td>:</td>
</tr>
<tr>
<td>1.10</td>
<td>No. of Stroke and Cylinder</td>
<td>:</td>
</tr>
<tr>
<td>1.11</td>
<td>Fuel Consumption / Hr.</td>
<td>:</td>
</tr>
<tr>
<td>1.12</td>
<td>Voltage regulation from on load to no load</td>
<td>:</td>
</tr>
<tr>
<td>1.13</td>
<td>Speed regulation form 0.8P.F. to unity power factor</td>
<td>:</td>
</tr>
<tr>
<td>1.14</td>
<td>Heat Exchanger</td>
<td>:</td>
</tr>
<tr>
<td>a)</td>
<td>Type</td>
<td>:</td>
</tr>
<tr>
<td>b)</td>
<td>Make &amp; Model</td>
<td>:</td>
</tr>
</tbody>
</table>

The Contractor shall be required to carry out any further tests/trials that the Architects / Consultants / Owners may desire to satisfy themselves that the Generator Sets and associated equipments fully comply with the conditions as set out in these Specifications.

All instruments, materials, load configurations and labour required for carrying out of the test shall be provided by the Contractor free of cost. Fuel required for testing and commissioning shall however be provided by Owners free of cost to the Contractor.

The Contractor shall give ample notice of the test to the Architects/Consultants/Owners.
### 12.0 DISTRIBUTION FEEDER PILLAR

#### 12.1 Outdoor type Distribution Feeder Pillars shall be suitable for 3 phase, 50Hz, 415 volts, A.C. system and shall generally conform to IS 5039. Rating and size of Distribution Feeder Pillar shall be as detailed in drawings and in BOQ.

The Distribution Feeder Pillars shall be fabricated out of heavy gauge 2.00 mm thick MS sheet steel with suitable stiffners. Distribution Feeder Pillar shall be constructed with slanting roof top/over hang for protection against rain & weather and adequately ventilated by providing louvers with wire mesh from inside. The Distribution Feeder Pillar shall be provided with degree of protection IP 54 as per IS : 2147. Distribution Feeder Pillar shall be double door construction with M.S. hinges and handle for opening the door. Each door shall open to minimum 135 degrees. Locking on both the doors with two keys for each lock shall be provided with each pillar. The Distribution Feeder Pillar shall be dust, vermin proof and weatherproof type.

Neoprene gaskets shall be provided for the doors. The enclosure shall be provided with ventilated louver cover with wiremesh, lifting hooks, supporting legs and double earth terminal with double washer.

The metallic parts of the enclosure shall be subjected to seven-tank process to include cleaning, derusting, rinsing, phosphatising etc. and epoxy painted.

Distribution Feeder Pillar shall be provided with suitable size of aluminium alloy busbars.

Moulded case circuit breaker shall be provided for incoming and MCB shall be provided for outgoing feeders & conforming to IS 8828-1978. Gland plate shall be 3mm thick with suitable number of flanged type brass cable glands of required sizes shall be provided. Provision shall be suitable for lighting the interior when the doors are open. Danger notice board shall be provided on front door of the Distribution Feeder Pillar. Distribution Feeder Pillar shall be complete with contactor, timers & switch gears for auto / manual operation of Street / Road lighting.

Distribution Feeder Pillar shall fully comply with CPWD General Specification for Electrical works (Part-II External-1994). Erection or installation shall also be carried out as specified in CPWD Specification 1994.

#### 12.1.1 INSTALLATION

Distribution Feeder Pillar shall be erected/installed on brick masonry foundation 600mm above surrounding ground level. All civil work like excavation PCC base concrete, brick masonry work, plastering, refilling, painting of brick masonry pedestal/foundation of Distribution Feeder Pillar including providing PVC sleeves in foundation for cable entry shall deemed to be included in quoted rates of Distribution Feeder Pillar.

#### 12.2 MOULDED CASE CIRCUIT BREAKERS

#### 12.2.1 GENERAL
Moulded Case Circuit Breaker shall be incorporated in the Distribution Feeder Pillar. MCCBs shall conform to IS : 13947 (Part-II) IEC-947(2) in all respects. MCCBs shall be suitable either for single-phase AC 230 volts or three phase 415 volts.

12.2.2 FRAME SIZES
The MCCBs shall be of the standard frame of the manufacturer sizes subject to meeting the fault level as specified elsewhere.

12.2.3 CONSTRUCTIONS
The MCCB’s cover and case shall be made of high strength heat treatment and flame retardant thermo-setting insulating material. Operating handle shall be quick make/quick break, trip-free type. The operating handle shall have suitable “ON”, “OFF” “and” “tripped” indicators. Three phase MCCBs shall have common operating handle for simultaneous operation and tripping of all the three phases. MCCB shall be provided with rotary handle. MCCB shall be load/line reversible type. MCCB shall be site adjustable type with thermal setting of 80% to 100%.

Suitable extinguishing device shall be provided for each contact. Tripping unit shall be of thermo-magnetic or static release type provided in each pole and connected by a common trip bar such that tripping of any pole operates all three poles to open simultaneously. MCCB shall be current limiting type. Contacts trips shall be made of suitable air resistant, silver alloy for long electrical life. Terminals shall be of liberal design with adequate clearance.

12.2.4 RUPTURING CAPACITY
The Moulded Case Circuit Breaker shall have a minimum service breaking capacity (Ics) of not less than 25KA RMS at 415 volts for Feeder Pillar.

12.2.5 TESTING
a. Type test certificate of the MCCB as per relevant Indian Standards (IS) shall be furnished.
b. Pre-commissioning tests on the Distribution Feeder Pillar incorporating the MCCB shall be done as per standard.

12.3 MINIATURE CIRCUIT BREAKER
The MCB’s shall be of the completely moulded design suitable for operation at 240/415 Volts 50 Hz system.

The MCB’s shall have a rupturing capacity of 10 KA.

The MCB’s shall have inverse time delayed thermal overload and instantaneous magnetic short circuit protection.

Type test certificates from independent authorities shall be furnished.

12.4 CABLE TERMINATIONS
Cable termination compartment and arrangement for power cables shall be suitable for stranded aluminium conductors, armoured, PVC insulated and sheathed. 1100 V grade cables. The temperature rise over ambient of 50 degree C. at bus bars / terminals for external cable connections shall be limited to 20 degree C. For power wiring colour-coded wires shall be preferred. All necessary cable terminating accessories such as Gland plates, supporting clamps and brackets, power cable lugs, hardware etc. shall be provided by the contractor.

The gland plates shall be removable type and shall cover the entire cable alley. Bidder shall ensure that sufficient space is provided for all cable glands. Gland plates for power cables only shall be factory drilled according to the cable gland sizes and number. For all single core cables, gland plates shall be of non-magnetic material. Provision shall be made for top or bottom entry of cables as required. Generous size of cabling chambers shall be provided, with the position of cable gland and terminals such that cables can be easily and safely terminated.

Barriers or shrouds shall be provided to permit safe working at the terminals of one circuit without accidentally touching that of another live circuit.

Cable risers shall be adequately supported to withstand the effects of rated short circuit currents without damage and without causing secondary faults.

12.5 TEST AT MANUFACTURES WORK
All routine tests specified in IS: 8623-1977 shall be carried out and test certificates produced to the Department.

12.6 TESTING AND COMMISSIONING
Commissioning checks and tests shall be included all wiring checks and checking up of connections. Primary/secondary injection tests for the relays adjustment/setting shall be done before commissioning in addition to routine meggar test. Checks and tests shall include the following.

a) Operation checks and lubrication of all moving parts.
b) Interlocking function check.
c) Insulation test: When measured with 500V meggar, the insulation resistance shall not be less than 100 mega ohms.
d) Trip tests & protection gear test.

13.0 EARTHING

13.1 GENERAL
Earthing of Substation equipment shall be carried out in conformity with IS 3043-1987, Indian Electricity Rules and CPWD specification.

13.2 EARTHING OF NON CURRENT CARRYING METAL PARTS OF SUBSTATION EQUIPMENT (BODY EARTHING).
Body earthing of Substation equipment like 11KV VCB Panel Board, Transformer, Main L.T. Panel, Capacitor Panel etc. shall be through a common grid formed in the Substation Building. Each equipment shall be connected with two independent earth conductors to earth bar located in respective area. Each earth bar shall be connected to Earth Grid by two independent earth conductors. Earthing Grid shall be directly connected to number of earth electrodes as shown on drawing. Earthing electrode shall be 600 x 600 x 6mm thick G.I plate (existing).

13.3 NEUTRAL EARTHING OF EQUIPMENT
Neutral terminals of Transformers shall be earthed independently. Each neutral terminal shall be earthed with two independent earth electrode. Earth electrode shall be 600 x 600 x 3mm thick copper plate. Earthing conductor shall be 25mm x 5mm copper. Earthing conductor in ground shall be in G.I. pipe whereas inside building shall be on SMC insulator on surface.

13.4 EARTHING CONDUCTOR FOR SUB-STATION EQUIPMENT
Earthing conductor shall be G.I. Earthing conductor from earth electrode to earth bar shall be of 25mm x 5mm G.I. Strip. G.I. Strip laid in ground shall be protected with G.I. pipe whereas inside the building shall be on SMC insulator on surface. Body earthing of each equipment like H.T. Panel, Transformer, Capacitor Panel, Main L.T. Panel (Normal Supply), Main L.T. Panel (Essential Supply), other electrical equipment / Panel shall be done with 2 No. 25mm x 5mm G.I. strip.

13.5 PLATE EARTH ELECTRODE
Earthing shall be provided with copper/G.I plate electrode of following.

i. Copper Plate Electrode. : 600mm x 600mm x 3mm thick
ii. G.I plate Electrode : 600mm x 600mm x 6mm thick

The electrode shall be buried in ground with its faces vertical and not less 4.5metres below ground level. 20mm dia medium class GI pipe shall be provided and attached to the electrode.

A funnel with mesh shall be provided on the top of this pipe for watering and earth electrode. Earth electrode the watering funnel attachment shall be housed in masonry enclosure of not less than 300 x 300 x 300mm deep. A precast RCC frame with cover shall be provided at top of chamber. Earth electrode may not effect the column footing or foundation of the building. In such cases electrode may be further away from the building.
13.6 **ARTIFICIAL TREATMENT OF SOIL**

If the earth resistance is too high and the multiple electrode earthing does not give adequate low resistance to earth, then the soil resistivity immediately surrounding the earth electrodes shall be reduced by addition of sodium chloride, calcium chloride, sodium carbonates copper sulphate, salt and soft coke or charcoal in suitable proportions.

13.7 **RESISTANCE TO EARTH**

The resistance of earthing system shall not exceed 1 ohm.

14.0 **ELECTRIC POWER DISTRIBUTION AND WIRING**

14.1 **INTRODUCTION**

The electric power will be received and distributed in a building, through following means:-

(i). Cabling and switchgears to receive power.

(ii). The building is divided into convenient number of parts, each part served by a rising mains system to distribute power vertically / horizontally.

(iii). Power flows from rising mains through tap – off box to floor main board to final DBs and then to wiring.

(iv). While rising main takes care of general lighting and power outlet load of the building, other loads like lifts, pump sets, AC plants, other motor loads are fed by independent cables of suitable capacity fed from properly designed essential / non-essential LT panels with suitably designed switchgear having necessary control and safety features.

(v). Therefore the distribution / wiring system essentially consists of provision of cables, switchgears, rising main, bus-ducting earthing, laying of pipes/ conduits etc. (in surface of recess) based on proper detailed designing to decide on various sizes/ capacities of these components and various controls and safety involved, to provide an efficient, reliable, safe and adequate electrical. Distribution and wiring system,

(vi). A typical schematic diagram of power distribution of a building is shown in (See Fig. 3) General specification for Electrical works Part I Internal -2013.

14.2 **SYSTEM OF DISTRIBUTION AND WIRING**:

(i) The wiring shall be done from a distribution system through main and / or branch distribution boards. The system design and location of boards will be properly worked out.

(ii) Each main distribution board and branch distribution board shall be controlled by an incoming circuit breaker / linked switch with fuse. Each outgoing circuit shall be controlled by a circuit breaker / switch with fuse.

(iii) For non- residential buildings, as far as possible, DBs shall be separate for light and power.

(iv) Only MCCB / MCB / HRC fuse type DBs shall be used. Rewireable type fuses shall not be used.

(v) Three phase DBs shall not be used for final circuit distribution as far as possible.

(vi) ‘Power’ wiring shall be kept separate and distinct from light wiring, from the level of circuits, i.e. beyond the branch distribution boards. Conduits for Light / power wiring shall be separate.

(vii) Essential / non essential / UPS distribution each will have a completely independent and separate distribution system starting from the main,
switchboard up to final wiring for each system. As for example, conduit carrying non-essential wiring shall not have essential of UPS wiring. Wiring for essential and UPS supply will have their own conduit system. No mixing of wiring is allowed.

(viii) Generally, no switchboard will have more than one source of incoming supply. More than one incoming supply will be allowed only at main board with proper safety and interlocking so that only one source can be switched on at a time.

(ix) Each MDB / DB/ Switch board will have reasonable spare outgoing way for future expansion.

(x) Balancing of 3 Phase circuit shall be done.

14.3 WIRING:

14.3.1 Sub-main & Circuit Wiring

a) Sub-main Wiring
   Sub-main wiring shall mean the wiring from one main/distribution switchboard to another.

b) Circuit Wiring
   Circuit wiring shall mean the wiring from the distribution board to the 1st tapping point inside the switch box, from where point wiring starts.

14.3.2 Measurement of Sub-main and Circuit wiring.

(i). Circuit and sub-main wiring shall be measured on linear basis along the run of the wiring. The measurement shall include all lengths from end to end of conduit or channel as the case may be, exclusive of interconnections inside the switchboard etc. the increase on account of diversion or slackness shall not be included in the measurement.

(ii). The length of circuit wiring with two wires shall be measured from the distribution board to the nearest switch box from which the point wiring starts. Looping of switch boxes also will be counted towards circuit wiring measured along the length of conduit / channel.

(iii). When wires of different circuits are grouped in the single conduit / channel, the same shall be measured on linear basis depending on the actual number and sizes of wires run.

(iv). Protective (loop earthing) conductors, which are run along the circuit wiring and the sub-main wiring, shall be measured on linear basis and paid for separately.

(v). NOTE : Conduit carrying sub-main will not carry circuit / point wiring. Similarly conduit carrying circuit wiring will not carry sub-main / point wiring. Conduit carrying point wiring not carry sub-main / circuit wiring

14.3.3 Measurement of other wiring work :-

Except as specified above for point wiring, circuit wiring and sub-main wiring, other types of wiring shall be measured separately on linear basis along the run of wiring depending on the actual number and sizes of wires run.

14.4 POINT WIRING :-

14.4.1 Definition

A point (other than socket outlet point) shall include all work necessary in complete wiring to the following wiring to the following outlets form the controlling switch or MCB.
a) Ceiling rose or connector (in the case of point for ceiling / exhaust fan points, pre-wired light fittings and call bells).
b) Ceiling rose (in case pendant except stiff pendants).
c) Back plate (in case of stiff pendants).
d) Lamp holder (in case of goose neck type wall brackets, batten holders and fittings which are not pre-wired).

14.4.2 Scope:

Following shall be deemed to be included in point wiring.

a) Conduit / channel as the case may be, accessories for the same and wiring cables between the switch box and the point outlet, loop protective earthing of each fan / light fixtures.
b) All fixing accessories such as clips, screws, phil plug rawl plug etc. as required.
c) Metal or PVC switch boxes for control switches, regulators, socket etc. recessed or surface type, and phenolic laminated sheet covers over the same.
d) Outlet boxes, junction boxes, pull – through boxes etc. but excluding metal boxes if any, provided with switchboard for loose wires/ conduit terminations.
e) Any special block required for neatly housing the conductor in batten wiring system.
f) Control switch or MCB, as specified.
g) 3 pin or 6 pin socket, ceiling rose or connector as required. (2 pin and 5 pin socket outlet shall not be permitted).
h) Connections to ceiling rose, connector socket outlet, lamp holder, switch etc.
i) Bushed conduit or porcelain tubing where wiring cables pass through wall etc.

14.4.3 Measurement

Point wiring (other than socket outlet points)

Unless and otherwise specified, there shall be no linear measurement for point wiring for light points, fan points, exhaust fan point and call bell points. These shall be measured on unit basis by counting, and classified as laid down in 14.4.4.

14.4.4 Classifications

Point measured under 14.4.3 on unit basis shall be classified as under according to the type of building.

a) Residential buildings :
   i. Group ‘A’ for point wiring for type I, type II and type III residential quarters and hotels.
   ii. Group ‘B’ for point wiring for type IV and above type of residential quarter and brackets.

b) Non –residential buildings :
   Group ‘C’ for all types of non-residential building such as offices, hospitals, laboratories, educational institutions, libraries etc.

c) For any other type of building :
   The group under which the points are to be classified shall be decided by the concerned Chief Engineer (Elect.).
14.4.5 Point wiring for socket outlet points :-
   a) The light (6A) point and power (16A) point wiring shall be measured on linear basis, from the respective tapping point of live cable, namely switchbox another socket outlet point, or the sub distribution board as the case may be, up to the socket outlet.
   b) The metal / PVC box with cover, switch / MCB, socket outlet and another accessories shall be measured and paid as a separate item.
      Note: - There shall normally be no “On the board” light plug point.
   c) The power point outlet may be 16A /6A, six pin socket outlet, where so specified in the tender documents.

14.4.6 Group Control Point Wiring.
   a) In the case of points with more than one point controlled by the same switch, such points shall be measured in parts i.e. (a) from the switch to the first point outlet as one point and classified according to 14.4.4, and (b) for the subsequent points, the distance from that outlet to the next one and so on, shall be treated as separate point (s) and classified according 14.4.4.
   b) No recovery shall be made for non-provision of more than one switch in such cases.

14.4.7 Twin Control Light Point wiring:–
   a) A light point controlled by two numbers of two way switches shall be measured as two points from the fitting to the switches on either side and classified according to 14.4.4.
   b) No recovery shall be made for non-provision of more than one ceiling rose or connector in such cases.

14.4.8 Multiple Controlled Call Bell Point wiring :–
   a) In the case of call bell points with a single call bell outlet, controlled from more than one place, the point shall be measured in parts i.e. (a) from the call bell outlet to one of the nearest ceiling roses meant for connection to bell push, treated as one point and classified according to 14.4.4 and (b) from that ceiling rose to the next one and so on, shall be treated as separate point (s) and classified according to 14.4.4.
   b) No recovery shall be made for non-provision of more than one ceiling rose or connector for connection to call bell in such cases.

14.5 WIRING SYSTEM :–
   a) Wiring shall be done only by the looping system. Phase / live conductors shall be looped at the switchbox. Fr point wiring, neutral wire /earth wire looping for the 1st point shall be done in the switch box; and neutral earth looping of subsequent points will be made from point outlet.
   b) In wiring, on joints in wiring will be permitted anywhere, except in switchbox or point outlets, where jointing of wires will be allowed with use of suitable connector.
   c) The wiring throughout the installation shall be such that there is no break in the neutral wire except in the form of linked switchgears.
   d) Colour coding :-
      Following colour coding shall be followed in wiring
      Phase : Red / Yellow / Blue (Three Phase Wiring)
      Live : Red (Single Phase Wiring)
      Neutral : Black
Earth : Yellow / Green.

e) Termination of circuit into switchboard :-

Circuit will consist of Phase / Neutral / Earth wire. Circuit will terminate in a switch board (first taping point, where from point wiring starts) in following manners :-

a) Phase wire terminated in phase connector.
b) Neutral wire terminated in neutral connector
c) Earth wire terminated in earth connector.
d) The switchboard will have phase neutral and earth termination connector blocks to receive phase / neutral / earth wires. (See fig. 4)

14.6 RUN OF WIRING :-

a) The type of wiring shall be specified in the tender documents namely, surface conduit / recessed conduit, steel / PVC channel.
b) Surface wiring shall run as far as possible along the walls and ceiling, so as to be easily accessible for inspection.
c) Above false ceiling, in no case, open wiring shall be allowed. Wiring will be done in recessed conduit or surface steel conduit.
d) In recessed conduit system, routes of conduit will be planned, so that various inspection boxes provided don’t present a shabby look. Such boxes provided 5mm above plaster level, and they can be covered with plaster of paris with marking of junction boxes.
e) Where number of electrical services like electrical wiring, telephone wiring, computer cabling, pass through corridors, it may be proper to plan such service with properly designed aluminum / PVC channels duly covered by a false ceiling, so that subsequently such service can be maintained and additional cables can be provided.
f) Generally conduits for wiring will not be taken in floor slabs. When it is unavoidable special precaution to be taken to provide floor channels with provision for safety and maintenance. Alternatively false flooring can be provided.

14.7 PASSING THROUGH WALL OR FLOORS :-

a) When wiring cables are to pass through a wall these shall be taken through a protection (Steel / PVC) pipe or porcelain tube of suitable size such that they pass through in a straight line without twist or cross in them on either they pass through in a straight line with twist or cross in them on either end of such holes. The ends of metallic pipe shall be neatly bushed with porcelain, PVC or other approved materials.
b) All floors openings for carrying any wiring shall be suitably sealed after installation.

14.8 JOINTS IN WIRING

a) No bare conductor in phase and / or neutral or twisted joints in phase, neutral, and / or protective conductors in wiring shall be permitted.
b) There shall be no joints in the through – runs of cables. If the length of final circuit of sub-main is more than the length of standard coil, thus necessitating a through joint, such joint shall be made by means of approved mechanical connectors in suitable junctions boxes.
c) Termination of multi-stranded conductors shall be done using suitable crimping type thimbles.
14.9 RATING OF OUTLETS (TO BE ADOPTED FOR DESIGN)
   a) Incandescent lamps in residential and non-residential buildings shall be rated at 60W and 100W respectively.
   b) Ceiling fans shall be rated at 60W. exhaust fans, fluorescent tubes, compact fluorescent tubes, HPMV lamps, HPSV lamps etc. shall be rated according to their capacity. control gear loses shall be also considered as applicable.
   c) 6A and 16A socket outlets points shall be rated at 100W and 1000W respectively, unless the actual values of loads are specified.

14.10 CAPACITY OF CIRCUITS :
   a) Lighting circuit shall feed light / fan / call bell points. Each circuit shall not have more than 800Watt connected load or more than 10 Points. However in case of CFL points where load per point may be less, number of points may be suitably increased.
   b) Power circuit in non-residential building will have only one outlet per circuit.
   c) Each power circuit in residential building can feed following outlets :
      i. Not more than 2 Nos. 16A outlets.
      ii. Not more than 3 Nos. 6A outlets.
      iii. Not more than 1 No. 16A and 2 No. 6A outlets.
   d) Load more than 1KW shall be controlled by suitably rated MCB and cable size shall be decided as per calculations.
   e) Power wiring with bus trunking :- It is permitted to meet large – scale power requirement in a hall, or floor, with use of single phase or 3 phase bus bar running inside a metal enclosure. This will be provided with careful design and use of factory fabricated bus-trunking of reputed make, conforming to relevant BIS standards and with standard accessories link end feed unit, tap off with necessary safety features like over current, and short circuit and earth fault protection. Such trunking will be of specified breaking KA raking.

14.11 SOCKET OUTLETS :-
   a) Socket outlet shall be 6A, 3 Pin, 16Amp 3pin or 16/6Amp 6pin. 5 pin socket outlets will not be permitted.
   The third pin shall be connected to earth through protective (loop earthing) conductor, 2 Pin or 5 pin sockets shall not be permitted to be used.
   b) Conductors connecting electrical appliances with socket outlets shall be of flexible type with an earthing conductor for connection to the earth terminal of plug and the metallic body of the electrical appliance.
   c) Socket for the power outlet of rating above 1KW shall be of industrial type with associated plug top and controlling MCB.
   d) Where specified, shutter type (interlocking type) of socket shall be used.
   e) Every socket outlet shall be controlled by a switch or MCB, as specified. The control switch / MCB shall be connected on the ‘live’ side of the line.
   f) 5A/6A and 15A /16A socket outlets shall be installed at the following positions, unless otherwise specified.
      i. Non –residential building – 23cm above floor level.
      ii. Kitchen – 23cm above working platform and away from the likely positions of stove and sink
      iii. Bathroom – No socket outlet is permitted for connecting a portable appliance thereto. MCB / IC switch may be provided above 2m for fixed appliances, and at least 1m away from shower.
iv. Rooms in residences – 23cm above floor level, or any other level in special cases as desired by the Engineer – in Charge.

g) Unless and otherwise specified, the control switches for the 6A and 16A socket outlet shall be kept along with the socket outlets.

14.12 CABLES

a) Copper conductor cable only will be used for sub-main / circuit / point wiring.

b) Minimum size of wiring:
   - Light wiring: 1.5 sq.mm.
   - Power wiring: 4.0 sq.mm.
   - Power circuit rated More than 1KW: Size as per calculation

c) Insulation: Copper conductor cable shall be PVC insulated, Fire retardant, low smoke (FRLS) type conforming to BIS specifications.

d) Multi-stranded: Cables are permitted to be used.

14.13 FLEXIBLE CABLE:

a) Conductor of flexible cables shall be of copper. The cross-sectional area of conductor for flexible cable shall be as per design.

b) Only 3 core flexible cables shall be used for connecting single – phase appliances.

c) Unless the flexible cables are mechanically protected by armoured, or though rubber, or PVC sheathed, these shall not be used in workshops and other places where they are liable to mechanical damage.

d) Flexible cable connection to bell push from ceiling rose shall be taken through steel conduit / metallic casing and capping.

14.14 WIRING ACCESSORIES:

a) Control switches for points:
   i. Control switches (single pole switch) carrying not more than 16A shall be modular type. The switch shall be ‘ON’ when the knob is down.
   ii. Modular type switches of reputed make along with matching mounting boxes, shall be used in non-residential buildings and residential quarters of all types. Modular type sockets, stepped type fan regulators shall be used. All such boxes switches and accessories shall be of same make of modular switch manufacturer.
   iii. It is recommended to provide double pole MCB in proper enclosure as power outlet for window type AC unit, geysers etc.

b) Switch Boxes:
   i. Switch box shall be hot dip galvanized, factory fabricated. Suitable in size for surface / recess mounting and suitable in size for accommodating the required number of switches and accessories (where required to be used for applications other than modular switches / sockets).
   ii. Switch box also can be of non – metallic material. The technical sanctioning authority will approve specified makes of reputed quality and specifications.

c) Switchbox cover (for application other than modular type):
Phenolic laminated sheets of approved shade shall be used for switch box covers. These shall be of 3mm thick synthetic phenolic resin bonded laminated sheets as base material and conforming to Grade P-I of IS : 20361974.

Note: Specification for switch boxes is covered in the chapters on the various types of wiring.

d) Ceiling rose :
   i. A ceiling rose shall not be used on a circuit, the voltage of which normally exceeds 250V.
   ii. Only one flexible cord shall be connected to a ceiling rose. Specially designed ceiling roses shall be used for multiple pendants.
   iii. A ceiling rose shall not embody fuse terminals as an integral part of it;

e) Lamp Holders :
   i. Lamp holders may be batten, angle, pendant of bracket holder type as required. He holder shall be made of brass and shall be rigid enough to maintain shape on application of a nominal external pressure. There should be sufficient threading for fixing the base to the lamp holder part so that they do not open out during attention to the lamp or shade.
   ii. Lamp holder for use no bracket and the like shall have not less than 1.3cm nipple, and all those for use with flexible pendant shall be provided with cord grips.
   iii. All lamp holders shall be provided with shade carriers.
   iv. Where centre contact Edison Screw lamp holders are used, the outer or screw contact shall be connected to the ‘middle wire’ or the neutral conductor of the circuit.

f) Fitting types:
   The types of fittings shall be as specified in the tender documents.

   Indoor type fittings:
   i. Where conductors are required to be drawn through tube or channel leading to the fitting, the tube or channel must be free from sharp angles or projecting edge, and of such size as will enable them to be wired with the conductor used for the final circuit without removing the braiding or sheathing. As far as possible all such tubes or channels should be of sufficient size to permitted looping back.
   ii. Wires used within pre-wired fittings shall be flexible with PVC insulation and 14/0.193 mm (minimum) copper conductors. The leads shall be terminated on built – in – terminal block, ceiling rose or connector as required.
   iii. Fittings using discharge lamps shall be complete with power factor correction capacitors, either integrally or externally. An earth terminal with suitable marking shall be provided for each fitting of discharge lamps.
   iv. Fittings shall be installed such that the lamp is at a height of 2.2m above floor level, unless otherwise directed by the Engineer – in – charge.
   v. Fittings made of CRCA shall be phosphatized and powder / epoxy painted. for coastal areas and humid area like toilets, kitchen, for prolonging the life of such fittings, corrosion free materials like engineering plastic, aluminium, stainless steel, etc. should be used.

Outdoor type fittings:
Outdoor fittings shall have suitable IP protection. It is preferable that street
light fittings are of cast aluminium body of IP65, for reducing recurring
maintenance cost and improved performance. Where required IP 66 fittings
also can be provided for reducing maintenance frequency and cost.
Other fittings are not available with tested IP 65/54 protection, can be properly
fabricated with weatherproof features, proper gasketing etc. as far as possible
corrosion free material like cast aluminium, stainless steel, engineering
plastics may be used for fabrication of such fittings, to prolong life such fittings.
There should not be any exposed wiring in such outdoor fittings

14.15 ATTACHMENT OF FITTINGS AND ACCESSORIES :-

a) Conduit wiring system :-
   i. All accessories like switches, socket outlets, call bell pushes and
      regulators shall be fixed in flush pattern inside the switch / regulator
      boxes. Accessories like ceiling roses, brackets, batten holders etc. shall
      be fixed on outlet boxes. The fan regulators may also be fixed on outlet
      boxes, if so directed by Engineer – in – charge.
   ii. Aluminium alloy or cadmium plated iron screws shall be used to fix the
       accessories to their bases.
   iii. The switch box / regulator box shall normally be mounted with their
        bottom 1.2m from floor level, unless otherwise directed by the Engineer

b) Fixing to wall and ceiling :-
   i. Wooden plug for fixing to wall / ceiling will not be allowed. Fixing will be
      done with the help or PVC sleeves / Rowel plugs / dash fasteners as
      required.
   ii. Drilling of holes shall be done by drilling machines only. No manual
       drilling of hole will be allowed.

14.16 FANS, REGULATORS AND CLAMPS :-

a) Ceiling Fans :-
   i. Ceiling fans including their suspension shall conform to relevant Indian
      Standards.
   ii. All ceiling fans shall be wired to ceiling roses or to special connector
       boxes, and suspended form hooks or shackles, with insulators between
       hooks and suspension rods. There shall be no joint in he suspension
       rod.
   iii. For wooden or steel joists and beams, the suspension shall consist of
        GI flat of size not less than 40mm x 6mm, secured on the side of the
        joists or beam by means of two coach screws of size not less than 5cm
        for each flat. Where there is space above the beam, a through- bolt of
        size not less than 1.5cm dia, shall be placed above the beam the beam
        from which the flats are suspended. In the letter case, the flats shall be
        secured from movements by means of another bolts and nut at the
        bottom of the beam. A hook consisting of MS rod of size not less than
        1.5cm. dia shall be inserted between the MS flat through oval holes on
        their sides. Alternatively, the flats may be bent inward to hold tightly
        between them by means of a bolt and nut, a hook of ‘S’ form.
   iv. In the case of ‘I’ beams, flats shall be shaped suitably to catch the
       flanges and shall be held together by means of a long bolt and nut.
v. For concrete roofs, a 12mm dia. MS rod in the shape of ‘U’ with their vertical legs bent horizontally at the top at least 19cm or either side and bound to the top reinforcement of the roof shall be used.

vi. In buildings with concrete roofs having a low ceiling height, where the fan clamp mentioned under sub clause (v) above cannot be used, or wherever specified, recessed type fan clamp inside metallic box shall be used.

vii. Canopies on top suspension rod shall effectively hide the suspension.

viii. The leading in wire shall be of nominal cross sectional area not less than 1.5 sq.mm. and shall be protected from abrasion.

ix. Unless otherwise specified, all ceiling fans shall be hung 2.75m above the floor.

x. In the case of measurement of extra down rod for ceiling fan including wring, the same shall be measured in units of 10cm. any length less than 5cm shall be ignored.

xi. The wiring of extra down rod shall be paid as supplying and drawing cable in existing conduit.

b) Exhaust Fans :

i. Exhaust fans shall conform to relevant Indian Standards.

ii. Exhaust fans shall be erected at the place indicated by the engineer – in – charge. For fixing an exhaust fan, a circular opening shall be provided in the wall to suit the size of the frame, which shall be fixed by means of rag bolts embedded in the wall. The holes shall be neat plastered to the original finish of the wall. The exhaust fans shall be connected to the exhaust fan point, which shall be wired as near to the opening as possible, by means of a flexible cord, care being taken to see that the blades rotate in the proper direction.

iii. Exhaust fans for installation in corrosive atmosphere, shall be painted with special PVC paint or chlorinated rubber paint.

iv. Installation of exhaust fan in kitchens, dark rooms and such other special location need careful consideration; any special provision needed shall be specified.

c) Regulators :-

The metallic body of regulators of ceiling fans / exhaust fans shall be connected to earth by the protective conductor.

14.17 MARKING OF SWITCHBOARD :-

(a) Schematic Diagram :- First a comprehensive schematic diagram for each building is to be prepared, starting from Main L.T. Panel, rising main, sub-main boards, DBs, etc. and the manner in which they are connected. This will include essential, non –essential and UPS system main sub-main cables shall be indicated

(b) Marking of each main Board :- Each main board Sub-main board shall be marked indicating rating of each incoming / outgoing switch and the details of loads / area it feeds. Detail / size of incoming and outgoing cable also shall be marked indicating from where the incoming cable has originated.

(c) Marking of Distribution Board :- Each Distribution board shall be marked indicating detail of incoming switch (Size of cable and from where it is fed) and marking of each outgoing MCB indicating the area it feeds. Suitable marking sticker will be suitably fixed to indicate such details.
(d) Marking of Power / Light DBs: Power / Light DBs shall be marked ‘P’ and ‘L’ respectively.

(e) Marking for Non-essential / Essential / UPS / Switchboard: Each switchboard shall be marked essential / non-essential / UPS to indicate the nature of such switchboards.

(f) Marking of Main earthing terminal: Main earthing terminals in main / sun-main switchboard shall be permanently marked, as ‘Safety Earth – don’t remove’.

15.0 PREAMBLE TO BILL OF QUANTITIES

15.1 The Bill of Quantities should be read with all the other sections of this tender. All the items of work mentioned in the Bill of Quantities covered by this contract shall be carried out as per the drawings, specifications and directions of the DEPARTMENTS and shall include the cost of all labour, materials, tools and plants, equipments, and testing of materials, if any, with CONTRACTOR’s testing appliance, all octroi, duties, royalties, sales tax on works contract, toll tax, taxes (including service tax) and CONTRACTOR’s profit and overheads etc.

15.2 The TENDERERS shall be deemed to have studied the drawings, specifications and details of work to be done within the time schedule and to have acquainted himself of the conditions prevailing at site. The quoted rates shall be applicable for all works in any section / size / shape and Design etc.

15.3 The quantities shown against the various items are only approximate. Any increase or decrease in the quantities shall not form the basis for alteration of the rates quoted and accepted. Quantities can be eliminated if required from tender.

15.4 In case where the specifications given in the Description of the item of work given in Bill of Quantities are found wanting, the C.P.W.D. General specifications for Electrical Works – I, II, VI, & VII shall be followed.

15.5 The rates quoted for items of work shall include working in all conditions at all heights / depths including in / under water, liquid mud, foul conditions etc. and shall also include bailing or pumping out water from the foundations basements or any other place of construction collected from rain or any other source whatsoever at any time, till the completion of work including all suspension period and delays whatsoever.

15.6 The DEPARTMENT reserves the right to withdraw from the scope of work and/or to order to any other agency for any item or group of work, or to split the work between two or more sub-CONTRACTOR’s if necessary. Such a step shall not constitute a breach of the contract.

15.7 All the items of work shall be carried out as per description given in the Bill of Quantities and as shown in the drawings. All materials to be got approved from the Architect / EPI / Project Managers.

15.8 The rates quoted for cable tray & suspenders shall include two coats of red oxide primer paints after dust and dirt removal and finished with two coats of spray paints of approved make and shade synthetic enamel paint.

16.0 TECHNICAL SPECIFICATION OF CIVIL WORK

General

The Contractor may make a special note of the strictness of the concrete mix to be adopted in items of maximum water-cement ratio, minimum slump, control of total chloride and sulphate contents, use of admixtures etc.

Minimum cement contents are given purely from durability point of view. Larger contents shall have to be provided if demanded by mix design.
Provision of cement slurry to create bond between plain/reinforced concrete surface and subsequent applied finishes (floor, plaster, dado, skirting etc.) shall not be paid extra.

All full-fledged laboratories shall be established at site to start of construction and shall also stock all relevant codes as per the requirements of the special specifications.

Procedure of mixing the admixtures shall be strictly as per manufactures recommendations if not otherwise directed by the Engineer.

The batching plant for all concrete shall be used. Alternatively, use of ready mix concrete from an approved source shall be permitted. Concrete shall be transported using concrete pumps of adequate capacity including necessary stand by.

All the water tanks and other liquid retaining concrete structures shall undergo hydro-testing as per special specifications.

Special benches shall be provided at site for stacking reinforcement bars of different sizes as per the specifications.

Form work for beams of RCC areas shall be designed in such a way that the form work of the adjacent slabs can be removed without disturbing the props/supports of the beams.

Wherever there are tension/suspended concrete members, which are suspended from upper level structure members, the shuttering/scaffolding of such members at lower level shall have to be kept in place till upper level supporting members gain minimum required strength. Cost of such larger durations of keeping in place the shuttering/scaffolding shall be deemed to be included in the price quoted for respective structural members.

In the mobilization period, the contractor shall carry out expeditiously and without delaying the following works

- Material testing and mix design of concrete as contemplated in the specifications.
- Setting up of full-fledged site laboratory as per the requirement of these specifications.
- Any other pre-requisite items required for final execution.

The specifications for market rate items to be executed under this contract are enclosed.

Items, which are not covered under the specifications, shall be executed; as per latest CPWD specification and relevant IS codes or with specifications under the direction of engineer in charge.

**Testing**

It is made clear that cost of testing, cost of material for testing, all field apparatus required for sampling and testing as per CPWD/IS codes and manpower incident to such testing will be provided along with necessary transport arrangement to and fro the approved testing agency or laboratory by the Contractor during the construction phase of the work and defect liability period. The expenditure in this regard shall be borne by the Contractor and nothing extra shall be payable by owner on this account. Field laboratory with all the required apparatus and staffs shall be established by the Contractor at site of work at his cost for carrying out field tests at stipulated frequencies.

**Sampling and Testing**

The Contractor or his accredited representative shall be present during sampling/testing and signify his concurrence for sampling / testing carried out by signing the test records. The Contractor shall be liable of all actions consequent to the test and their results as if he himself attended to the tests. The Contractor is duly advised to be present himself for sampling and testing or in the alternative, have fully qualified duly
authorized Engineer for this purpose.

17.0 **SPECIFICATIONS FOR ANTITERMITE TREATMENT**

17.1 **Pre-Construction Chemical Treatment**

- Treatment shall be done by the approved specialist Subcontractor / Agency as per the procedures laid down in IS : 6313 (Part-II) in the following areas or elsewhere as required to make chemical barriers against termites:

  - At Column-Pits, Wall-Trenches and Basement Excavations
  - At Plinth Filling
  - At the Junction of Wall & Floor
  - Along External Perimeter of Building
  - At Expansion Joints
  - At Soil Surrounding Pipes / Wastes Pipes & Conduits

- Hand operated pressure pump shall be used for uniform spraying of the chemicals. To have proper check for uniform spraying of chemicals, graduated containers shall be used. Proper check shall be kept so that the specified quantity of chemicals is used for the required area during the operation.

17.2. The contractor shall arrange entire quantity of chemical (Chlorophyriphos or Lindane 20% EC) required for entire work. The chemical shall be brought in sealed container. Concentration percentage, Date of manufacturer and expiry shall be clearly indicated on the containers. Samples shall be obtained from the lot and got tested on approved laboratory before using in work.

17.3. The material so brought shall be safely and securely stored (away from other materials) and shall be under the control of Engineer-in-Charge. The quantity required on particular day based on area shall be issued on written requisition, records of which shall be safely and securely kept.

17.4. If any portion in original container remains unused, the same duly sealed shall be returned to store and reissued against next use.

17.5. The empty can should immediately be punctured and crushed so that the cans cannot be used for any other purpose. Such destroyed cans shall be returned to store for a counter check of inventory and the actual quantum of chemical used.

17.6. The work shall be carried out by approved agency as per following procedure.

17.7. Chemical solution shall be made by mixing one litre of Chlorophyriphos or Lindane 20% EC with 19 litres of water and this solution shall be used in the following steps:

<table>
<thead>
<tr>
<th>S.No.</th>
<th>STAGE</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>a.</td>
<td>Bottom &amp; sides of trenches</td>
<td>5 Litre per Sqm of surface area.</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Details</td>
</tr>
<tr>
<td>---</td>
<td>----------------------------</td>
<td>-------------------------------------------------------------------------</td>
</tr>
<tr>
<td>b.</td>
<td>Back Filling</td>
<td>7.5 litre per Sqm of vertical surface in contact with the soil. The treatment shall be done in sequence of layers of filling. For spray &amp; saturating the soil holes @ 150 mm centre to centre shall be made in soil with crow bar.</td>
</tr>
<tr>
<td>c.</td>
<td>Junction of wall &amp; floor</td>
<td>7.5 Litre per Sqm of vertical wall and column surface</td>
</tr>
<tr>
<td>d.</td>
<td>External Perimetre</td>
<td>7.5 litre per Sqm of vertical surface in contract with the Soil for spray &amp; saturating the soil holes @ 150mm centre to centre shall be made in soil with crow bar.</td>
</tr>
<tr>
<td>e.</td>
<td>Under Apron/ Plinth protection/ top surface of plinth filling</td>
<td>5 litre per Sqm</td>
</tr>
</tbody>
</table>

Critical areas such as trenches carrying conduits, sanitary lines and expansion joints also be treated as per specifications.

Signing guarantee Performa for anti-termite treatment i.e. satisfactory performance for minimum of ten years from the date of final completion of project on an approved Performa. The guarantee shall be executed and extended by the contractor and not by the anti-termite agency.
1. GENERAL INSTRUCTIONS

1.1 Fire fighting works specified in the tender have to be executed in accordance with:
1.1.1 The rules and regulations of Local Fire Authority as per the statutory regulations applicable for obtaining the occupation/No objection certificate from the Local Development / Fire Authority.
1.1.2 Applicable norms laid down by the relevant sections of latest editions of National Building Code (NBC) and all relevant codes of Bureau of Indian Standards (B.I.S.) shall be followed as applicable.
1.1.3 The codes of the National Fire Protection Association of USA (N.F.P.A.) shall used as a general guide for good engineering practice, design and workmanship norms. No certificate of compliance to NFPA codes will be required.

1.2 All materials used in the works shall have Bureau of Indian Standards valid certification stamped, marked or cast on the material in an acceptable and approved manner, as specified hereinafter.

1.3 It is the contractor's responsibility to ensure the competence of design to meet the above requirements.

1.4 Quantities in the tender document are approximate / Tentative worked out on the tender drawing issued.

1.5 Contractors are invited to highlight any aspects of the contract document that may need revision or reconsideration before the work is started. He must furnish details of any variations in the specifications or the quantities that may be necessary for him to comply with the Code and statutory requirements. These may be identified and approval of the Engineer-In-Charge taken before the start of the work.

1.6 Contractors shall furnish detailed Shop drawings for submission and approval of the Local Fire Authority and for Insurance Companies as may be required by the Client.

2. INSPECTION AND TESTING OF MATERIALS

2.1 Contractor shall be required, if requested, to produce manufacturers Test Certificate for the particular batch of materials supplied to him. The tests carried out shall be as per the relevant Indian Standards.

2.2 For examination and testing of materials and works at the site Contractor shall provide all Testing and Gauging Equipment as necessary.

3. METRIC CONVERSION

3.1 All dimensions and sizes of materials and equipment given in the tender document are commercial metric sizes.

3.2 Any weights, or sizes given in the tender having changed due to metric conversion, the nearest equivalent sizes accepted by Indian Standards shall be acceptable without any additional cost.

4. REFERENCE DRAWINGS

4.1 The Contractor shall maintain one set of all drawings issued to him as reference drawings. These shall not be used on site.

All corrections, deviations and changes made on the site shall be shown on these reference drawings for final incorporation in the completion drawings. All changes to be made shall be initialed by the Engineer-in-Charge.

5. COMPLETION DRAWINGS

5.1 On completion of work, Contractor shall submit one complete set of original tracings and six prints of “as built” drawings to the Engineer-in-Charge.
6. **LICENSE AND PERMITS**

6.1 Contractor must keep constant liaison with all relevant authorities and shall be responsible for obtaining all approvals relating to fire fighting system. He shall also be responsible for co-ordination, with other agencies working on the project relating to their scope of work and shall take approval from the Engineer-In-Charge / Owner where ever required.

6.2 Contractor shall obtain, from the local authorities all related completion certificates and NOC (No objection certificate) with respect to his work as required for occupation of the building.

6.3 All inspection fees or submission fees shall be paid by the Contractor.

7. **MATERIALS**

7.1 All materials used in the works shall conform to the tender specifications.

7.2 As far as possible materials bearing I.S. certification marks shall be used with the approval of the Engineer-in-Charge and shall confirm to the Tender specification / BOQ / Drawing requirements.

8. **PROTECTION AGAINST DAMAGE**

The Contractor shall take every precaution to protect all Fire fighting equipments against damage, misuse, cracking, staining, breakage and pilferage by providing proper wrapping and locking arrangement till the completion of the installation and handling over. At the time of handling over, the Contractor shall clean, disinfect and polish all the Fire fighting equipments & fittings. Any Equipment found damped, cracked, clipped, strained or scratched shall be removed and new Equipments and fittings free from defects shall be installed at his own cost to complete the work.

9. **GUARANTEE / WARRANTY**

9.1 The contractor shall submit a warranty for all equipment, materials and accessories supplied by him against manufacturing defects, malfunctioning or under capacity functioning.

9.2 The warranty shall be valid for a period of one year from the date of commissioning and handing over.

9.3 The warranty shall expressly include replacement of all defective or under capacity equipment. Engineer-in-charge may allow repair of certain equipment if the same is found to meet the requirement for efficient functioning of the system.

9.4 The warranty shall include replacement of any equipment found to have capacity lesser than the rated capacity as accepted in the contract. The replacement equipment shall be approved by the Engineer-in-charge.

10. **SCOPE**

10.1 Work under this sub-head consists of furnishing all Labour, Materials, equipment and accessories necessary and required to completely install the Fire Fighting equipment etc., specified hereinafter and given in the Schedule of Quantities.

10.2 Without restricting to the generality of the foregoing the work of Fire Fighting System shall include the following:

- Portable Fire Extinguishers.
- Fire Buckets

The fire bucket shall be painted with Red shade Fire paint and “FIRE” should be written on it as per specification.

11.0 **APPLICABLE CODES**

a) IS:15683 - Portable fire extinguishers

12.0 **General Requirements**

All materials shall be of the best quality conforming to the Specifications and subject to the approval of the Engineer-in-Charge/ Project Manager/ Owner.
13.0 Portable Fire Extinguisher
Portable fire extinguishers shall be provided as per Bill of Quantities and installation of extinguishers shall conform to IS: 15683.

14.0 TESTING & COMMISSIONING
After successful testing of the different items in parts, the Contractor shall provide all facilities including necessary labor, tools and equipments etc. for carrying out testing and commissioning of the entire fire fighting system complete as per requirement in the presence of Client’s representative and during the visit of the Fire Officer whenever and as may be required.

LIST OF INDICATIVE MAKES:

The following is the list of products and indicative makes. Bidder is free to propose any other equivalent Make meeting entire Technical Requirements, Specifications along with required details in support of the same. The same would be analyzed and accepted if found suitable after discussion between EPI and bidder. The Makes shall be finalized during Technical evaluation prior to opening of Price-Bids.

Bidders are required to offer reputed equipment / component which is strictly meeting technical requirements, enclosed specifications along with NIT and other relevant / latest applicable Standards & Rules.

LIST OF PREFERRED VENDORS

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Name of Items</th>
<th>List of approved manufacturers / brand / applicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Civil Works</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>Cement</td>
<td>ACC / Grasim / Ambuja / Ultratech / Lafarge or equivalent</td>
</tr>
<tr>
<td>2.</td>
<td>Reinforcement Steel TMT Bars (Fe 500 grade) &amp; TMT Re-bars conforming to IS 1786-2008 Fe500 corrosion resistant steel grade</td>
<td>SAIL, TISCO, RINL JINDAL STEEL &amp; POWER LTD, JSW STEEL LTD. or equivalent</td>
</tr>
<tr>
<td>3.</td>
<td>Structural Steel, MS Plates, ISMB Etc.</td>
<td>SAIL, Tata Steel Limited, Rashtriya Ispat Nigam Ltd. (RINL), Apollo, Jindal Steel or equivalent</td>
</tr>
<tr>
<td>5.</td>
<td>Hardware Like: Mortice Lock With Pair Of Handles, Recess Handle Fittings, Floor Spring, DoorCloser, Tower Bolts, Floor door stoppers Etc.</td>
<td>Dorma GMBH &amp; Co.KG , D-Line Carl F International, Assa Abloy,Hafele India (P) Ltd</td>
</tr>
<tr>
<td>7.</td>
<td>Flush Doors/ Ply</td>
<td>Greenply Industries Limited, Century Plyboards (I) Ltd, Archid ply,Merino ply</td>
</tr>
<tr>
<td>No.</td>
<td>Item Description</td>
<td>Suppliers</td>
</tr>
<tr>
<td>-----</td>
<td>------------------------------------------------------</td>
<td>---------------------------------------------------------------------------</td>
</tr>
<tr>
<td>15.</td>
<td>S.S. Sink</td>
<td>Nirali, Franke, Kitchen Queen</td>
</tr>
<tr>
<td>16.</td>
<td>G.I. Pipe</td>
<td>Tata Steel Limited, Jindal Pipe Industries, Parkash</td>
</tr>
<tr>
<td>17.</td>
<td>CPVC Pipes</td>
<td>Supreme/ Prince/ Ori-Plast, Surya</td>
</tr>
<tr>
<td>19.</td>
<td>Tile Adhesive</td>
<td>FERROUS CRET (FERRO-1122)/ARDEX ENDURE (GOLD STAR)/PIDILITE (FEVIMATE XL)</td>
</tr>
<tr>
<td>20.</td>
<td>Glass Mirror</td>
<td>Modi Guard, Atul Ltd</td>
</tr>
<tr>
<td>23.</td>
<td>STONE ADHESIVE</td>
<td>FERROUS CRETE (FERRO-113)/ARDEX ENDURA (DIAMOND STAR)/PIDILITE (ROFF STONE ADHESIVE)</td>
</tr>
<tr>
<td>24.</td>
<td>PLASTIC EMULSION PAINT</td>
<td>ICI (SUPER SMOOTH), NEROLAC (BEAUTY GOLD), ASIAN PAINTS (PREMIUM EMULSION/ PROFESSIONAL INTERIOR EMULSION), ACRO PAINT (ACRO PERAL).</td>
</tr>
<tr>
<td>25.</td>
<td>ROOF TILES</td>
<td>THERMATEK, INSUTILE, INSULA</td>
</tr>
<tr>
<td>26.</td>
<td>DASH,ANCHORING FASTENERS</td>
<td>HILTI, FISCHER, CANON, AXEL, BOUN</td>
</tr>
<tr>
<td>27.</td>
<td>Epoxy grout</td>
<td>FERROUS CRET /ARDEX ENDURE /PIDILITE</td>
</tr>
</tbody>
</table>

B Sanitary Items

<table>
<thead>
<tr>
<th>No.</th>
<th>Item Description</th>
<th>Suppliers</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.</td>
<td>Plastic W.C Seats with cover (Except where to be supplied)</td>
<td>ADMIRAL, COMMANDER</td>
</tr>
<tr>
<td>No.</td>
<td>Item Description</td>
<td>Brands</td>
</tr>
<tr>
<td>-----</td>
<td>-------------------------------------------------------</td>
<td>---------------------------------------------</td>
</tr>
<tr>
<td>3.</td>
<td>Hand dryer/ Tissue paper holder</td>
<td>EURONICS, UTEC, JAQUAR</td>
</tr>
<tr>
<td>4.</td>
<td>Liquid Soap Dispensor</td>
<td>EURONICS, KIMBERLEY CLARK, UTEC</td>
</tr>
<tr>
<td>5.</td>
<td>Air Purifier / Aerosol Dispenser</td>
<td>EURONICS, UTEC, JAQUAR</td>
</tr>
<tr>
<td>6.</td>
<td>C.P Bottle Trap</td>
<td>JAQUAR, VIJAY METAL WORKS</td>
</tr>
<tr>
<td>7.</td>
<td>Multi-Pan WC Connector</td>
<td>VIEGA, MCALPINE</td>
</tr>
<tr>
<td>8.</td>
<td>C.P fittings</td>
<td>Kohler, JAQUAR, PARRYWARE/ ROCA,</td>
</tr>
<tr>
<td>9.</td>
<td>Stainless Steel Sink</td>
<td>AMC, JAYNA, NEELKANTH</td>
</tr>
<tr>
<td>10.</td>
<td>Electrical Water Heater / Geyser</td>
<td>VENUS, BRAUN, AO SMITH</td>
</tr>
<tr>
<td>11.</td>
<td>R.O. Drinking water system</td>
<td>EUREKA FORBES, SIMA LABS, ION EXCHANGE</td>
</tr>
<tr>
<td>12.</td>
<td>CP / SS Grating for Floor Trap &amp; Floor Drain</td>
<td>VIJAY METAL WORKS, ACO, NEER</td>
</tr>
<tr>
<td></td>
<td><strong>PLUMBING LOW SIDE (PIPES &amp; FITTINGS)</strong></td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>G.I. pipes</td>
<td>TATA, JINDAL, SURYA PARKASH</td>
</tr>
<tr>
<td>4.</td>
<td>CPVC Pipes</td>
<td>ASTRAL FLOWGUARD, ASHIRVAD FLOWGUARD</td>
</tr>
<tr>
<td>5.</td>
<td>SS Pipes</td>
<td>JINDAL STAINLESS, RAMPART</td>
</tr>
<tr>
<td>6.</td>
<td>UPVC pipes</td>
<td>SUPREME, AKG, FINOLEX, PRINCE, SURYA PARKASH, JAIN PIPE</td>
</tr>
<tr>
<td>7.</td>
<td>HDPE Pipes</td>
<td>JAIN PIPES, ORIPLAST, VERTEX</td>
</tr>
<tr>
<td>8.</td>
<td>Sand Cast Iron Pipes &amp; fittings</td>
<td>NECO, HEPCO, BIC, RIF</td>
</tr>
<tr>
<td>9.</td>
<td>SWR Pipes</td>
<td>FINOLEX, AKG, SUPREME, PRINCE</td>
</tr>
<tr>
<td>10.</td>
<td>Stoneware pipes &amp; Gully Trap</td>
<td>ANAND, BK CERAMICS INDUSTRY, BASANT INDUSTRIES</td>
</tr>
<tr>
<td>11.</td>
<td>CILA pipes</td>
<td>KESORAM, NECO, BIC, ELECTROSTEEL</td>
</tr>
<tr>
<td>12.</td>
<td>C.I. fittings</td>
<td>NEEL, KARTAR, BIC, SARKAR</td>
</tr>
<tr>
<td>13.</td>
<td>Insulation For Hot water Pipes</td>
<td>KAIFLEX, ARMAFLEX, THERMAFLEX</td>
</tr>
<tr>
<td></td>
<td>Insulation For External / Exposed Hot water Pipes</td>
<td>KAIFLEX, ARMAFLEX</td>
</tr>
<tr>
<td>---</td>
<td>-------------------------------------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>14</td>
<td>Pipe protection For External Water Supply Pipes</td>
<td>PYPKOTE, MAKPOLYKOTE, ARMAFLEX</td>
</tr>
</tbody>
</table>

### PLUMBING LOW SIDE (VALVES & RELATED ACCESSORIES)

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gunmetal Fullway Valve</td>
<td>ZOLOTO, LEADER, SANT</td>
</tr>
<tr>
<td>2</td>
<td>Gunmetal Fullway Valve</td>
<td>LEADER, SANT, ZOLOTO</td>
</tr>
<tr>
<td>3</td>
<td>Ball valve</td>
<td>ARCO, CIM, TIEMME</td>
</tr>
<tr>
<td>4</td>
<td>Ball valve w/ In-Built Filter</td>
<td>ARCO, RB</td>
</tr>
<tr>
<td>5</td>
<td>Butterfly Valve</td>
<td>KSB, SKS, AIP</td>
</tr>
<tr>
<td>6</td>
<td>Air Release Valve</td>
<td>RBM, TIEMME, SKS</td>
</tr>
<tr>
<td>7</td>
<td>Float valve (gunmetal) upto 40mm</td>
<td>LEADER, CSE ENGINEERS, APAR</td>
</tr>
<tr>
<td>8</td>
<td>Float valve (C.I) 50mm and above</td>
<td>LEADER, CSE ENGINEERS, APAR</td>
</tr>
<tr>
<td>9</td>
<td>Altitude / Equilibrium Float Valve</td>
<td>CSA, HONEYWELL, DANFOSS</td>
</tr>
<tr>
<td>10</td>
<td>C.I Strainer more than 65mm dia.</td>
<td>LEADER, SANT, AIP</td>
</tr>
<tr>
<td>11</td>
<td>Pressure Reducing Valve</td>
<td>RBM, TIEMME, SKS</td>
</tr>
</tbody>
</table>

### PLUMBING EXTERNAL ITEMS

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>C.I Manholes cover</td>
<td>NECO, KARTAR, BIC, RIF</td>
</tr>
</tbody>
</table>

### ELECTRICAL WORK

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>11KV VCB Panel Board With Built in HT AVR</td>
<td>ABB-Ambit Switchgears. Schneider - Sudhir Siemens (APSPL) or equivalent</td>
</tr>
<tr>
<td>2</td>
<td>Distribution Transformer (Oil Type) (OLTC Type)</td>
<td>Crompton Greaves Intra Vidyut Ltd Kirloskar Voltamp ESENNAR or equivalent</td>
</tr>
<tr>
<td>3</td>
<td>Package / Compact Type Substation</td>
<td>ABB ESENNAR Schneider - Sudhir or equivalent</td>
</tr>
<tr>
<td></td>
<td>Description</td>
<td>Manufacturers</td>
</tr>
<tr>
<td>---</td>
<td>-------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>4</td>
<td>Main L.T. Panel, Capacitor Panel &amp; AMF Panel</td>
<td>Adlec Systems Pvt. Ltd.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Advance Panel &amp; Switchgear (P) Ltd.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Sudhir Gensets Ltd.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Jakson Engineers Ltd.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conquerent Controls Pvt. Ltd. (Madhu Electrical)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or equivalent</td>
</tr>
<tr>
<td>5</td>
<td>Air Circuit Breaker</td>
<td>Schneider Electric (Master pact – MVS)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Siemens (3 WT)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>L&amp;T (C Power)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Eaton Power Quality Pvt. Ltd.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or equivalent</td>
</tr>
<tr>
<td>6</td>
<td>Moulded Case Circuit Breaker with rotary operating handle.</td>
<td>L &amp; T (D Sine &amp; DH Range)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Siemens (3VT)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Schneider (Compact CVS)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Eaton Power Quality Pvt. Ltd.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or equivalent</td>
</tr>
<tr>
<td>7</td>
<td>Contactors, Timers, HRC Fuses, Fuse Fitting, Indicating Lamps.</td>
<td>L &amp; T</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Siemens</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Schneider Electric</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or equivalent</td>
</tr>
<tr>
<td>8</td>
<td>Miniature Circuit Breaker</td>
<td>Schneider Electric (Multi-9)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Legrand</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Hager</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or equivalent</td>
</tr>
<tr>
<td>9</td>
<td>Capacitor</td>
<td>L &amp; T</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EPCOS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Matrix</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or equivalent</td>
</tr>
<tr>
<td>10</td>
<td>APFC Relay (Microprocessor based)</td>
<td>Conzerv</td>
</tr>
<tr>
<td></td>
<td></td>
<td>L &amp; T</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EPCOS</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Trinity</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or equivalent</td>
</tr>
<tr>
<td>11</td>
<td>Protective Relays</td>
<td>L &amp; T</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Alstom</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conzerv</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or equivalent</td>
</tr>
<tr>
<td>12</td>
<td>Energy Analyser Meter</td>
<td>L &amp; T</td>
</tr>
<tr>
<td></td>
<td></td>
<td>AMTL</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Secure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EL-Measure</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Conzerv</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or equivalent</td>
</tr>
<tr>
<td>13</td>
<td>Current Transformer</td>
<td>AE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kappa</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Newtek Electricals (Aurangabad)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or equivalent</td>
</tr>
<tr>
<td>14</td>
<td>Voltmeter, Ammeter Selector Switch</td>
<td>AE</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Rishline (L &amp; T)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>MECO</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kaycee</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or equivalent</td>
</tr>
<tr>
<td>15</td>
<td>Indicating Lamp</td>
<td>L &amp; T</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Siemens</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Kaycee</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or equivalent</td>
</tr>
<tr>
<td></td>
<td>Item Description</td>
<td>Manufacturer(s)</td>
</tr>
<tr>
<td>---</td>
<td>----------------------------------------------------------------------------------</td>
<td>-------------------------------------------</td>
</tr>
<tr>
<td>16</td>
<td>PLC</td>
<td>Allan Bradley Siemens or equivalent</td>
</tr>
<tr>
<td>17</td>
<td>L.T. Wire &amp; Cable, 1.1 KV grade XLPE Insulated AL Conductor AR Cable.</td>
<td>Havell’s KEI Finolex Skytone Polycab or equivalent</td>
</tr>
<tr>
<td>18</td>
<td>XLPE 11 KV Cable</td>
<td>Skytone Gloster Havell’s Nicco or equivalent</td>
</tr>
<tr>
<td>19</td>
<td>Termination Kits (Heat shrinkable Type)</td>
<td>Raychem Xicon (CCI) Denson or equivalent</td>
</tr>
<tr>
<td>20</td>
<td>Cable Lug (Tinned Copper)</td>
<td>Dowells Multi Capital Action or equivalent</td>
</tr>
<tr>
<td>21</td>
<td>Cable Gland</td>
<td>Peeco Commet Gripwell Dowells or equivalent</td>
</tr>
<tr>
<td>22</td>
<td>Cable Tray</td>
<td>Fedders Lloyd Corp. Ltd Slotco Pillco Indiana or equivalent</td>
</tr>
<tr>
<td>23</td>
<td>Battery Charger</td>
<td>Uptron Volstat Electronics AE Statcon or equivalent</td>
</tr>
<tr>
<td>24</td>
<td>Batteries</td>
<td>Exide Standard Furukawa Prestolite or equivalent</td>
</tr>
<tr>
<td>25</td>
<td>MS &amp; GI Pipes</td>
<td>Jindal - Hissar Jindal Star (above 150MM) Tata or equivalent</td>
</tr>
<tr>
<td>26</td>
<td>MS Conduit &amp; Accessories (ISI Marked)</td>
<td>BEC, AKG, Gupta or equivalent</td>
</tr>
<tr>
<td>27</td>
<td>PVC Conduit (ISI Marked)</td>
<td>BEC, Precision, AKG, S &amp; G Control &amp; Switchgear (P) Ltd., Polypack</td>
</tr>
<tr>
<td>28</td>
<td>Telephone Wires</td>
<td>Skytone, Bonton, Polycab, Finolex, Havells</td>
</tr>
<tr>
<td>No.</td>
<td>Description</td>
<td>Brands</td>
</tr>
<tr>
<td>-----</td>
<td>------------------------------------</td>
<td>--------------------------------------</td>
</tr>
<tr>
<td>29</td>
<td>Modular Type Light &amp; Power Accessories (Switches, Socket etc.) M.S. Switch Boxes Series</td>
<td>Legrand, Schneider Electric, L&amp;T, Wipro</td>
</tr>
<tr>
<td>30</td>
<td>Ceiling Fan</td>
<td>Orient, Usha, Crompton, Havells</td>
</tr>
<tr>
<td>31</td>
<td>Exhaust Fan</td>
<td>Alstom, Usha, Havells</td>
</tr>
<tr>
<td>32</td>
<td><strong>Light Fixtures &amp; Lamps</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(a) Fluorescent Light Fixtures, CFL &amp; LED lights</td>
<td>Wipro, Philips, Eglo, HPL, Siemens</td>
</tr>
<tr>
<td>33</td>
<td><strong>Fire Fighting &amp; Prevention Works</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Fire Extinguisher</td>
<td>Supercr, Lifeguard, Safeguard</td>
</tr>
<tr>
<td>34</td>
<td><strong>Diesel Generator Set</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>a Diesel Engine</td>
<td>Cumins - Sudhir Genesets Ltd</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Caterpillar</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Perkins</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Volvo Penta</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or equivalent</td>
</tr>
<tr>
<td></td>
<td>b Alternator</td>
<td>Kirloskar Electric Company</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Stamford</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Leroy somer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>or equivalent</td>
</tr>
</tbody>
</table>
# LIST OF TENDER DRAWINGS

## LIST OF DWG. OF POWER SUPPLY PACKAGE FOR CENTRAL UNIVERSITY (JAMMU)

<table>
<thead>
<tr>
<th>S.NO</th>
<th>DRAWING TITLE</th>
<th>DRAWING NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SITE PLAN ESS &amp; COMPACT TYPE SUBSTATION, LT CABLE ROUTE LAYOUT</td>
<td>ESC/CUJ/EL-SITE-02</td>
</tr>
<tr>
<td>2</td>
<td>SINGLE LINE DIAGRAM FOR ESS</td>
<td>ESC/CUJ/SS-SLD-01</td>
</tr>
<tr>
<td>3</td>
<td>ESS PLAN</td>
<td>ESS/A-01</td>
</tr>
<tr>
<td>4</td>
<td>CABLE SCHEDULE FOR LT CABLE</td>
<td>ESC/CUJ/EL-SITE-02 (LT)</td>
</tr>
<tr>
<td>5</td>
<td>EXTERNAL LIGHTING LAYOUT PHASE-1 (PART PLAN-1)</td>
<td>ESC/CUJ/EXT/L-01</td>
</tr>
<tr>
<td>6</td>
<td>EXTERNAL LIGHTING LAYOUT PHASE-1 (PART PLAN-2)</td>
<td>ESC/CUJ/EXT/L-01</td>
</tr>
<tr>
<td>7</td>
<td>GROUND, FIRST &amp; TERRACE FLOOR PLAN – ESS1 (PLUMBING DWG.)</td>
<td>MKG/PL/CUJ/ESS-01</td>
</tr>
<tr>
<td>8</td>
<td>GROUND, FIRST &amp; TERRACE FLOOR PLAN – ESS2 (FIRE FIGHTING)</td>
<td>MKG/PL/CUJ/ESS-02</td>
</tr>
<tr>
<td>9</td>
<td>SINGLE LINE DIAGRAM FOR CSS</td>
<td>ESC/CUJ/SS-SLD-02</td>
</tr>
</tbody>
</table>