AN ISO 9001 & 14001 COMPANY

TENDER DOCUMENT

TENDER No: DLI/CON/752/565

FOR

Construction of Modernized and Technologically Advanced Work Centres and other Buildings for Offices and State-of-The-Art Research Development Centre at ALIMCO, Kanpur (U.P.).

VOLUME - II

Additional Conditions of Contract & Technical Specifications, Drawings
ADDITIONAL CONDITIONS OF CONTRACT (ACC)

1.0 The following Additional Conditions of Contract shall be read in conjunction with General Conditions of Contract. If there are any provisions in these Additional Conditions of Contract, which are at variance with the provisions of General Conditions of Contract, the provisions in these Additional Conditions of Contract shall take precedence.

2.0 INTRODUCTION

Artificial Limbs Manufacturing Corporation of India (ALIMCO), Kanpur under the Ministry of Social Justice and Empowerment, Department of Empowerment of Persons with Disabilities, Govt. of India intends to construct of Modernized and Technologically Advanced Work Centers and other Buildings for Offices and State-of-The-Art Research Development Center at ALIMCO, Kanpur (U.P.).

3.0 APPROACHES TO WORKSITE

The contractor shall make his own arrangement for approach to work site including borrow/ disposal area and for movement of men, materials, machineries, other equipment etc. required for carrying out the work under this contract.

The access roads/ path to the work site may not be available at all places and at all time. The contractor shall plan his work as per the availability of access roads/ path at site. All drainage of works area and all weather truck able haulage roads as required by the contractor shall be constructed and maintained during the construction period by the contractor at his own cost, including portions of the road already existing.

4.0 WATER AND ELECTRICITY

In addition to clause no. 44 in GCC, Water and Electricity connection can be provided by ALIMCO/EPI if available, at one point and further distribution shall be made by contractor at his own cost. The recovery of Water and Electricity charges shall be made on actual basis. Necessary Electricity / Water meter shall be arranged by contractor at his own cost.

The contractor is advised to quote his rates for different works considering the above factors.

5.0 SCOPE OF WORK INCLUDED IN THE CONTRACT

The brief scope of work as mentioned below included in this tender shall include (but not limited to) Civil, Structural works (PEB), External & Internal Electricals, Plumbing, Water supply, Fire Fighting, Landscaping, Road development and Solar Lighting system etc. for Construction of Modernized and Technologically Advanced Work Centers and other Buildings for Offices and State-of-The-Art Research Development Center at ALIMCO, Kanpur (U.P.).
6.0 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), NIT 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/ ALIMCO in this regard shall be final & binding on the bidders.

7.0 SPECIFICATIONS

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

7.2 The work in general shall be carried out as per latest CPWD specifications for Civil Works (updated with correction slips issued upto last date of submission of tender) and latest CPWD specification for electrical works (updated with correction slips issued up to last date of submission of tender) unless otherwise specified in the nomenclature of the individual item or in the particular specifications of concerned items of works.

7.3 For items not covered under latest CPWD specification, for Civil Works / latest CPWD specification for Electrical Works and in particular specification, Technical specification or nomenclature of the individual item as above, the work shall be done as per latest relevant IS codes of practice.

7.4 In case specification are not covered under para 7.1 to 7.3 above the work shall be carried out as per the provisions of technical specification given in Vol. II.

7.5 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.

7.6 Thermo Mechanically Treated bars conforming to IS: 1786, Fe 500 grade as required, from approved manufacturers viz SAIL/RINL/TISCO shall be used. The other provisions of clause 45.2 of G.C.C. remain unchanged.

The structural steel used on the works shall also be by prime manufacturers i.e. SAIL, TISCO, RINL.

7.7 The Portland Pozzolona Cement (PPC) as per IS:1489-1991 or ordinary Portland Cement (OPC) as per IS:8112 shall be used in the works, however difference in price of PPC & OPC cement if is there shall be recovered from the contractor. The other provisions of clause 45.1 of GCC remain unchanged.

7.8 Specified material viz: cement, steel, structural steel etc shall be used. Material other than specified can be used only with prior approval of client/EPI and recovery at
prevailing market rate shall be done if material other than specified shall be used.

7.9 The contractor is responsible for executing and completing the work in accordance with the specified standards and specification and as per requirements of GOLD rating of GRIHA. 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

7.10 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 deemed to be included in the item rates quoted by the contractor and nothing shall be paid as an extra on this account.

7.11 Specialized work will be carried out by the specialized agency duly approved by Engineer Incharge.

7.12 Contractor will ensure the compliance with CPWD norms, CTE, CVC and any other guidelines of Govt. of India.

7.13 Contractor shall be responsible for the consequential effects arising out of the inspection of the project by the Chief Technical Examiner Cell, Central Vigilance Commission. CAG or any other statutory body during the progress or any time after the completion of project and shall take appropriate action including submission of documentary support, records, replies etc. rectification of defective work at the risk and cost of the Contractor. Rectification of defective work/ replacement of substandard as pointed out by Chief Technical Cell, CVC, ALIMCO/ EPI or his authorized representative shall be carried out by Contractor at their own cost. ALIMCO/ EPI shall not be directly responsible to submit requisite information/ details or pay any extra amount for such type of queries/ liabilities.

8.0 Clause No.69.1 (IV) of GCC stands modified as under:

If the rates for the altered, additional or substituted work cannot be determined in the manner as specified in the DSR, 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.
9.0 **The clause No.72.1 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 submitted by contractor and agreed by Engineer Incharge so that the activities are completed in the period allowed in the completion schedule as given in Additional Conditions of Contract (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 in ACC. If the Contractor fails to maintain the above progress or to complete the work 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. Compensation for delay shall be charged @0.5% of the balance value of work per week of delay, subject to maximum of 10% of the balance value of work.

10.0 **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.

11.0 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.

12.0 Clause no 1.0 of Instructions to Tenders i.e. Mode of submission shall also include the following paras:

(a) The Envelope-1 shall also contain the documents meeting the eligibility criteria mentioned in “Notice Inviting Tender and “INSTRUCTIONS TO TENDERERS”.

(b) The tenderer who download the tender documents directly from EPI’s website shall have to submit tender fees of Rs. 25,000/- (Twenty Five Thousand only) (Non-Refundable) by Crossed Demand Draft favouring “Engineering Projects (India) Ltd.”, payable at New Delhi along with their bid in Envelope-1.

13.0 CLAUSE NO.1.1 OF INSTRUCTIONS TO TENDERERS as given in Page (2) of INSTRUCTIONS TO TENDERERS stands amended as below:

First the Envelope-1 of the tenderer shall be opened. Tenderers who unconditionally accept the tender conditions, deposit the required Earnest Money, meet the eligibility criteria mentioned in NIT, deposit the tender fees and whose Techno-Commercial Bid is found suitable, shall be considered for the opening of their Price Bid and Envelope-2 of such tenderers shall be opened. The Tenders not accompanied by requisite Earnest Money and/or not accompanied by the requisite tender fees and / or not conveying un-conditional acceptance of tender conditions and / or not meeting the eligibility criteria or whose Techno-Commercial Bid are not found acceptable, shall be rejected and such tenderer shall not be allowed to attend Price Bid opening i.e. opening of Envelope-2.

14.0 Bidders must submit the unpriced copy of the price bid duly stamped & signed along with other documents in the techno-commercial bid as a confirmation of having quoted for all items of the price bid.

15.0 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
cope. 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 and structural 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.

16.0 SITE LABORATORY

As part of the contract the contractor shall provide and maintain a site laboratory for the routine testing of construction material under the direction and general supervision of Engineer-in-charge. The laboratory room shall be constructed and installed with the appropriate facilities. Temperature and humidity controls shall be made available wherever necessary during the testing of samples.

All equipments shall be provided by the contractor so as to be compatible with the specified testing requirements. The contractor shall maintain the equipment in good working conditions for the duration of the contract.

The Contractor shall provide approved qualified personnel to run the laboratory for the duration of the contract. The number of staff and equipment available must at all times be sufficient to keep pace with the sampling and testing programme as required by Engineer-in-charge. The laboratory Incharge of the contractor shall report to Engineer-in-charge.

The Contractor shall fully service the site laboratory and shall supply everything necessary for its proper functioning, including all transport needed to move equipment and samples to and from sampling points on the site etc.

The Contractor shall re – calibrate all measuring devices whenever so required by the Engineer-in-charge and shall submit the results of such measurements without delay.

For all other tests as required by Engineer-in-charge, the Contractor shall get the same carried out / conducted by approved testing Laboratory. In addition if, EPI/ALIMCO feels, may direct the Contractor to conduct the tests in the presence of EPI/ALIMCO representative at site lab / outside labs. All expenses payable for transport of samples and conduction of tests shall be borne by the contractor.
17.0 VARIATION IN TAXES, DUTIES, LEVIES & IMPOSITION OF NEW TAXES ETC:

i) The price bid shall be inclusive of work contract tax / VAT / GST / Labour Cess or any other tax levied on the transfer of property and goods involved in the “Works Contract” in accordance with the relevant Act in the State Act and rules made there under including amendments, if any. The liability on account of such tax as per the rates of tax prevailing as on seven days prior to last date of bid submission shall be included in the price bid. In case of any variation in the rates of tax after this date, the same shall be paid / recovered from the contractor subject to the submission of documentary evidence and proof of having made the payment at the revised rate.

ii) The price bid shall also be inclusive of Service tax, if applicable on Construction Service as per the rates prevailing as on seven (7) days prior to the last date of submission of tender (including abatement as applicable). In case of any variation in the rate of Service Tax, after this date, an equitable adjustment of the Contract Price shall be made to fully take into account any such change by addition / deduction to the Contract Price.

iii) If a new tax, duty or levy is imposed under statute or law in India after the date seven (7) days prior to the last date of submission of tender and the contractor becomes liable there under to pay and actually pays the said new tax, duty or levy for bonafide use on the works contracted, the same shall be reimbursed to the contractor against documentary evidence of proof of payment, provided that the amount thus claimed is not paid / payable under price variation provision of the Contract.

iv) The payment / reimbursement of statutory variations in the rates of tax and / or of new tax, duty or levy imposed under statute or law in India as per para (i), (ii) & (iii) above, would be restricted only to direct transaction between the EPI and the Contractor.

v) Rates shall remain firm till completion of entire works and shall be inclusive of all taxes, Entry tax, duties, Octroi, Royalties, VAT / WCT/GST or any other similar tax in the state concerned, Labour Cess and other levies etc. as applicable.

18.0 PRICE VARIATION

No price variation is allowed in this contract since it is a firm rate contract till completion of work.

19.0 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.

20.0 For dispatch of materials to site, equipment manufacturer / supplier shall mark consignee as self A/c Artificial Limbs Manufacturing Corporation of India (ALIMCO) through Engineering Projects (India) Ltd (EPI).

21.0 GENERAL

21.1 Flooring works shall be executed as per the approved drawings / design & specifications. The pattern shown in the tender drawings, if any, can be modified as per the site requirements by Engineer-in-Charge within the proportions of the flooring materials to be provided and nothing extra whatsoever shall be payable over and above the rate quoted.

21.2 The water proofing for the terraces, underground tanks / toilet floor etc. shall be got executed only through the authorized applicators of the manufacturers and the guarantee for the same shall be in the name of EPI / owner for a period of ten years after the expiry of defect period liability on the prescribed format given in the GCC.

21.3 Plumbing & Sanitary work to be executed by licensed plumber and the plumbing scheme / drawing to be got approved from statutory authorities through the appointed licensed plumber without any extra cost. The agency shall have to submit the valid license of plumbers before starting the work.

21.4 SCI pipes for sanitary and GI pipes for water supply if fixed in RCC members like columns, beams etc. shall be fixed with scrub plugs.

21.5 The contractor shall be responsible for all protection of sanitary, water supply, electrical fittings & fixture against pilferage, breakage during period of installation until the completion of work and handed over to EPI.

21.6 Welding wherever required in the work like in grill, railing etc shall be done in full length of the contact area and grinding shall be done properly to get an even
surface. SFRC covers for manholes etc, if provided, shall have name of owner / client and year of manufacturer as engraved.

21.7 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.

21.8 It will be the sole responsibility of contractor to obtain all statutory approvals / compliance required for construction / implementation of the project including right of way Forest clearance and completion clearance from the all relevant statutory bodies for plumbing, sewerage, sanitary and PHE work, fire department for fire protection, fire fighting, fire fighting installation, electrical works etc. and 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 / owner with the local bodies will also have to be done by the contractor. Nothing extra shall be payable to contractor on this account.

21.9 The contractor shall erect MS sheet fencing along the periphery of the site as per drawing of EPI with proper colour as directed by the Engineer-in-Charge and name / logo, safety slogan etc. written at appropriate places within ten days of issue of LOI. The contractor shall be responsible for daily cleaning of this fencing with water etc. to keep the fencing in neat & clean condition at all times. The damaged fencing should be replaced immediately by the contractor. The cost of MS sheet fencing, its maintenance etc. is deemed to be included in the quoted rates. The contractor shall engage sufficient number of security guards at his cost to ensure controlled entry to site and not to allow unauthorized personnel at site.

21.10 The tenderers shall make necessary safety arrangements at site including as mentioned in GCC and indemnify EPI against any consequence of accident at site.

EPI is awarding this Contract on behalf of ALIMCO. In case M/s. EPI cease to be an agency for the project, the right and responsibility etc. of EPI in the Contract shall get transferred to ALIMCO or their nominated agency shall operate this Contract.

22.0 ROAD PERMIT

Road permit for transportation of goods across state border shall not be issued by ALIMCO / 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.

23.0 Invoice should be raised by Contractor in the name of Engineering Projects (India) Ltd., at Project Site Office.

24.0 MOBILIZATION ADVANCE

Interest bearing Mobilization Advance is applicable in this contract as clause no 8.0 of GCC. The recovery of Mobilization Advance paid shall be commenced after @10% of work is completed and the entire amount together with interest shall be recovered by the time 80% of work shall be completed.
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.

Structural soundness of the Building: Contractor shall be responsible for structural soundness of the project in all respects and a certificate thereon shall be furnished by Contractor to the ALIMCO/ EPI on the completion of work.

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 as above 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. However, the contractor has to deploy following minimum plant & machinery in good condition at site immediately after award of work.

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<tr>
<th>S. No.</th>
<th>Description</th>
<th>Minimum Number Required</th>
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<tbody>
<tr>
<td>1.</td>
<td>Total station for surveying work.</td>
<td>One</td>
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<tr>
<td>2.</td>
<td>Vibrators (Petrol / Electrical)</td>
<td>Six</td>
</tr>
<tr>
<td>3.</td>
<td>Needles of Vibrator</td>
<td>Twelve</td>
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<tr>
<td>4.</td>
<td>Excavator/Poclain</td>
<td>One</td>
</tr>
<tr>
<td>5.</td>
<td>Tipper / Dumper (3 cum.)</td>
<td>Two</td>
</tr>
<tr>
<td>6.</td>
<td>DG Set (63 KVA &amp; 125 KVA)</td>
<td>One Each</td>
</tr>
<tr>
<td>7.</td>
<td>Leveling Instruments</td>
<td>One</td>
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8. Water Tanker  

9. Concrete Mixture machine with weigh batcher 14/10 capacity  

10. Tractor with trolley for transportation of material  

11. The agency shall provide sufficient area lighting for the safe execution of works during night hours through static / mobile arrangements.  

12. Laboratory equipments  

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**Note:**

a) In addition to above contractor has to arrange sufficient plant & machineries to complete the work as per completion schedule.

b) Any other equipment for site test as outlined in CPWD / BIS specification and as directed by the Engineer-in-charge.

c) The quantities of equipments mentioned above are indicative only and can be increased as per the requirement of quantum work OR as per the direction of Engineer-in-Charge. The above equipment list is indicative and not complete. The contractor has to deploy all the required equipment to complete all the works within stipulated specifications and time period as per contract documents.

d) The contractor will not be allowed to take out equipments from the site without the written permission of Engineer-in-charge.

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

**27.0 CENTERING & SHUTTERING**

27.1 Centering & shuttering works for columns shall be made out of laminated shuttering plywood of minimum 12mm thickness as per BIS, with angle iron frame. The staging system shall be got approved from the Engineer-in-charge. Scaffolding of latest materials/round steel pipes with couplers and brackets shall be used. Wooden planks, props, ballies etc are not permitted for use and steel plate shuttering is also not permitted.

27.2 The shuttering used for beam shall be of laminated shuttering plywood as per BIS. The support system shall be integrated with the slab. For slabs in case ply wood shutters is not used, (because of site or practical consideration) welded steel plates will be allowed to be placed in uniform pattern. The thickness of plates and pattern to be got approved from the Engineer-in-charge.

27.3 All joints in the shuttering i.e. plate to plate etc shall have to be sealed with adhesive / foam, to ensure water tightness of the form work.
27.4 All shuttering work for Architect features shall be with fiber glass moulds and the rate quoted by the contractor in the schedule of rate shall be inclusive of same.

27.5 All shuttering joints in the slab, beams and lintels etc. shall be treated with tape of required width to make it water tight and the rates quoted for centering shuttering work shall be all inclusive and nothing extra whatsoever shall be payable over and above the quoted price.

27.6 The shuttering shall be tightened by using runners, tie rods and bracings. No Ghughoo / welded system shall be allowed. Support shall be adequate and proper.

28.0 CONCRETING

28.1 The concreting shall be done by mixture machine with weigh batcher 14/10 hr capacity.

28.2 Alternatively, the contractor may opt to use Ready Mixed Concrete (within 50km distance from the site of work) of repute after obtaining prior written approval from the Engineer-in-charge at his own cost. No extra payment shall be made on this account.

Ready mix concrete brought from outside sources or produced at site shall have minimum quantity of cement as specified in BIS specifications and as per approved design mix.

28.3 The batching plant of minimum capacity of 30cum./hr. with a least count of 0.5kg, drum type four load cells, computer compatible print out for each batch only shall be allowed.

28.4 The concreting shall be placed by concrete pumps of required capacity. Concreting by crane and buckets will be allowed in rare case with the prior approval of Engineer-in-charge.

28.5 The contractor shall provide construction joints only at the specified positions and as per BIS codes and the concreting for columns shall be floor to beam height in one lifts, and in case the concreting is to be done in two lifts the minimum height of first lift of columns shall be 2.4 meters.

28.6 The stone aggregate and sand of required zone shall be from the quarries as approved by Engineer-in-charge. The samples of the materials shall be got approved along with the mix design.

28.7 Plasticizers of the required specification and make shall only be permitted as per approved mix design.

28.8 The contractor shall provide all cut outs in RCC work in co-ordination with other agencies and as per instructions of Engineer-in-charge and nothing extra shall be payable. In case the same is not provided by the contractor the same shall be got done at their risk and cost.
28.9 To ensure proper cover, only factory made approved cover blocks will be used to avoid displacement of bars in any direction.

28.10 The steel bars of different diameter should be stored about 30-45 cm. above ground level or on concrete surface to avoid corrosion of steel. No extra payment shall be made on this account.

29.0 DESIGN MIX CONCRETE

29.1 Design mix concrete shall be used in the work for all structural members. For design mix, CPWD specification along with relevant IS codes shall be followed in general along with the specific provisions made herein.

29.2 All parameters shall be adopted for design mix as per latest relevant BIS code.

29.3 Approved admixtures conforming to latest relevant IS code shall be permitted to be used. The chloride content in the admixture shall satisfy the requirement of latest IS code. The total amount of chloride content in the admixture mixed concrete shall satisfy the requirement of latest IS code.

29.4 The concrete mix design with and without admixture will be carried out by the contractor through one of the following laboratories/ Test houses to be approved by Engineer-in-charge.

- IIT, NIT only

29.5 In the event of all the above laboratories being unable to carry out the requisite design/ testing, the contractor shall have to get the same done from any other reputed Govt. approved laboratory with prior approval of the Engineer-in-charge.

29.6 The various ingredients for mix design/ laboratory tests shall be sent to the lab/test houses through the Engineer-in-charge and the samples of such ingredients sent shall be preserved at site by the department till completion of work or change in Design mix whichever is earlier. The sample shall be taken from the approved materials which are proposed to be used in the work.

29.7 The contractor shall submit the mix design report from approved laboratory for approval of Engineer-in-charge within 45 days from the date of issue of letter of acceptance of the tender. No concreting shall be done until the mix design is approved.

29.8 The contractor shall make cubes of trial mixes as per approved mix design for all grades of concrete in presence of the Engineer in charge using same ingredients as adopted for design mix, prior to commencement of concreting and get them tested in presence of Engineer-in-charge for 7 days and 28 days. For each design mix, a set of six cubes shall be prepared from each of the three consecutive batches. Three cubes from each set shall be tested at the age of 7 days and three cubes at the age of 28 days. The cubes shall be made, cured, transported and tested strictly in accordance with CPWD specifications. The average strength of nine cubes at the age of 28 days shall exceed the specified target mean strength for which design mix has been approved.
29.9 80% of the total tests shall be done at the laboratory established at site by the contractor and remaining 20% in the approved laboratory as directed by Engineer-in-Charge and the testing charges of the samples shall be borne by the contractor.

29.10 For each change of source or quality/characteristic properties of the ingredients from that approved & used in the concrete mix during the work, a fresh mix design shall be got done by the contractor. Revised trial mix test shall be conducted at laboratory established at site/reputed Laboratory with prior approval of Engineer-in-charge and shall be submitted by the contractor as per the direction of engineer-in-charge.

29.11 The cost of packaging, sealing, transportation, loading & unloading cost of all samples-concrete/cubes/steel/other material etc and the testing charges for mix design in all cases shall be borne by the contractor.

30.0 COMPLETION SCHEDULE

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Period from the date of Start</th>
<th>Cumulative Value as a percentage of total value of work to be completed till the end of period specified as under Column No. 2</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 the end of 3rd month.</td>
<td>30%</td>
<td>Completion of foundation up to plinth level.</td>
</tr>
<tr>
<td>2.</td>
<td>From the start of 4th month to the end of 9th month.</td>
<td>70%</td>
<td>Completion of structure/brick work of all buildings and Completion of 50% flooring, plastering, internal services of electrical and start of other services.</td>
</tr>
<tr>
<td>3.</td>
<td>From the start of 10th month to the end of 12th month.</td>
<td>90%</td>
<td>Completion of all balance civil work including electrical, plumbing etc.</td>
</tr>
<tr>
<td>4.</td>
<td>From the start of 13th month to the end of 15th month.</td>
<td>100%</td>
<td>Finishing of all the work and finally handing over the project to Client.</td>
</tr>
</tbody>
</table>

Note: In case of mismatch in financial and physical progress as above at any milestone stage, the financial progress shall be considered for levy of compensation of delay, if any. All infrastructural development works shall be completed within the stipulated time frame.
31.0 The contractor shall comply with legal orders, directions and by laws of local bodies / authorities. The contractor shall give to the Municipality, Police, Local Bodies and concerned Governmental authorities all necessary notices relating to works that may be required under the law and obtain all requisite licenses, permissions for temporary obstructions, enclosures, collection and stacking of materials, etc. The contractor shall pay at his own cost all fees, taxes and charges that may be liable on account of these operations in executing the contract. Nothing extra shall be paid by EPI on this account.

The contractor shall be bound to follow the instructions and restrictions imposed by the administration / Police authorities on the working and / or movement of labour, materials etc. nothing extra shall be payable due to less / restricted working hours at site or any detours in movement of vehicles.

32.0 INSPECTION, TESTING AND ACCEPTANCE

32.1 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/ALIMCO.

33.0 GUARANTEE

The contractor shall also guarantee the performance of individual equipment.

34.0 INSURANCE UNDER WORKMEN COMPENSATION ACT

The clause ‘18.0’ (Insurance Under WCA) at page 22 of General Conditions of Contract (GCC shall be replaced and read as under:

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 sub-section (1) of section 12, of the workmen’s Compensation Act, 1923 by the contractor and if the contractor fails to compensate, the EPI / ALIMCO shall be entitled to recover from the contractor the amount of the compensation so paid, without prejudice to the rights of the EPI / ALIMCO under section 12, sub-section (2), of the said Act.

EPI / ALIMCO 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 / ALIMCO 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 / ALIMCO might become liable in consequence of contesting such claim.

35.0 **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 ALIMCO, EPI and the Contractor for the contract period and 24 months after Successful completion / handling over of work. The Insurance coverage shall be on the total value of work awarded to contractor by EPI.

36.0 **Secured advance against Non-Perishable Materials as per clause no. 35.0 of GCC stands deleted in this contract.**

37.0 **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.

38.0 **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.

39.0 **The work shall be carried out in accordance with the drawings/documents approved by the EPI / ALIMCO. Before the commencement of any item of work, the contractor shall correlate all the relevant architectural and structural 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 carrying out surveying 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.**

40.0 **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.**
41.0 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.

42.0 SITE ENGINEER 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 is 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 Civil Engineer/Engineer – As a Principal Technical Representative/Project-in-charge</td>
<td>1</td>
<td>Atleast 20 years experience in execution of reputed project of multi-storey residential / non residential buildings / institutional buildings including external development work etc.</td>
</tr>
<tr>
<td>2.</td>
<td>Graduate Civil Engineer/Engineer – As a Project Manager</td>
<td>4</td>
<td>Atleast 10 years experience in execution of reputed project of multi-storey residential / non residential buildings / institute etc.</td>
</tr>
<tr>
<td>3.</td>
<td>Diploma Engineer (Civil) as a Site Engineer for execution of civil work.</td>
<td>5</td>
<td>Minimum 5 years experience in execution of multi-storey residential / non residential buildings / institute etc.</td>
</tr>
<tr>
<td>4.</td>
<td>Graduate/Diploma (Electrical) as a Site Engineer for execution of electrical work.</td>
<td>2</td>
<td>Atleast 5-8 years experience in execution of electrical work in multi-storey residential / non residential buildings / institute etc.</td>
</tr>
</tbody>
</table>
5. Graduate Civil Engineer for QA & QC work as an Incharge of Site Laboratory.  
   1 Atleast 8-10 years relevant experience in QC/QA work of institutional & residential building.

   2 Minimum 5 years experience in Surveying work of hilly terrain using total station.

7. Graduate/ Diploma Engineer as a Site Safety Engineer  
   1 Minimum 5 years experience in safety work of multi-storey residential / non residential buildings / institute etc.

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:

<table>
<thead>
<tr>
<th>Sl. No</th>
<th>Experience</th>
<th>Graduate /degree holder (INR P.M)</th>
<th>Diploma holder (INR P.M)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>20 years</td>
<td>1,00,000</td>
<td>70,000</td>
</tr>
<tr>
<td>2</td>
<td>10 years</td>
<td>70,000</td>
<td>45,000</td>
</tr>
<tr>
<td>3</td>
<td>8-10 years</td>
<td>60,000</td>
<td>40,000</td>
</tr>
<tr>
<td>4</td>
<td>5-8 years</td>
<td>50,000</td>
<td>35,000</td>
</tr>
<tr>
<td>5</td>
<td>5 years</td>
<td>45,000</td>
<td>30,000</td>
</tr>
<tr>
<td>6</td>
<td>Without experience</td>
<td>30,000</td>
<td>---------</td>
</tr>
</tbody>
</table>

43.0 COMPLETION AND TAKING OVER

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

44.0 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.

45.0 The contractor shall make necessary safety arrangement at site including as mentioned in GCC and indemnify EPI against any consequence of accident at site.

46.0 ISO COMPLIANCE

47.0 FACILITIES

The sub-clause 28.3 of the clause no. 28 of General Conditions of Contract (GCC) for Furnished Office Accommodation & Mobility and Communication to be Provided by Contractor to EPI shall be replaced and read as under:-

The contractor shall make his rates in Bill of Quantities sufficiently comprehensive to cover the cost of the facilities as per details shown below and the contractor shall not be entitled for any extra payment for the same.

<table>
<thead>
<tr>
<th>Description</th>
<th>Unit</th>
<th>Qty</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. OFFICE WITH FACILITIES – The contractor is to provide office with following facilities till defect liability period.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A (i) PORTA CABIN OFFICE ACCOMODATION</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Furnished office with one conference room at one or more locations as per direction of Engineer-in-Charge with basis amenities like Toilets, Drinking water arrangement, lights, other facilities for winter and summer season etc. for EPI Engineer &amp; Staff &amp; maintenance of it till Defect Liability Period</td>
<td>Sq. ft.</td>
<td>1500</td>
</tr>
<tr>
<td>(ii) FURNITURE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Office tables</td>
<td>Nos.</td>
<td>5</td>
</tr>
<tr>
<td>Office Chairs</td>
<td>Nos.</td>
<td>10</td>
</tr>
<tr>
<td>Executive Table &amp; Chair</td>
<td>Nos.</td>
<td>4</td>
</tr>
<tr>
<td>Steel Almirah</td>
<td>Nos.</td>
<td>3</td>
</tr>
<tr>
<td>File Cabinet</td>
<td>Nos.</td>
<td>3</td>
</tr>
<tr>
<td>B) OFFICE EQUIPMENT</td>
<td></td>
<td></td>
</tr>
<tr>
<td>a) Fax Machine</td>
<td>No.</td>
<td>1</td>
</tr>
<tr>
<td>b) Computer (Pentium-IV, Office Edition) with minimum 40 GB HDD along with UPS &amp; Operator (In case computer operator is not provided by the contractor, recovery of Rs. 15,000/- per month shall be made from the Contractor’s bill in this regard) and latest Version of Software’s like MS Project, Windows, MS Office etc.</td>
<td>No.</td>
<td>2</td>
</tr>
<tr>
<td>c) Laser Printer or any other Printer of equivalent amount A3 size</td>
<td>No.</td>
<td>2</td>
</tr>
<tr>
<td>d) Internet Facilities</td>
<td>No.</td>
<td>2</td>
</tr>
<tr>
<td>e) Refrigerator (165 Ltrs) or any other gadget of equivalent cost as decided by EPI.</td>
<td>Nos.</td>
<td>1</td>
</tr>
<tr>
<td>f) Aqua Guard (Drinking water) or any other gadget of equivalent cost as decided by EPI.</td>
<td>Nos.</td>
<td>2</td>
</tr>
<tr>
<td>g) Air Conditioner with cooling &amp; heating (1.5 ton capacity)</td>
<td>Nos.</td>
<td>3</td>
</tr>
</tbody>
</table>
**h) Photocopy machine (CANON NP 3050 or equivalent model) or any other gadget of equivalent cost as decided by EPI.**  
| No. | 1 |

**i) Digital Camera**  
Running & maintenance of the equipments mentioned above are to be done by the contractor at his own cost.  
| As per actual |

**C) CONSUMABLES**  
All consumables like Stationary, ink etc. shall be provided by Tenderer till end of defect liability period. (Stationary items are inclusive of visiting cards, rubber stamps, letter pads, photocopies papers & other items of daily office use). Amount shall be restricted to Rs. 10,000/- per month.  

**D). CONVEYANCE AND OTHER FACILITIES**  
Vehicle (Brand New) Four wheel drive Renault Duster vehicle or equivalent with Driver and accessories,  
| No. | 2 |

Monthly running shall be restricted to 4000 Kms each.  

**E). TELEPHONE WITH STD FACILITIES AND INSTRUMENTS**  
| No. | 1 |
| Nos. | 5 |

a) Office Telephone (Fixed Line)  
b) Mobile Phone  
Monthly operational expenditure on account of all telephones shall be restricted to Rs. 15,000/-per month  
The cost of each Mobile Phone instrument shall be restricted to Rs. 10,000/-  
Office Boy Cum-Cook on full time basis for EPI  
| Nos. | 3 |

The vehicle shall be brand new and shall be provided with driver on full time basis. Consumables like diesel/petrol/oil lubricants and spare parts etc. shall be provided by the Tenderer at their cost till the end of Defect Liability Period. The vehicles shall be maintained in good working condition. In case of breakdown, replacement of vehicle shall be provided by Tenderer.

In case Driver, POL, maintenance of any vehicle is not required by EPI for any vehicle, a recovery of Rs. 50,000.00 per month per vehicle shall be made from the Tenderer for this purpose till the end of defect liability period.

The above gadgets facilities should be brand new and of reputed make and all facilities shall be provided and maintained properly (including payment of water & electricity bills etc. for office accommodation only) by the Tenderer at Project site or at any other office related with execution of this project till completion of work, handing over, defect liability period in all respect at his own cost. The Tenderer shall also make stand-by arrangement for water & electricity to ensure uninterrupted supply. The equipment/items shall be the property of Tenderer at the end of contract. The Tenderer shall be responsible for watch and ward of
site office and other facilities etc. In case of

Theft/damage of any equipment/items, the Tenderer shall immediately replace the same within a maximum period of two days.

The Tenderer shall provide ‘Sign Board(s)’ as per design approved by EPI and/or Client.

In case the above facilities are not provided by the Tenderer within 10 (ten) days of award of work or replacement is not provided within the specified period, EPI shall arrange the same at the risk and cost of the PARTY and make the recoveries from the bills of the Tenderer for the same. The decision of EPI shall be final and binding on the Tenderer in this regard.

48.0 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.

49.0 ARBITRATION: Modification of arbitration’s clause no 76.0 of GCC

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

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

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

a) such as the existence either direct or indirect, of any past or present relationship with or interest in any of the parties or in relation to the subject-matter in dispute, whether financial, business, professional or other kind, which is likely to give rise to justifiable doubts as to his independence or impartiality; and
b) which are likely to affect his ability to devote sufficient time to the arbitration and in particular his ability to complete the entire arbitration within a period of twelve months.

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

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

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

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

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

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

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

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

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

50.0 DEFECT LIABILITY PERIOD
Clause no. 74.0 of GCC shall be read as for a period of 24 months from the date of taking over of the works in place of 12 months.

51.0 GENERAL CONDITION OF “GRIHA” REQUIREMENT FOR ALIMCO PROJECT
The ALIMCO intends to develop green complex & obtain “GRIHA” requirement for the proposed facilities included “GOLD” rating of “GRIHA” in the project. Bidder to familiarize the requirements and note that all requirements of above pertaining to construction for achieving the above targeted rating. No extra payment shall be made on this account.
52.0 COMPLIANCE OF CONSTRUCTION & DEMOLITION WASTE MANAGEMENT RULES 2016.

The contractor shall comply all the rules & regulation of Construction & Demolition Waste Management Rules 2016 as notified by the Government of India as applicable for the said work and subsequent amendment if any, in the said act notified by the Government time to time. Nothing shall be paid extra.

53.0 FACILITIES TO BE PROVIDED AT SITE FOR LABOUR WELFARE

All facilities to be provided him at site for fulfilling all GRIHA & statutory 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”.

The contractor shall deploy an experienced & qualified person exclusively for implementation of “GRIHA” requirements for the entire contract period.

54.0 SKILL DEVELOPMENT TRAINING AND EMPLOYMENT OF SEMISKILLED/SKILLED WORKERS BY CONTRACTOR.

In compliance to directive issued vide letter dated 30.05.2016 by Department of Heavy Industries, Govt. of India and considering the nation requirement, contractor is required to impart Skill Development training to 25 Nos. local unemployed youths / unskilled workers in trades of Plumbing, Masonry, Carpentry, Bar Binding, Welding etc. from reorganized / reputed institutes. After successful completion of training of these tradesman, the 25% of trained manpower shall be employed on projects by the contractor.

..........
TENDER DOCUMENT

TENDER No.: ..............................................

FOR
CONSTRUCTION OF NEW WORK CENTER, WARE HOUSES, APOC BUILDING, SITE DEVELOPMENT WORK AT ALIMCO AUXILIARY PRODUCTION CENTER KANPUR (UP)

VOLUME – II

TECHNICAL SPECIFICATIONS AND DRAWINGS
TECHNICAL SPECIFICATION
PARTICULAR SPECIFICATIONS FOR CIVIL WORK

1.0 All works will be executed in the most substantial and workman like manner both as regards materials and otherwise in every respect in strict accordance with DSR-2014/ Latest CPWD Specifications with up to date correction slips and as per the direction of Engineer of in charge. The decision of Engineer in charge shall be final and binding. All special activities shall be carried out by specialized agency only after approval of Engineer In-Charge.

2.0 EARTH WORK

2.1 Before commencing the earth work, the ground levels shall be taken at 5 to 15m interval or as shall be directed by the Engineer-in-charge. Where local mounds, pits or undulations are met with closer internal shall be adopted.

2.2 The ground levels shall be recorded in the level books and plotted on plan on suitable scale as per direction of Engineer-in-charge. The North direction and position of Bench Mark shall be shown on the plans. The ground levels for building and the sub-soil water level shall be determined with respect to the bench mark approved by the Engineer-in-charge before commencement of the work and these levels shall be recorded in the level book and also indicated on the ‘Plan’ showing ground levels. These plans shall be signed by the Contractor and the Engineer-in-charge before the earth work is started.

2.3 All labour and material for setting out and making profile and taking ground levels shall be supplied by the contractor and nothing extra shall be payable on this account.

2.4 The Bidder shall co-operate and provide all possible assistance to the other agency / agencies executing other works. He shall adjust his execution program to accommodate such essential activities of construction.

2.5 Rate for earth work shall include the following operations:
   a. Setting out works, profiles
   b. Site clearance
   c. Protection measures and putting up caution signs and lights.
   d. Handling useful materials and Antiques.
   e. Bailing out or pumping of rain water out of excavation.

3.0 CONCRETE / REINFORCED CEMENT CONCRETE WORK/ DESIGN MIX CONCRETE

3.1. Cement concrete work using nominal mix concrete shall be executed as per DSR/CPWD Specifications with up to date correction slips.
3.1(a) The item machine batched, machine mixed and machine vibrated design mix concrete used in the nomenclature of “Sub head RCC Work” shall mean the concrete produced in automatic concrete batching and mixing plant and transported by transit mixers (if necessary), placed in position and vibrated by surface vibrator / needle vibrator / plate vibrator as the case may be to achieve required strength and durability.

3.2. All stone aggregate and stone ballast shall be of hard stone variety to be obtained from approved quarries or any other source to be got approved by the Engineer-in-charge.

3.3. Sand to be used for cement concrete RCC work shall not contain silt content by more than 8%.

3.4. Ordinary Portland Cement (OPC) not less 43 grade as per IS: 8112 or Portland Pozzolona
Cement (PPC) as per IS: 1489-1991 shall be used for the entire work. However, necessary deduction towards difference of rates between OPC & PPC cement shall be account fore.

3.5. All shuttering shall either be of steel or marine ply. All scaffolding shall be of steel. The contractor will have to manufacture new shuttering so as to obtain exposed concrete surface of even and uniform shade wherever required. Shuttering already used on other work(s) will not be permitted to be used in this work for obtaining exposed concrete surface. The steel / marine ply centering, shuttering and steel scaffolding shall be as per DSR/CPWD specifications.

3.6. Keeping in view the flooring thickness as per nomenclature of the item, the structural drawings shall be reconciled with the architectural drawings to make appropriate adjustment in the level of shuttering for RCC slab so as to achieve the final floor finish level as per Architectural drawing.

**DESIGN MIX CONCRETE**

3.7. The contractor shall exercise “very good” quality control over site conditions for production of controlled concrete by using fresh cement and regular tests employing fully automatic cement batching plant for batching of all materials, grading of aggregate, determination of moisture contents and control of water cement ratio, frequent supervision and by conducting regular workability and strength tests and maintaining adequate field laboratory facilities to maintain the specified quality of concrete consistently.

3.7(a) The aggregate used for RCC work shall be 20mm nominal maximum size aggregate. The minimum cement content and the maximum water cement ratio for various grades of concrete shall be as given below:
<table>
<thead>
<tr>
<th>Grade Designation</th>
<th>Compressive strength 15cm cubes min 7 days (N/mm²)</th>
<th>Specified Characteristic compressive at 28days (N/m²)</th>
<th>Minimum cement content (kg per cubic metre)</th>
<th>Maximum water cement ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-25</td>
<td>AS per Design</td>
<td>25</td>
<td>330</td>
<td>0.50</td>
</tr>
<tr>
<td>M-30</td>
<td>AS per Design</td>
<td>30</td>
<td>340</td>
<td>0.45</td>
</tr>
<tr>
<td>M-35</td>
<td>AS per Design</td>
<td>35</td>
<td>350</td>
<td>0.45</td>
</tr>
</tbody>
</table>

Note: Excess/Less cement content used as per design mix in respect of the above specified limit is payable / recoverable separately.

3.7(b) The concrete mix will be designed for minimum workability as per the table given below:

<table>
<thead>
<tr>
<th>Placing conditions</th>
<th>Degree of workability</th>
<th>Slump (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lightly reinforced sections in slabs, beams, walls and columns</td>
<td>Low</td>
<td>25 –75</td>
</tr>
<tr>
<td>Heavily reinforced section in slabs beams, walls and columns</td>
<td>Medium</td>
<td>50-100</td>
</tr>
<tr>
<td>Pumped concrete</td>
<td>Medium</td>
<td>75-100</td>
</tr>
</tbody>
</table>

3.8. The contractor shall engage one of the following approved laboratories, test houses for designing the concrete mix in accordance with the relevant I.S. Codes and to conduct laboratory tests to ensure the target mean strength and workability criteria for a given grade of concrete

i. I.I.T./ NIT/any Government laboratory
If all the above laboratories express in writing their inability to carry out designing and testing of concrete mixes by a specified date, the contractor may be allowed to engage any other laboratory with prior approval of Engineer-in-charge.
3.9. The source and quality of all ingredients of a concrete mix shall be got approved from the Engineer-in-charge before designing the mixes and their testing and the same shall be maintained during the execution of the work as well.

3.10. Any change in source or characteristic of any ingredient used in the concrete mix during the work execution shall require revised mix design and laboratory testing as per direction of the Engineer-in-charge and no further concrete work shall be proceeded without approval of the revised design mix.

3.11. In the event of use of admixtures to achieve the required workability, the mix shall be designed and tested using the admixture in suitable proportion.

3.12. All cost and charges of designing the concrete mix and its testing by approved laboratory including the redesigning of the concrete mix, whenever required and directed by the Engineer-in-charge, shall be borne by the Contractor and nothing extra shall be payable over the quoted rates.

3.13. The designed mix proportions shall be checked for target mean compressive strength by means of trial batches.

3.14. The quantities of materials for each trial mix shall be sufficient for at least six specimens (cubes) and the concrete required for carrying out workability test.

3.15. The workability of trial mix No. 1 shall be measured and mix shall be carefully observed for freedom from segregation, bleeding and its finishing characteristics. The water content, if required, shall be adjusted corresponding to the required change in the workability.

3.16. With the modified water content, the mix proportions shall be recalculated by keeping with water cement ratio unchanged. The mix proportion, so modified, shall form the Trial Mix No. 2 and tested for the specified strength and workability.

3.17. In addition, trial mix No. 3 and 4 shall be designed by keeping water contents same as that determined for trial mix 2 but varying the water cement ratio by ± 10 percent of the specified value and tested for their design characteristics.

**APPROVAL OF DESIGN MIX CONCRETE**

3.18. Minimum three sets of separate preliminary tests shall be carried out for each trial batch of concrete mix. Each test shall comprise of six specimens and only one test-set of six specimens shall be made on any particular day.

3.19. Of the six specimens of each test-set, three specimens shall be tested at 7 days and remaining three at 28 days.

3.20. The Preliminary tests at 7 days are intended only to indicate the likely strength to be attained at 28 days while the design mix shall be approved only on the basis of test strength at 28 days.

3.21. The contractor shall submit the design mix report from the approved laboratory within 45 days of award of work for approval of Engineer-in-charge. No concreting work shall be executed until the mix design is approved.
3.22. The design mix shall be considered satisfactory and approved if at least three preliminary test-sets individually satisfy the following strength and workability criteria:

a. The average strength of each test-set is not less than the specified target mean compressive strength.

b. The strength of any specimen cube is not less than 0.85 times the target mean compressive strength.

c. The concrete mix is of required degree of workability and acceptable concrete finish.

**PRODUCTION OF CONTROLLED CEMENT CONCRETE**

3.23 Automatic Batching Plant conforming to IS 4925-1968 and minimum 30 cum/ hour capacity shall be used for production of controlled concrete.

3.24 Automatic batcher shall be charged by devices which, when actuated by a single starter switch, will automatically start weighing operation of each material and stop automatically and interlocked when the designated weight of each material has been reached.

3.25 The batching system shall have rated capacity (in terms of concrete in a single batch) to match the maximum rated size of the mixer that could be adopted for use with the plant.

3.26 The mixers shall be free fall tilting type conforming to IS 1791-1968.

3.27 All measuring equipment shall be maintained in a clean and serviceable condition and their accuracy shall be checked at least once a month.

3.28 Only single sized good quality stone aggregate shall be brought to site of work from the approved source. The grading of the stone aggregate shall be controlled by blending the aggregate of different sizes in the required proportions at site of work.

3.29 The aggregate of different sizes shall be stock-piled separately at least a day before use. The grading of coarse and fine aggregates shall be checked as frequently as possible and as directed by the Engineer-in-charge to ensure that the specified grading and quality of aggregate is maintained.

3.30 It is important to maintain the water cement ratio constant at its specified or approved value by making adjustment for the moisture contents of both fine and coarse aggregates.

3.31 The moisture contents in the aggregate shall be determined as frequently as possible in keeping with the weather conditions as per the provisions of IS 2386 (Part III) 1963.

3.32 All other operations involved in concrete work like laying, placing, compaction and curing etc. shall be done as per CPWD specifications 1996 Volume I to VI with up to date correction slips.

3.33 For RCC Work, the contractor may be permitted to use ready mixed concrete (RMC) procured from the approved suppliers of RMC instead of producing concrete at site. The specifications for RMC shall be same as for Design mix concrete produced at site. The prescribed tests for design mix concrete shall also be carried out for RMC in addition to getting the test report from the supplier. Nothing extra shall be paid for using RMC.

3.33(a) The contractor shall obtain prior approval of Engineer –in - Charge for using RMC, which shall be granted only in exceptional cases like failure of plant or other exigencies.

**SAMPLING AND STRENGTH OF WORK TEST OF CONCRETE**

3.34 Samples from fresh concrete shall be taken as per IS-1199-1959 and the test cubes shall be made, cured and tested in accordance with IS 516-1959.
3.35 Each test sample shall comprise of six test cubes (specimen), three of which shall be tested at 7 days and remaining for tests at 28 days.

3.36 A random sampling procedure shall be adopted to ensure that the sampling is spread over the entire period of concreting and cover all mixing units.

3.37 The concrete work shall be notionally divided into lots as under for the purpose of sampling conditions:

a. Footings, rafts, etc.
b. Columns and walls at all levels
c. Beams at all levels
d. Slabs at all levels

3.38 At least one test sample shall be taken for each lot of concrete work.

3.39 Each grade of concrete shall form different lot of testing.

3.40 The minimum frequency of sampling of concrete of each grade shall be as given below:

<table>
<thead>
<tr>
<th>Qty. of Concrete work (in Cum .)</th>
<th>Number of Samples</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-5</td>
<td>1</td>
</tr>
<tr>
<td>6-5</td>
<td>2</td>
</tr>
<tr>
<td>16-30</td>
<td>3</td>
</tr>
<tr>
<td>31-50</td>
<td>4</td>
</tr>
<tr>
<td>51 and above</td>
<td>4+ one sample for additional 50m³ or part thereof.</td>
</tr>
</tbody>
</table>

The concrete work shall be assessed on day to day basis and samples shall be taken as specified.

**TEST STRENGTH OF A SAMPLE**

3.41 The test strength of the sample shall be taken as the average of the strength of its three specimens, the individual variation between the three specimens should not be more than ± 15 percent of the average test results of the sample.

3.42 If individual variation in strength of three specimens is more than ± 15 percent of average, the test results of the sample shall be invalid.

3.43 90% of the total work tests shall be done at the field laboratory established at the site of work and the remaining 10% work tests shall be got done from any Govt. laboratory or the laboratory approved by the Engineer in charge.

**MEASUREMENTS**
3.44 The measurements of work and the allowable tolerances shall be governed by provisions of CPWD specifications read with up to date correction slips.

3.45 The theoretical consumption of cement in designs mix concrete shall be worked out on the basis of proportions approved for Design mix subject to the permissible variations under clause 42 of the tender documents.

**RATE**

3.46 The rate shall include cost of all materials and labour involved in all operations described above including the cost of designing and testing of concrete mix in the approved laboratory including admixture but excluding the cost of centering, shuttering and reinforcement.

### 4.0 WATER PROOFING TREATMENT

#### 4.1 GENERAL

4.1.1 The waterproofing treatment shall be carried out as per detailed specifications indicated for the same from the agency to be approved by the Engineer in Charge.

4.1.2 Two samples of the waterproofing materials / compound proposed to be used shall be submitted to the Engineer-in-charge along with test result from a testing laboratory of repute confirming its quality and performance and the constituents making it.

4.1.3 Total quantity of the waterproofing material / compound required shall be arranged only after obtaining the prior approval of the Engineer-in-charge in writing. Materials shall be kept under double lock and key and proper account of the waterproofing / material compound used in the work shall be maintained. It shall be ensured that the consumption of the material / compound is as per specified requirement.

4.1.4 Cement based integral waterproofing compound

   Shall be of specified quality and also satisfy all the performance requirements indicated in IS Code 2645-1975. The compound shall be used @ 2% by weight of cement used (or as recommended by the manufacturer).

   Any other waterproofing compound, if specified for use, shall satisfy the manufacturer’s specifications.

#### 4.2 MEASUREMENT

4.2.1 The measurement shall be taken along the finished surface of treatment including the rounded and tapered portions at junctions. Length and breadth shall be measured correct to one centimeter and area shall be worked out nearest to two decimals.

#### 4.3 RATE

4.3.1 The rate shall be inclusive for all operations described in the nomenclature and the specifications applicable to the item, including any incidental expenditure. Nothing extra shall be payable on any account whatsoever.

### 5.0 BRICK WORK

5.1 The brick work shall be carried out with good quality well burnt bricks of specified designation, free from ash, dust or mud etc.

5.2 Only well wet bricks shall be used for brick work in cement mortar.

5.3 The cement mortar of specified mix shall be uniformly mixed to the required consistency in the Mixer Machine with hopper attached only and measuring boxes shall be used for proper proportion of mortar mix.
5.4 All the joints of brick work both horizontal and vertical shall be filled in completely with cement mortar. The joints shall be of uniform thickness of not more than one cm.

6.0 Wood Work (Doors / Cup Board frames and shutters)

6.1 The contractor shall procure the shutters and get them fixed only from approved manufacturer / contractor for manufacturing such shutters as per the specification specified herein.
6.2 The specialized agency manufacturing factory made shutters shall be got approved from the Engineer-in-charge before placing bulk supply order.
6.3 The contractor shall get at least 4 shutters of each type of door fabricated from the approved manufacturer immediately after start of the work and give written intimation to the Engineer-in-charge who shall arrange inspection of the samples at factory premises for approval. The two approved samples shall be left with manufacturer / suppliers and the remaining two samples will be delivered at the site of work for sample fixing.
6.4 The officer approving each shutter shall put his signature on each of the approved shutter and the contractor shall fix such approved shutters only and preserve the officer’s signature until the completion of work.

7.0 Powder coated Aluminum Work for Doors and windows:

7.1 The Contractor shall engage specialized agency for doing the aluminum work and the agency shall be got approved from the Engineer—in-Charge.
7.2 The materials conforming to specifications as mentioned in the nomenclature of item shall only be used for fabrication of Aluminum doors and windows.
7.3 All Aluminum work shall be free from defects impairing strength, durability and appearance. The makes of aluminum sections shall be as given in “List of approved Makes for Civil Work”
7.4 The contractor shall submit shop drawings and samples of each type of doors and windows to the Engineer-in-charge for approval. The shop drawings shall show full size sections of doors and windows. Shop drawings shall be based on actual dimensions available on site, which should not vary from those on drawings by 1.5mm.
7.5 The glazed aluminum windows shall be made completely water proof to the satisfaction of the engineer-in-charge. Silicon/ Polysulphide sealants etc; shall be provided wherever required to make the window water proof.
7.6 All joints shall be accurately fabricated. The finished surface shall be free from visible defects.
7.7 The Powder coating shall be of approved colour and conform to IS code
7.8 Doors, windows or fixed glazing, frames shall be fixed to concrete /brick work / base frame with approved metal fasteners. Method of fixing shall be approved by the Engineer-in-charge before mass fabrication.
7.9 A thick layer of the clear transparent lacquer based Methacrylates or Cellulose Butyrate shall be applied on the powder coated surfaces before they are brought to site. The same shall be removed on completion of erection.
7.10 All screws shall be stainless steel screws.

7.11 The corners of the frame shall be fabricated true to right angle. Both the fixed and openable frames shall be fabricated out of sections, which have been cut to length, mitred and jointed mechanically. All members shall be accurately machines milled and fitted to form hair line joints. The joining accessories such as cleats, brackets, etc shall be such material so as not to cause any bimetallic corrosive action.

All frame members shall be in plumb and level and jointed in such a way that the expansion and contraction shall not cause distortion or leakage. The contractor shall be responsible for their satisfactory performance/ operation after fixing is complete.

7.12 Clear glass : The glass shall be float glass of Brand Modi or equivalent. Clear glass used in glazing of openable / fixed doors ,windows and ventilators shall provide clear, completely undistorted vision and reflection. It shall be free from any bubbles, waves or blemishes. Glass used shall be of required size as per drawings.

7.13 Tinted Glass : Tinted glass shall have same quality and specifications as indicated above for clear glass. It shall however be transparent glass tinted to Bronze/ Blue/Green/Smoke grey shade as required and would be expected to absorb a greater proportion of sun’s radiant heat and reduce transmission than clear glass.

7.14 Rate: The rate shall include the cost of all materials as mentioned above and in the nomenclature of item , labour and T&P required for proper completion of the work including the sealant but excluding the clear/ tinted glass which shall be measured and paid separately under relevant item. For payment purposes, the weight of aluminium sections finished to size as provided in doors and windows excluding the cleats shall only be measured.

7.15 Five years guarantee bond in prescribed Performa `B’ attached in Tender Document Volume - I shall be submitted by the contractor which shall also be signed by both the specialized agency and the contractor to meet their liability/ liabilities under the guarantee bond against structural stability, water leakage, faulty materials, workmanship and defective anodized finish.

8.0 Flooring

8.1 Only machine cut Kota stone, sand stone marble, granite slabs shall be used for flooring and veneering work.

8.2 Proper gradient shall be given to flooring for toilets, verandah, kitchen, court, yard etc and shall be determined by providing required gradient in the lean concrete/ sub-grade surface.

8.3 The bed mortar on concrete shall be fully compacted, particularly at the junctions of panels, during laying of flooring so that the finished floor does not give hollow sound.

9.0 Roofing

9.1 The roofing shall be executed as specified in the nomenclature and detailed specifications for the item.

9.2 The work of fixing rainwater pipes, grouting around mouth of rain water pipes and making khurra shall be done before starting the items of roofing. The roofing shall overlap the khurra surface by about 100mm.
9.3 Plastering of parapet wall shall only be done after providing required cement concrete gola at the junctions with horizontal surface of roofing. In case of RCC parapet wall 75 x 75mm cement concrete gola shall be provided after making groove at at least 20mm in depth. Cement slurry shall be applied over the groove before laying cement concrete gola. For parapets walls in brick work, the cement concrete gola shall be provided as per operations described in DSR/CPWD Specifications with up to date corrections slips.

10.0 Finishing

10.1 The cement paint, primer, synthetic enamel paint, bitumen, plastic emulsion and distemper etc. of approved manufacturer shall only be brought to the site of work in the original sealed containers. The material brought to the site of work in lots of at least 25% of the total requirement. The materials shall be kept under the joint custody of contractor and Engineer-in-charge. The empty containers shall not be removed from the site till the completion of the work.

10.2 Nothing extra shall be paid for providing drip course or moldings in RCC projected slabs wherever required.

10.3 The item of glass mosaic tiles included under the sub head of “Road and Path Work“ shall also be executed on building facias in bands of required width as shown in the Architectural drawings and nothing extra shall be paid for the same.

10.4 The rate for relating to stainless steel cramps shall include the cost of 100mmx100mm x100mm cement concrete 1:2:4 (1 cement:2 coarse sand:4 graded stone aggregate 20 mm nominal size) blocks in brick masonry wall in which the cramp shall be embedded.

10.5 The rate for to stainless steel cramps of size 15x6mm-16.5cm long shall include the cost of two nos. Wedge expansion type hold fasteners (with threaded dia of size 6mm) for fixing each cramp to RCC / CC backing.

10.6 Nothing extra shall be paid for shuttering and other inputs required at the locations of construction joints in RCC work.

11 RCC WORK

11.1 To ensure proper cover only factory made approved cover blocks will be used to avoid displacement of bars in any direction.

11.2 The Steel bars of different diameters should be stored about 30 to 45 cm above ground level to avoid corrosion of steel. No extra payment shall be made on this account.

12 WOOD WORK

12.1 Thickness of glass in glazing shall be as specified in the item in woodwork / steel works. Glazing in toilets shall be of opaque type.

13 FLOORING:

The rate of items of flooring is inclusive of providing sunk flooring in bathrooms, kitchen etc. and nothing extra on this account is admissible. The flooring is to be laid in pattern of various combinations as per architectural drawings. The flooring in treads and risers of stair case is to be laid in single piece. Nothing extra shall be paid on these accounts. The measurement shall be made for finished work of flooring.

Misc

1. Structural glazing
Genera

1) Framing system

Aluminium anodized extruded sections manufactured by reputed manufacturers. For all types of members like brackets, mullions, transom etc.

2) Sealant

As specified in the item of silicon sealant

3) Insulation

50mm thick glass wool of minimum density 48kg/cum sandwiched with black polythene sheet 100 micron on one side and aluminium foil of 100 Micro on the other side or as specified by manufacturer at spandrel area. The surface after fixing insulation shall be plain without any distortion.

4) Heat reflective Toughened Glass

(a) St. Gobain – Reflectosolar as specified.
(b) Glaverbel/ Glavermass – Super Silver (c)Visteon Ford Brown or Grey Color or any shade approved by the Client/ Engineer-in-Charge/ Architect.

SCOPE OF WORK

Preliminary Requirements

(i) The contractor shall design, test, fabricate, deliver, install and guarantee all construction necessary to provide a complete curtain wall system for the proposed building, all in conformity with the drawings as shown.

(ii) Specification and all relevant construction regulations including providing any measures that may be required to that end, notwithstanding any omissions or inadequacies of the drawings.

(iii) The curtain wall system shall also include the following activities:
(a) Metal frames, glass glazing, spandrels, ventilators, finish hardware, copings, metal closure, windows etc.
(b) All anchors attachments, reinforcement and steel reinforcing for the systems required for the complete installations.
(c) All thermal insulation associated with the system
(d) All fire protection associated with the system
(e) All copings and closure and metal cladding to complete the system
(f) All sealing and flushing including sealing at junctions with other trades to achieve completewater tightness in the system.
The contractor shall also be responsible for providing the following:

(a) Engineering proposal, shop drawings, engineering data and structural calculations in connection with the design of the curtain wall system.
(b) Mock-ups, samples and test units.
(c) Performance testing of the curtain wall framing and glazing assembly.
(d) Co-ordination with the work of other trade.
(e) Insulation with glass wool 48 kg/ cum at spandrels area.
(f) Protection.
(g) All final exterior and interior cleaning and finishing of the curtain wall system.
(h) As built record drawings and photographs.
(i) Guarantees and warranties.
(j) All hoisting, scaffolding, staging and temporary services.
(k) Conceptualizing and design of a suitable maintenance system for curtain glazing.
(v) The water tightness and structural stability of the whole curtain wall system are prime responsibility of the contractor. Any defect or leakage found within the guarantee period shall be sealed and made good at all the risk and cost of the contractor.
(vi) The curtain wall system shall be designed to provide for expansion and contraction of components which will be caused by an ambient temperature range without causing buckling, stress on glass, failure of joint sealants, undue stress on structural elements or other detrimental effects, specific details should be designed to accommodate thermal and building movements.

Quality Consideration and Other Activities

(i) The contractor while submitting the detailed design calculations should submit the following information on the quality of materials to be used and other aspects as detailed below:

1. Metal quality, finishes and thickness
2. Glass quality, coating and thickness and proposed manufacturer’s brand names
3. Aluminium extruded sections including mullions and transoms together with structural calculations and proposed manufacturer’s brand name and also the name of agency proposed for fabrication work
4. Arrangement and jointing of components.
5. Field connections especially mullion to mullion and transom to mullion.
6. Fixing and anchorage system of typical wall unit together with structural calculations.
7. Drainage system and provision in respect of water leakage in the curtain wall system
11. Wind load and seismic load and any other specific load considered in the design

(ii) Design concept over lightening protection link-up system of the curtain wall for connection and incorporation into the lightening conductor system of the building (Lightening conductor system of the building to be done by any other agency)
(iii) The maximum permissible structural tolerances of the building that the system has been designed to accommodate in case these tolerances exceed those specified in the specification.

**Tolerances**

Any parts of the curtain wall, when completed, shall be within the following tolerances:

1. Deviation from plumb, level or dimensioned angle must not exceed 3mm per 3.5m length of any member or 6mm in any total run in any line.
2. Deviation from theoretical position on plan or elevation, including deviation from plumb, level or dimensioned angle must not exceed 9mm total at any location.
3. Change in deviation must not exceed 3mm for any 3.5m run in any deviation.

**Test of Wind Pressure**

(i) The equivalent load of wind pressure or wind suction shall be given to the test unit as increasing or decreasing the inside pressure in the “pressure chamber” at which the test unit is fixed.

(ii) The static wind pressure shall be applied up to 1.5 kpa at maximum wind pressure.

(iii) The variation of dynamic pressure shall be of any approximate sine curve line.

(iv) Deflection on each observational points of the test unit shall be observed and recorded under static pressure as described above.

(v) Any damage and harmful permanent deformation on any parts except sealing materials shall not be found at maximum wind pressure.

(vi) The deflection on the main structural parts in this condition shall not exceed:

1. 1/175 of the span between supports or 20mm, whichever is less for vertical elements.
2. 1/250 of the span between supports for horizontal elements.

3. The extent of recovery of deformation, 15 minutes after the removal of the test load, is to be at least 95%.

**Test of Lateral Deflection per Floor Height**

(i) Lateral deflection per floor height shall occur on the test unit, when the structural frame which fixes the test unit is deflected horizontally.

(ii) The deflection of every ± 2.5mm shall be increased up to ± 13mm on the test unit (static deflection test)

(iii) The dynamic deflection shall be applied up to ± 13mm.

(iv) The variation of dynamic deflection shall be of an approximate sine curve line, on period of 3 seconds.

(v) The dimensions of the deflection on each observational point of the test unit shall be measured under the condition as described above and the same shall be observed.

(vi) Any damage and harmful permanent deformation shall not be found in any parts of the curtain wall except the damage to sealant at maximum deflection.
**Water Tightness Test**

(i) Water shall be sprinkled to the ‘Test Unit’ under wind pressure.
(ii) Pressure shall not be applied to the test unit
(iii) The volume of the sprinkling water in one minute shall be 5 litres per sqmt minimum (01.gal/sq.ft.)
(iv) All water leakage and drainage system at the joint and the openable sash of the curtain wall system shall be observed from the outside of the chamber.
(v) Hold the test two times, in sequence as described below, conforming to the above mentioned conditions.
(1) Install the test unit.
(2) Hold first water tightness test
(3) Hold test of wind pressure as described above
(4) Hold second water tightness test.
(5) Lateral deflection test
(vi) Water leakage shall not be observed inside at all parts of the test unit during first water tightness test.

**Mode of Measurement**

the breadth and the height of the finished work including the openable windows shall be measured in meters and centimetre and the net quantity for payment shall be calculated in sqm up to two place of decimal, the area to be considered for measurement shall be the net area of the exterior face of the curtain wall as fixed including the openable windows if any as part of the curtain wall.

**Rate**
The rate shall include the cost of all operations described above including the cost of materials, labors, designs of drawings, erection and testing, mock-up test units, fabrication, erection, finishing, scaffolding, undertaking performance guarantee. No other claims of any kind pertaining to this work shall be entertained.

2. **Providing & fixing Slate tile work for wall lining over 12 mm thick bed of cement mortar 1:3 (1 cement : 3 coarse sand) ans cement slurry @ 3.3 Kg/Sqm including pointing in white cement complete.**

**General**

Slate Tile shall be of the type specified; It shall be machine cut to requisite size and thickness. They shall be of colour indicated in the drawings or as instructed by the Engineer-in-Charge. It shall be hard, sound, durable and tough, free from cracks, decay and weathering and defects like cavities, cracks, flaws, holes, patches of soft or loose materials etc. before starting the work, the contractor shall get the stones approved by Engineer-in-Charge.

All work related to this specification section should be coordinated with the works described in other specification sections, including:

**Mortar**
The mortar for jointing shall be as specified.
Laying
All stones shall be wetted before placing in position. These shall be floated on mortar and bedded properly. The walls and pillars shall be carried up truly plumb or battered as shown in drawings.

Joints
All joints shall be laid truly horizontal and vertical.

Curing
The work in cement or composite mortar shall be kept constantly moist on all faces for a minimum period of seven days.

Mode of Measurement
The finished work shall be measured correct to a centimetre in respect of length and breadth nearest to two places of decimal.

Rate
The rate shall include the cost of materials and labor required for all the operations described above.

3. Providing & fixing Bhuj block tile (stone look) work for wall lining over 12 mm thick bed of cement mortar 1:3 (1 cement : 3 coarse sand) and cement slurry @ 3.3 Kg/Sqm including pointing in white cement complete.

General
Bhuj Block Tile shall be of the type specified; It shall be machine cut to requisite size and thickness. They shall be of colour indicated in the drawings or as instructed by the Engineer-in-Charge. It shall be hard, sound, durable and tough, free from cracks, decay and weathering and defects like cavities, cracks, flaws, holes, patches of soft or loose materials etc. before starting the work, the contractor shall get the stones approved by Engineer-in-Charge.

All work related to this specification section should be coordinated with the works described in other specification sections, including:

Mortar
The mortar for jointing shall be as specified.

Laying
All stones shall be wetted before placing in position. These shall be floated on mortar and bedded properly. The walls and pillars shall be carried up truly plumb or battered as shown in drawings.

Joints
All joints shall be laid truly horizontal and vertical.
Curing
The work in cement or composite mortar shall be kept constantly moist on all faces for a
minimum period of seven days.

Mode of Measurement
The finished work shall be measured correct to a centimetre in respect of length and breadth
nearest to two places of decimal.

Rate
The rate shall include the cost of materials and labor required for all the operations described
above.

4. Granite work gang saw cut (polished and machine cut) of thickness 18mm for
wall lining, skirting and dado (veneer work) in cement mortar 1:3 (1 cement : 3 coarse
sand) including pointing with white cement mortar 1:2 (1 white cement : 2 marble dust)
with an admixture of pigment to match the marble shade: (To be secured to the backing
by means of cramps, which shall be paid for separately).

General
Granite Stone shall be of the type specified and the material promptly in accordance with
specifications, it shall be hard sound durable and tough free from cracks, and defects like
cavities cracks flaws holes etc. Before starting the work the contractor shall get the sample
approved by the Engineer – in – Charge / architect.

MATERIALS
Granite Standard: Granite shall comply Standard Specification for material
characteristics, physical requirements, and sampling for selection of granite.
All granite shall be of standard architectural grade, free of cracks, seams, or starts, which may
impair its structural integrity or function. Color or other visual characteristics indigenous to
the particular material and adequately demonstrated in the sampling will be accepted
provided they do not compromise the structural or durability capabilities of the material.
Texture and finish shall be within the range of samples approved by the Engineer – in – charge.
Anchor Provision: Cut and drill sink provisions and holes in stone for anchors, fasteners,
supports, and lifting devices as indicated or needed to set stone in place.
Provide chases, reveals, ringlets, openings, and similar features as required to accommodate
adjacent work.

Shop Drawings
The Contractor shall submit: copies of required shop drawings to the Engineer-in-charge for
approval. These drawings shall show all bedding, bonding, jointing and anchoring details,
and the dimensions of each piece of granite. No final sizing or finishing shall be done until
the shop drawings for that part of the work have been approved.

STONE INSTALLATION
Proceed with the installation of the stonework in accordance with Drawings and using skilled mechanics capable of proper handling of the setting of the stone and able to field cut where necessary with sharp and true edges. Set stone with joints uniform in appearance and stone edges and faces aligned tolerances indicated. Clean surfaces that are dirty or stained. Scrub with fiber brushes, and then rinse with clear water. Provide expansion, control, and pressure-relieving joints of widths and at locations shown on Drawings.

**Cleaning**
After installation and pointing or caulking are completed, the contractor shall carefully clean the granite, removing all dirt, excess mortar, weld splatter, stains, and/or other site incident defacement. Stainless steel wire brushes or wool may be used, but the use of other wirebrushes or of acid or other solutions which may cause discoloration is expressly prohibited. Fabricator should be contacted before cleaners other than detergents are used.

**Protection of Finished Work**
After the granite work is installed, the granite shall be properly and adequately protected from damage. Boxing or other suitable protection shall be provided wherever required, but no lumber which may stain or deface the granite shall be used. All nails used shall be non-corrosive. All granite work in progress shall be protected at all times during construction by use of a suitable strong, impervious film or fabric securely held in place.

**Defective Work**
Any area or piece of granite found defective it shall be removed, and to be patched or redressed for use. Nothing extra on this account will be entertained.

**Related sections**
All work related to this specification section should be coordinated with the works described in other specification sections, including:

- Mortar
- Joints
- Pointing
- Curing

**Mode of Measurement**
The finished work shall be measured correct to a centimetre in respect of length and breadth nearest to two places of decimal. The rate shall include the cost of all operations described above including the cost of materials, labors, designs of drawings, erection and testing, fabrication, erection, finishing, scaffolding, etc. No other claims of any kind pertaining to this work shall be entertained.

**Rate**
The rate shall include the cost of materials and labor required for all the operations described above.

5. Granite stone flooring with 18mm thick stone flooring (sample of shall be approved by Engineer-in-charge) over 20 mm (average) thick base of cement mortar 1:4 (1 cement : 4 coarse sand) laid and jointed with grey cement slurry including rubbing and polishing complete with:
General
Granite Stone shall be of the type specified and the material promptly in accordance with specifications, it shall be hard sound durable and tough free from cracks, and defects like cavities cracks flaws holes etc. Before starting the work the contractor shall get the sample approved by the Engineer – in –Charge / architect.

MATERIALS
Granite Standard: Granite shall comply Standard Specification for material characteristics, physical requirements, and sampling for selection of granite.
All granite shall be of standard architectural grade, free of cracks, seams, or starts, which may impair its structural integrity or function. Color or other visual characteristics indigenous to the particular material and adequately demonstrated in the sampling will be accepted provided they do not compromise the structural or durability capabilities of the material. Texture and finish shall be within the range of samples approved by the Engineer – in - charge.

Shop Drawings
The Contractor shall submit: copies of required shop drawings to the Engineer-in-charge for approval. These drawings shall show all bedding, bonding, jointing details, and the dimensions of each piece of granite. No final sizing or finishing shall be done until the shop drawings for that part of the work have been approved.

STONE INSTALLATION
Proceed with the installation of the stonework in accordance with Drawings and using skilled mechanics capable of proper handling of the setting of the stone and able to field cut where necessary with sharp and true edges. Set stone with joints uniform in appearance and stone edges and faces aligned tolerances indicated. Clean surfaces that are dirty or stained. Scrub with fiber brushes, and then rinse with clear water. Provide expansion, control, and pressure-relieving joints of widths and at locations shown on Drawings.

Cleaning
After installation and pointing or caulking are completed, the contractor shall carefully clean the granite, removing all dirt, excess mortar, weld splatter, stains, and/or other site incident defacements Stainless steel wire brushes or wool may be used, but the use of other wire brushes or of acid or other solutions which may cause discoloration is expressly prohibited. Fabricator should be contacted before cleaners other than detergents are used.

Protection of Finished Work
After the granite work is installed, the granite shall be properly and adequately protected from damage. Boxing or other suitable protection shall be provided wherever required, but no lumber which may stain or deface the granite shall be used. All nails used shall be non-corrosive. All granite work in progress shall be protected at all times during construction by use of a suitable strong, impervious film or fabric securely held in place.

Defective Work
Any area or piece of granite found defective it shall be removed, and to be patched or redressed for use. Nothing extra on this account will be entertained.

Related sections
All work related to this specification section should be coordinated with the works described in other specification sections, including:
Mortar
Joints
Pointing
Curing

**Mode of Measurement**

The finished work shall be measured correct to a centimetre in respect of length and breadth nearest to two places of decimal.

**Rate**

The rate shall include the cost of materials and labor required for all the operations described above.

**PUF Sand witched panel**

Materials Pre-painted glavalume steel (0.45 mm total coated thickness (TCT)-is a zinc aluminium alloy coated steel (of strength 550 mpa) offering high corrosion resistance. Alloy coated shall be AZ-150 as per AS: 1397 i.e. total 150gm/m2 minimum coating mass of both sides sheets shall confirm to AS: 2728, AS:1397, IS: 14246, IS: 513 & IS: 277. Sheets shall be painted with super polyester XRW silicon modified polyester or fluoro polymer 0.20 micron on exposed side and neutral alyd back coat of 5 micron over primer coat of 5 micron on both sides. Proper jointing of sheets ensure water tight joint and puncture less roofing

PUF (polyurethane Foam)

Polyurethane Foam shall be following properties:
- Density: 40+-2kg.m2
- Compressive strength at 10% deformation-172 KN/m2
- Closed cell content -90%
- Temperature:
  - Range: (-) 180 C to (+) 100 C (minus one hundred eighty degree Centigrade to plus One hundred Centigrade )
  - Thermal conductivity (K-Value)-0.023 W/mk at 10 C mean temperature
  - Fire resistance: Horizontal extent of burn-<125 mm
  - Water absorption-0.2% volume at 100% RH.

The PUF panels shall be provided with corner protection and flashing etc. of size and shape as provided

The rate shall include all materials, incidental charges, Carriage, Fixing, wastage, Sales Tax, VAT, Work Contract Tax, Excise duty and other duties etc. The contractor shall quote his rates considering above factors. No Claim for extra payment over the agreement item shall be entertained

**Specification for Roller Blind**

ECOLOGICAL FABRIC WITH RECYCLABLE QUALITY
Silk code : ecd  
Composition : 100% polyester  
Weight (g/sqm) : 250(+/-5%)  
Blackout : 100%  
Width : 200/250 cm  
Roll size : 30 lm  
Manufacturing properties : Cut with cold knife , special technology to avoid fraying employed .  
No ultrasonic cut required.

STRUCTURAL STEEL WORKS
1. GENERAL
1.1 This section covers the scope of works of structural steel works, submittals by the contractor, applicable codes of practice for structural steel work and the specifications for the material used.

1.2 This specification shall be read in conjunction with the relevant reference specification described in the section.

1.3 Contractor shall ensure that the Technical specifications detailed herein are carefully read and understood in conjunction with, and related to bill of quantities, and, the contractor in his rates includes all requirements defined herein and in other parts of the Contract Document.

1.4 PEB works shall be carried out by specialized agency duly approved by Site In-Charge.

2. Scope of Work
The scope of work for the contractor in respect of structural steel work shall cover, but shall not be limited to the following:

(a-d) Supply of all raw steel materials for fabrication, taking into account wastage margin, including storage and upkeep of the materials.

(e) Furnishing of all materials, labour, tools and plant and all consumable required for fabrication and supply of all necessary bolts, nuts, washers, tie roads and welding electrodes for field connections, with necessary wastage margins.

(f) Fabrication of the steel works in accordance with the approved fabrication drawings, including all shop assembling, matching and marking. Design, manufacture / fabrication and provision of all jigs, fixings, manipulators etc. required for the fabrication.

(g) Provision of shop painting and requisite site painting to all fabricated steelwork, as per requirements of the related specification of the painting.

(h) Suitability marking, bundling and packing for transport of all fabricated materials.

(i) Preparing and furnishing detailed bill of materials, drawing Office dispatch lists, Bolts Lists and any other lists of bought out items required in connection with the fabrication and erection of the structural steelwork.
(j) Loading, Transportation and unloading of all fabricated structural steel materials from site storage yard to erection site, handling, assembling, bolting, welding and satisfactory installation of all fabricated structural steel materials in proper location, according to approved erection drawings and/or as directed by the Engineer.

(k) The contractor shall submit, for examination by the Engineer, detailed particulars of his proposed methods of erection of the superstructure steelwork, together with complete calculations relating to strength and deflection. If the erection scheme necessitates the attachment of strength steelwork to the permanent steelwork, the contractor shall submit, for approval of the Engineer, the methods he proposes for making good the permanent steelwork after removing the temporary work. The contractor shall also submit the design and fabrication drawings of all temporary support, staging, braces etc. required for safe erection, for approval of the Engineer.

(l) The contractor shall provide all construction and transport equipment, tools, tackle, and consumables, materials, labour and supervision required for the erection of the structural steelwork.

(m) Receiving, unloading, checking and moving to storage yard, storage, guarding and upkeep of fabricated steelwork and other consumable materials and fasteners at site.

(n) Transportation of all fabricated structural steel materials from site storage yard, handling, assembling, bolting, welding and satisfactory installation of all fabricated structural steel materials in proper location, according to approved erection drawings and/or as directed by the Engineer.

(o) Setting out, aligning, plumbing, leveling, bolting, welding and securely fixing the fabricated steel structures in accordance with the erection scheme, or as directed by the Engineer.

(p) Provision of requisite site painting to all fabricated steelwork, as per requirements of related specifications of the painting.

(q) Providing protective treatment to the erected steel structures, as per Specification.

(r) All major modifications of the fabricated steel structures, as directed by the Engineer, including but not limited to the following:

i) Removal of bends, kinks, twists etc. for parts damaged during transport and handling.

ii) Cutting, chipping, filling, grinding etc. if required or preparation and finishing of site connections.

iii) Reaming of holes for use of higher size bolt if required.

iv) Re-fabrication of parts damaged beyond repair during transport and handling or re-fabrication of parts which are incorrectly fabricated.

v) Fabrication of parts omitted during fabrications by error, or subsequently found necessary.

vi) Drilling of holes which are either not drilled at all or are drilled in incorrect location during fabrication.

Vii) Carry out tests in accordance with the related Specification.

(s) Preparing and furnishing detailed bill of materials of fabricated parts received from concerned organisation or its authorized fabricator.
(t) The Contractor shall observe all safety requirements for erection of structural steelwork as covered in IS: 7205.

2.1 Design

(a) The contractor will be required to carry out work as per approved detailed design of the structures.

2.2 Drawings

(a) Tender Drawings’ shall be the ‘Basic’ drawings for developing design drawings. Design drawings shall then be developed in to final ‘Shop Drawings’ to be prepared by the contractor. For preparing shop drawings, the contractor shall obtain written approval from the Engineer.

(b) Tender drawings furnished to the Contractor shall form a part of these specifications. The Contractor shall consult these in detail for all the information contained therein, which pertains to and is required for his work.

(c) Revisions to drawings, even after release for preparation of shop drawings, are likely to be made to reflect additional data, or, additional details defining updated requirements. Revisions to drawings and any new drawings made to include additional work for the Contractor shall be considered a part of this specification and contract. Extra claims by the contractor on this account shall not be entertained.

(d) Tender drawings show all relevant dimensions, and if necessary, clearances of structures, special loading where necessary, general location of openings at various levels and all other information required to enable the Contractor to prepare drawings for general engineering / fabrication and erection.

(e) It shall be clearly understood that the Tender drawings are only informative Drawings and are not intended to show exact and final information or specific Connection details.

(f) In case of variations in ‘Drawings’ and ‘Specifications’, the decision of the Engineer shall be final and binding. Should the Contractor during the execution of his work, find discrepancies in the information furnished to him, he shall refer such discrepancies to the Engineer before proceeding with such work.

(g) Contractor shall prepare all fabrication and erection drawings necessary for completing the work satisfactorily.

(h) Drawings shall be of one standard size, and shall be clear and legible. Drawings shall be based on Tender drawings supplied to the contractor, but he shall verify actual clearances and dimensions from site on works executed by other agencies and from Engineer.

(i) Before submitting of shop drawings and calculations to the Engineer for his approval, these shall be checked and certified by the contractors own structural engineer. Till such time shop details of a component are approved by the Client, fabrication work for the component shall not be started.

(j) Shop drawings shall include, but not be limited to:

(i) Detailed marking plans

(ii) Details of member connections and connections to other structures/ components of buildings.

(iii) Detailed dimensions for fabrication indicating dimensional modifications required for field conditions.
(iv) Welding and bolting procedures to be used both at shop and field.

(v) Cambers required to be provided, and permissible tolerances in fabrication.

(vi) Assembly and erection sequences indicating components to be connected at field.

(vii) Complete bill of materials for each component (preferably drawing wise).

(k) If necessary and called for by the Engineer, shop drawings shall be revised to suit modified requirements, and these shall be resubmitted for approval of the Engineer.

(l) While the shop drawings prepared by the contractor, and approved by the Engineer represent the correct interpretation of work to be done, the contractor is not relieved of his responsibilities for:

(i) Dimensional accuracy

(ii) Correctness of engineering and design of connections

(iii) Fit of parts

(iv) Details

(v) Errors or omissions

(vi) Material and workmanship

(vii) Methodology of fabrication and erection

(viii) Safety of performance

2.3 Submittals

On commencement of the Project, the Contractor shall submit the following to the Engineer:

a) Prior to the technical submittals, the contractor shall submit detailed baseline program and methodology indicating the proposed overall schedule for documentation such as calculations, shop/working drawings, plan/procedures and records. Submission of samples, process of fabrication / delivery to site storage yard for the approval of the Engineer.

b) Complete fabrication drawings, materials lists, cutting lists, bolt lists, welding schedules and QC schedules, based on the design drawing furnished to him and in accordance with the approved schedule. It is highlighted that structural steel members, dimensions thereof indicated in tender drawings are tentative only, and may be modified during final design stage.

c) Results of any tests, as and when conducted and as required by the Engineer.

d) Manufacturer’s mill test reports in respect of steel materials, bolts, nuts and electrodes, wires as may be applicable.
e) A detailed list of all constructional Plant & Equipment, such as cranes, derricks, winches, welding sets etc. their makes, model, present condition and location, available to the contractor and the ones he will employ on the job to maintain the progress of work in accordance with the contract.

f) The total number of experienced personnel of each category, like fitters, welders, riggers etc., which he intends to deploy on the project.

g) The contractor shall submit complete design calculations for any alternative sections proposed by him, for approval of the Engineer. Use of any alternative section shall be subject to approval of the Engineer. However, no extra payment will be entertained on account of this except as specified in BOQ.

3. Furnishing of Information

(a) Design drawings shall be furnished to the contractor and all such drawings shall form part of these Specifications.

(b) The Engineer reserves the right to make changes in the design drawings even after release for preparation of shop drawings to reflect addition, omission & modifications in data/details and requirements. Contractor shall consider such changes as part of these Specifications and the contract, and no extra claims shall be entertained on this account.

(c) Design drawings, approved by the Engineer, will show as appropriate the salient dimensions, design loads, sizes of members, location of openings at various levels and other necessary information required for the preparation of fabrication drawings, designs and erection details.

(d) It shall be clearly understood that the drawings of the Engineer are design drawings. The typical details of connection, cuts, notches, bends, etc. where shown in the design drawings are only for general guidance of the contractor. The contractor shall design and develop all such details based on the design forces and functional requirements.

(e) In case of variations in design drawings and specifications, the decision of the Engineer shall be final. Should the contractor, find any discrepancy in the information furnished by the Engineer, same shall be immediately brought to the notice of Engineer for resolution. The contractor shall obtain clarifications on discrepancies from Engineer before proceeding with the work.

(f) No detailed shop drawings will be accepted for examination by the Engineer unless the same, have first been completely checked by the contractor's qualified structural engineer (independent agency to be appointed by contractor) and are accompanied by an erection plan showing the location of all pieces detailed. The contractor shall check and ensure that detailing of connections is carefully planned to obtain ease in erection of structures, including field-welded connections and/or bolting.

(g) No fabrication work shall be started by the contractor without having obtained approval of Engineer on the relevant drawings. Approval by the Engineer of any of the drawings shall not relieve the contractor of his responsibility to provide correct design of connections, workmanship, fit of parts, details, materials and errors or omissions of all work shown thereon. The approval of Engineer shall constitute approval of the size of members, dimensions and general arrangement, but shall not constitute approval of the connections between members and other details.

(h) Drawings, for approval, shall be submitted by the contractor in an orderly manner commensurate with erection sequence and approved construction programme.
(i) The contractor shall furnish ten prints of all approved final drawings for field use and record purpose.

(j) The drawings prepared by the Contractor, and all subsequent revisions thereof shall be at the cost of the Contractor, and no separate payments shall be made for the same. Revisions shall incorporate all modifications, field changes, substitutions etc. effected. The rates/prices quoted for fabrication work shall be deemed to include the cost of such drawing work.

(k) The Contractor shall give due consideration to the need of trial assemblage at shop, weight and size limitation of elements for transportation from shop to construction site, temperature variation of 25 degree centigrade between the fabrication shop and site, site measurements of the as-built dimensions and avoidance of site welding except for fixtures. All the drawings shall be prepared in metric units. The drawings should preferably be of A-1 standard size, and the details shown therein shall be clear and legible. These drawings shall include but shall not be limited to the following:

i) Assembly drawings, giving exact sizes of the sections to be used and identification marks of the various sections.

ii) Dimensional drawings of base plans, anchorages details in foundation, foundation bolts location etc.

iii) Complete Bills of Materials and detailed drawings of all sections including their billing weights.

iv) Shop details of temporary structures together with detailed calculations.

v) Detailed shop drawings for proper co-ordination with the concrete components to which the steel members shall be connected, as required.

vi) Any other drawings or calculations that may be required for proper completion of the works and clarification of the works or substituted parts thereof.

vii) All 'as-built' drawings.

4. Applicable Codes and Standards

The codes and standards generally applicable to the work of this section are listed below. These are in addition to all relevant Indian Standard Codes as specified in the referenced documents. Latest revisions of the codes shall only be applicable.

IS: 102 Ready mixed paint, brushing, red lead non-setting, priming

IS: 104 Ready mixed paint, brushing, zinc-chrome, priming

IS: 210 Gray Iron Castings

IS: 451 Technical Supply Conditions for Wood Screws

IS: 800 Code of Practice for General Construction in Steel

IS: 801 Code of Practice for use of Cold Formed Light Gauge Steel Structural Members in General Building Construction.

IS: 806 Code of Practice for use of Steel Tubes in General Building Construction
IS: 808 Dimensions of Hot Rolled Steel beam, channel and angle Sections
IS: 811 Cold Formed Light Gauge Structural Steel Sections
IS: 813 Scheme of Symbols for Welding
IS: 814 Covered Electrodes for Manual Metal Arc Welding of Carbon and Carbon-Manganese Steel
IS: 816 Code of Practice for use of Metal Arc Welding for General Construction in Mild Steel
IS: 818 Code of Practice for Safety and Health requirements in electric and Gas Welding and Cutting Operations
IS: 822 Code of Procedure for Inspection of Welds
IS: 875 Code of Practice for Structural Safety of Building, Loading Standards.
IS: 919 ISO System of Limits & Fits (Part 1 & Part 2)
IS: 1024 Code of Practice for use of Welding in Bridges and Structures Subject to Dynamic Loading
IS: 1030 Carbon Steel Castings for General Engineering Purposes
IS: 1120 Coach Screws
IS: 1148 Hot Rolled Rivet Bars (upto 40mm) for Structural Purposes.
IS: 1161 Steel Tubes for Structural Purposes
IS: 1182 Recommended Practice for Radiographic Examination of Fusion Welded Butt Joints in Steel Plates
IS: 1363 Hexagon Head Bolts, Screws and Nuts (Grade-C)
IS: 1364 Hexagon Head Bolts, Screws and Nuts (Grades A & B)
IS: 1365 Slotted Counter-sunk Head Screws
IS: 1367 Technical Supply Condition for Threaded Fasteners
IS: 1821 Dimensions for Clearance Holes for Bolts and Screws.
IS: 1852 Rolling and Cutting Tolerances for Hot Rolled Steel Products
IS: 1977 Low Tensile Structural Steel
IS: 2016 Plain Washers
IS: 2062 Steel for General Structural Purposes
IS: 2074 Ready Mixed Paint, Air drying, Red Oxide-Zinc Chrome Priming


IS: 3063 Fasteners- Single Coil Rectangular Section Spring Washers

IS: 3400 Methods of Test for Vulcanized Rubber

IS: 3443 Crane Rail Sections

IS: 3600 Testing Methods of Fusion Welded Joints and Weld Metal in Steel

IS: 3613 Acceptance Tests for Wire Flux combination for submerged, Welding


IS: 3757 High Strength Structural Bolts

IS: 4000 Code of Practice for High Strength Bolts in Steel Structures

IS: 4206 Dimensions for Nominal Lengths and Thread Lengths for Bolts, Screws and Studs.

IS: 4353 Recommendations for Submerged Arc Welding of Mild Steel Low Alloy Steel.

IS: 4943 Assessment of Butt and Fillet Fusion Welds in Steel Sheet, Plate and Pipe.IS: 4923 Hollow Steel Sections for Structural Use

IS: 5334 Code of Practice for Magnetic Particle Flow Detection of Welds

IS: 5369 General Requirements for Plain Washers and Lock Washers

IS: 5372 Taper Washers for Channels

IS: 5374 Taper Washers for I Beams.

IS: 5624 Foundation Bolts

IS: 6227 Code of Practice for use of Metal Arc Welding in Tubular Structures

IS: 6623 High Strength Structural Nuts

IS: 6639 Hexagonal bolts for steel structures.

IS: 6649 Specifications for hardening and tempering washers for high strength structural nuts.

IS: 6755 Double coil helical spring Washer

IS: 7215 Tolerances for Fabrication of Steel Structure.

IS: 7318 (Part I) Approval Tests for Welders When Welding Procedure Approval is not required -fusion Welding of Steel.
5. MATERIALS

5.1 Structural Steel

a) All structural components shall be made from Hot Rolled Sections conforming to IS: 2062 Grade –BR (with mandatory impact test)- Structural steel (Fusion welding quality). Minimum metal thickness for hot rolled shall be 6 mm. Such steel shall be procured from approved manufacturers.

b) All steel tubes for structural purpose, shall be electric resistance welded (ERW) having minimum thickness as per class Heavy 3, and as approved by the Engineer, and shall conform to IS: 1161.

c) Purlins and side cladding runners only, shall be made from Cold Formed Sections and shall conform to A570 Gr 50 ASTM with minimum yield strength of 345 MPa.

d) Minimum metal thickness for Cold Formed Sections shall be 3.0 mm, UNLESS SPECIFICALLY PERMITTED BY Engineer-in-charge/Structural Consultants.

e) Structural steel conforming to Grade Fe540HT as per IS: 8500 will be adopted in case high strength steel is required.

f) IS: 226 Structural steel (Standard Quality).

g) IS: 961 High Tensile Structural Steel (Ordinary). The Contractor shall supply to the Engineer copies of the manufacturer certificate that the steel brought to the site for incorporation in the works is of a quality fully complying with the specification. If required by the Engineer, the Contractor shall arrange for testing of the steel samples as per IS: 1608 - 1599.

5.2 Bolts and Nuts

For splicing of any structural member wherever required HSFG bolts and nuts of property class-8.8 conforming to IS:3757 and IS:6623 (1985) respectively shall be used. Unless specified otherwise, the bolts shall be hexagonal. All anchor bolts shall be of property class of 8.8 and nuts shall conform to IS:1363 (1992), IS:1364 (1992) and IS:1367, as applicable, and unless specified otherwise, shall be hexagonal. All nuts shall conform to property class compatible with the property class of the bolt used.

5.3 Washers
For HSFG bolts, washer shall be conforming to IS:6649 (1985). Plain washers shall be conforming to IS:5369 (1975), unless otherwise specified. One washer shall be supplied with each bolt and, in case of special types of bolts, more than one washer as needed for the purpose shall be supplied. An additional double coil helical spring washer, conforming to IS:6755 (1980), shall be provided for bolts carrying dynamic or fluctuating loads and those in direct tension. Tapered washers, conforming to IS:5372 (1975) and IS:5374 (1975), shall be used for channels and beams respectively wherever required.

5.4 Electrodes

Electrodes used for metal are welding of mild steel shall be heavy coated type electrodes conforming to IS: 814 (Part I & II) and shall be of the best quality approved by the Engineer. All electrodes/wires/flux shall be kept under dry conditions. Any electrode /wires/flux damaged by moisture shall not be used unless it is guaranteed by the manufacturer that, when it is properly dried, there will be no detrimental effect. Any electrode, which has part of its flux coating broken away or is otherwise damaged, shall be rejected. Any electrode /wires/flux older than six (6) months from the date of manufacture shall not be used. Batch certificates for electrodes/wires/flux shall be submitted by the Contractor Welding consumables for Manual metal arc welding shall conform to IRS-M-28, Wire and Flux combination for Submerged Arc welding to IRS-M-39 and filler wires for CO2 welding to RDSO/ M & C, Specification.

5.5 Steel Supplied by the Contractor

a) The Contractor shall furnish to the Engineer all mill orders covering the material ordered by him for this project and also the test reports received from the Mills for his approval and information. It is not intended that all the steel materials to be supplied by the Contractor for the work shall be specially purchased from the rolling mills. The Contractor’s stock material may be used, provided the mill test reports identified with the materials, satisfactorily demonstrate the specified grade and quality. The Engineer shall have the right to test random samples to prove authenticity of the test certificates produced by the Contractor, at the Contractor’s cost.

b) All steel materials supplied by the Contractor shall be in a sound condition, of recent manufacture, free from defects, loose mill scale, slag intrusions, laminations, pitting, flaky rust, etc. and be of full weight and thickness specified.

c) Wherever the Contractor, in order to accommodate his other materials in stock, desires to substitute structural steels or plates for the sizes shown on drawings, such substitutions shall be made only after authorization in writing by the Engineer.

d) The Engineer may direct that substitution be made, when he considers such substitutions is necessary.

6. FABRICATION

a) All fabrication work shall be done in accordance with IS: 800, read in conjunction with relevant codes mentioned therein.

b) Fabrication shall be done in workshops approved by Engineer, unless specifically permitted by Engineer that fabrication can be done at site. Under such circumstances work shall be done on a specially designed and constructed platform. Location, size, specification and construction of such a platform shall have prior approval of Engineer. Loads associated with such platforms shall be provided to Engineer.

c) Mild steel rolled sections and plates shall be cut by shearing/machining and grinding the surfaces to true sizes and shapes. Gas cutting of mild steel may be permitted by the Engineer, provided that every cut face and edge is smoothened by grinding operation. Prior approval of Engineer must be obtained for using gas-cutting
techniques either by mechanized gas cutters or manually operated gas cutters. While, using gas-cutting methods, proper allowance must be made for grinding to bring the cut piece to exact required dimensions.

d) Extensive use of templates shall be made in doing fabrication work. Templates shall be clean and should have true surfaces prepared for every successive use. Reinforcements for the structural steel members if required shall be included. In case actual members are used as templates for similar pieces, it will be at the discretion of the Engineer to decide whether such pieces are fit to be incorporated in the finished structure. Jigs and manipulators shall be used, where practicable, and shall be designed to facilitate welding and to ensure that all welds are easily accessible to the operators.

e) All material shall be straight and free from twist and bends unless required to be curvilinear in from. If necessary the material shall be straightened and / or flattened / straightened by pressure. Heating of rolled sections and plates for purpose of straightening shall not be permitted.

f) Curvilinear members shall be formed by bending with the help of pneumatic press. Final shaping, to a very limited extent, however, may be done by local heat application. This shall be done only on receiving approval from the Engineer.

7. Holing

All holes shall be made at right angles to the surface of the member. Holes shall be clean cut without any torn or jagged edges. Holes shall be done by drilling. Punching shall not be resorted to, unless previously approved by the Engineer. In any case, punching of holes in materials having a thickness in excess of the connector diameter, or, for materials thicker than 16 mm, the hole shall be punched 3 mm less in diameter than the required size and then reamed to the full size. Holes shall not be formed or enlarged by burning or gas cutting under any circumstances.

8. WELDING

8.1 General

a) In general only Automatic submerged arc welding will be used for fabrication. Subject to approval of Engineer, Metal inert gas welding may be done for short length where access to the location of the weld does not permit submerged arc welding. The welding and the welded work shall conform to IS: 816, unless otherwise specified. As much work as possible shall be welded in shops and the layout and sequence of operations shall be so arranged as to eliminate distortion and shrinkage stresses. Unless otherwise specified all weld shall be for full contact for all sides.

b) Electrodes for shielded-arc manual welds shall comply with the requirements of IS:814 and shall be amenable to radiographic tests and shall be of approved make. The electrodes for manual arc welding shall be suitable for use in the position and type of work, as laid down in the above specifications and as recommended by the manufacturers. Electrodes classification group 1 or 2 as given in IS: 814 shall be used for welding steel conforming to IS: 2062. Electrodes shall conform to IS-1442 for steel conforming to IS: 8500. Joints in materials above 20 mm thick, and, all important connections shall be made with low hydrogen electrodes Electrode flux covering shall be sound and unbroken. Broken or damaged coating shall cause the electrodes to be discarded. Covered electrodes for manual arc-welding shall be properly stored in an oven prior to use in a manner recommended by the Manufacturer and only an hour’s quota shall be issued to each welder from the oven.

c) Electrodes larger than 5 mm diameter shall not be used for root-runs in butt weld. Welding plant and accessories shall have capacity adequate for the welding procedure laid down and shall satisfy appropriate standards and be of approved make and quality. the Contractor shall maintain all welding plant in good working order. All the electrical plant in connection with the welding operation shall be properly and
adequately earthed and adequate means of measuring the current shall be provided. All welds shall be made only by welders and welding operators who have been properly trained and previously qualified by tests to perform the type of work required as prescribed in the relevant applicable standards. All welds shall be free from defects like blow holes, slag inclusions, lack of penetration, undercutting, cracks etc. All welds shall be cleaned of slag or flux and show uniform sections, smoothness of weld metal, feather edges without overlap and freedom from porosity.

d) Fusion faces and surfaces adjacent to the joint for a distance of at least 50 mm on either side shall be absolutely free from grease, paint, loose scales, moisture or any other substance which might interfere with welding or adversely affect the quality of the weld. Joint surfaces shall be smooth, uniform and free from fins, tears, laminations etc. Preparation of fusion faces shall be done in accordance with the approved fabrication drawings by shearing, chipping, machining or machine flame cutting except that shearing shall not be used for thickness over 8 mm.

e) In the fabrication of cover-plated beams and built up members all shop splices in each component part shall be made before such component part is welded to other parts of the member. Wherever weld reinforcement interferes with proper fit-up between components to be assembled for welding, these welds shall be ground flush prior to assembly.

f) Members to be joined by fillet welding shall be brought and held as close together as possible and in no event shall be separated by more than 3 mm. If the separation is 1.5 mm or greater, the fillet weld size shall be increased by the amount of separation. This shall only apply in the case of continuous welds. The fit-up of joints at contact surfaces which are not completely sealed by welds shall be close enough to exclude water after painting.

g) The separation between fraying surfaces of lap joints and butt joints with backingplate shall not exceed 1.5 mm. Abutting parts to be butt welded shall be carefully aligned and the correct root gap maintained throughout the welding operation. Misalignments greater than 25 percent of the thickness of the thinnerplate or 3 mm whichever is smaller shall be corrected and in making the correction the parts shall not be drawn into a slope sharper than 2 degrees (1 in 27.5).

h) Welding procedures recommended by appropriate welding standards and known to provide satisfactory welds shall be followed. A welding procedure shall be prepared by the Contractor and submitted to the Engineer for approval beforerestart of welding.

i) Approval of the welding procedure by the Engineer shall not relieve the Contractor of his responsibility for correct and sound welding without undue distortion in the finished structure.

j) Voltage and current (and polarity if direct current is used) shall be set according to the recommendations of the Manufacturer of the electrode being used, and suitable to thickness of material, joint form etc. The work shall be positioned for flat welding wherever practicable and overhead weld shall be avoided.

k) No welding shall be done when the surface of the members is wet, nor during periods of high wind unless the welding operator and the work are properly protected. In joints connected by fillet welds, the minimum sizes of single run fillet welds or first runs and minimum full sizes of fillet welds shall conform to therequirements of IS: 816 and IS: 823. Fillet welds larger than 8 mm shall be made with two or more passes.

l) All ‘full penetration butt welds’ made by manual arc-welding, except when produced with the aid of backing material or welded in flat position, from bothsides in square-edge material, not over 8 mm thick with root opening not less than one-half the thickness of the thinner part joined, shall have the root of the initial layer gouged out on the back side before welding is started from that side, and shall be so welded as to secure sound metal and complete fusion throughout the entire cross section.
m) Butt welds shall be terminated at the ends of a joint in a manner that will ensure their soundness. Where abutting parts are 20 mm or more in thickness, run-on and run-off plates with similar edge preparation end having a width not less than the thickness of the thicker part joined shall be used. These extension pieces shall be removed upon completion of the weld and the ends of the weld made smooth and flush with the abutting parts. Where the abutting parts are thinner than 20 mm the extension pieces may be omitted but the ends of the butt weld shall then be chipped or gouged out to sound metal and side welded to fill up the ends to the required reinforcement.

n) Each layer of a multiple layer weld except root and surface runs may be moderately peeled with light blows from a blunt tool. Care shall be exercised to prevent scaling or flaking of weld and base metal from over-peeling.

o) Before commencing fabrication of a member or structure in which welding is likely to result in distortion and/or locked up stresses, a complete program of fabrication, assembly and welding shall be made and submitted to the Engineer for his approval. Such a programme shall include, besides other appropriate details, full particulars in regard to the following:

i) Proposed pre-bending of components such as flanges and presetting of joints to offset expected distortion.
ii) Make up of sub-assemblies proposed to be welded before incorporation in final assembly.
iii) Proposed joint forms, classification of wire and flux or covered electrodes, welding process including fitting and welding sequence with directions in which freedom of movement is to be allowed.
iv) Proposed number, spacing and type of strong details of jigs and fixtures for maintaining proper fit up and alignment during welding.
v) Any other special features like assembling similar members back to back or stress relief.

Suggestive Minimum Preheating Of Metals:

<table>
<thead>
<tr>
<th>Thickness Of Thickest Part At Point Of Welding</th>
<th>Minimum Preheat &amp; Inter-pass Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Other than low-hydrogen welding electrodes</td>
</tr>
<tr>
<td>IS : 226 steel or IS : 2062 steel</td>
<td>IS : 961 steel</td>
</tr>
<tr>
<td>Upto 20 mm incl.</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>None</td>
</tr>
<tr>
<td>Over 20 mm to 40 mm incl.</td>
<td>65°C</td>
</tr>
<tr>
<td>Over 40 mm to 63</td>
<td>110°C</td>
</tr>
</tbody>
</table>


p) If so desired by the Engineer, mock up welding shall be carried out at the Contractor’s cost to establish the efficacy of the proposed program, with any modification suggested by the Engineer in limiting distortion or and residual stress to acceptable levels. Such modifications will not relieve the Contractor of any of his responsibilities.

q) The ends of butt joints shall be welded so as to provide full throat thickness. This may be done by the use of extension pieces, cross-runs or other approved means. The weld face shall, at all places, be deposited projecting the surface of the parent metal. Where a flush surface is required, the surplus metal shall be dressed off. Splices and butt joints of compression members, depending on contact for stress-transmission, shall be accurately machined over the whole section. In column bases, the ends of shafts together with the attached gussets, angles, Channels etc., after bolting and/or welding together as the case may be, shall be accurately machined so that the parts connected butt over the entire surface of contact. Care shall be taken that connecting angles or channels are fixed with such accuracy that they are not reduced in thickness by machining by more than 0.8mm.

r) The minimum leg length of a fillet weld as deposited shall be not less than the specified size. In no case shall a concave weld be deposited, unless specifically permitted. Where permitted, the leg length shall be increased above that specified length, so that the resultant throat thickness is as great as would have been obtained by the deposition of a flat-faced weld of the specified leg length.

s) After making each run of welding, all slag shall be thoroughly removed and the surface cleaned. The weld metal, as deposited (including tack welds), shall be free from cracks, slag inclusions, porosity, cavities and other deposition faults.

The weld metal shall be properly fused with the parent metal without under cutting or overlapping at the toes of the weld. The surface of the weld shall have a uniform consistent contour and regular appearance.

8.2 INSPECTION OF WELDS
a) All welds shall be inspected for flaws by any of the methods described in these specifications, and as per IS: 822. The choice of the method to be adopted shall be determined by the Engineer.

b) The Contractor shall arrange for all tests as called for in the schedule of quantities, at his own cost.

c) In case the tests uncover defective work, such tests shall be at the Contractor’s cost and the Contractor shall correct such defects at his own cost, and prove the soundness of rectified work.

d) The correction of defective welds shall be carried out as directed by the Engineer without damaging the parent metal. When a crack in the weld is removed, magnetic particle inspection or any other equally positive means as prescribed by the Engineer shall be used to ensure that the whole of the crack and material up to 25 mm beyond each end of the crack has been removed. Cost of all such tests and operations incidental to correction shall be to the Contractor’s account.

9. FABRICATION TOLERANCES
Unless otherwise shown on drawings, the fabrication tolerances shall generally be as detailed hereunder.

9.1 Straightness
The dimensional and weight tolerance for rolled shapes shall be in accordance with IS: 1852 for indigenous steel and equivalent applicable codes for imported steel. The acceptable limits for straightness (sweep and
camber) for rolled or fabricated members shall be: Struts and columns: L/1000 or 10 mm whichever is smaller for all other members not primarily in compression such as purlins, beams, bracings & web members of trusses and latticed girders: L/500 or 15 mm whichever is smaller. Where L is the length of finished member, or such lesser length as the Engineer may specify.

9.2 Twists
a) A limit for twist (prior to erection) in :-Box girders and heavy columns: L/1500Other members: L/1000
b) The twist of the member between any two sections shall be measured with the web vertical at one of the sections.

9.3 Camber
Tolerance in specified camber of structural members shall be + 3 mm.

9.4 Length
Tolerance in specified length shall be as follows :

Type of Member Tolerance
A column finished for contact bearing: + 1 mm
Other members (e.g. beams) under 10 m: + 0 and - 3 mm
Other members (e.g. beams) 10 m long and over: + 0 and - 5 mm

9.5 Square-Ness at End of Members
a) Beam to beam and beam to column connections where the abutting parts are to be joined by butt welds, permissible deviation from the square-ness of the end is:
Beams up to 600 mm in depth : 1.5 mm
Beams over 600 mm in depth : 1.5 mm every 600 mm depthUp to a max of 3 mm

b) Where abutting parts are to be joined by bolting through cleats or end plates, the connections require closer tolerance. Permissible deviation from square ness of the end is -
Beams up to 600 mm in depth: 1 mm
Over 600 mm in depth: max of 1.5 mm.

9.6 Butt Joints
9.6.1 For full bearing, two abutting ends of columns shall first be aligned to within 1 in 1000 of their combined length and then the following conditions shall be met:
a) Over at least 80% of the bearing surface the clearance between the surfaces does not exceed 0.1 mm.
b) Over the remainder of the surfaces the clearance between the surfaces does not exceed 0.3 mm. Where web stiffeners are designed for full bearing on either the top flange or bottom flange or both, at least half the stiffener shall be in positive contact with the flange. The remainder of the contact face could have a max. gap of 0.25 mm.

9.7 Depth of Member
Acceptable deviation from the specified overall depth is :
For depths of 900 mm and under: + / - 3 mm
For depths over 900 mm and under 1800 mm: + / - 5 mm
For Depths of 1800 mm and over: + 8 mm; - 5 mm.

9.8 Web Plates
Acceptable deviation from flatness in girder webs in the length between the stiffeners or in a length equal to the girder depth shall be 1/150th of the total web depth.
9.9 Flange Plates
a) Limit for combined warp-age and tilt on the flanges of a built up member is 1/200 of the total width of flange or 1.5 mm whichever is smaller measured with respect to center-line of flange.
b) Lateral deviation between center-line of web plate and center-line of flange plate at contact surfaces, in the case of built up sections shall not exceed 3 mm.

10. INSPECTION
10.1 The Contractor shall give due notice to the Engineer in advance of the materials or workmanship getting ready for inspection.
a) All rejected material shall be promptly removed from the shop and replaced with new material for the Engineer’s approval / inspection. The fact that certain material has been accepted at the Contractor’s shop shall not invalidate final rejection at site by the Engineer, if it fails to be in proper condition or has fabrication inaccuracies which prevent proper assembly. No materials shall be painted or dispatched to site without inspection and approval by the Engineer unless, such inspection is waived in writing by the Engineer.

b) Shop inspection by the Engineer or his authorized representative, or, submission of test certificates and acceptance thereof by the Engineer, shall not relieve the Contractor from the responsibility of furnishing material conforming to the requirements of these specifications. Nor shall it invalidate any claim, which the Engineer may make because of defective or unsatisfactory material and/or workmanship.

c) The Contractor shall provide all the testing and inspection services and facilities for shop work except where otherwise specified. For fabrication work carried out in the field, the same standard of supervision and quality control shall be maintained as in shop fabricated work. Inspection and testing shall be conducted in a manner satisfactory to the Engineer.

11. Testing

11.1 Material Testing
If mill test reports are not available for any steel materials, the same shall be got tested by the Contractor to the satisfaction of Engineer to demonstrate conformity with the relevant specification.

11.2 Tests on Welds
Magnetic Particle Test Only where the Engineer requires that flaw-detection of welds be done by ‘Magnetic Particle Test’, in such cases the tests are to be done in accordance with IS: 3703. If heat treatment is performed, the completed weld shall be examined after the heat treatment. All defects shall be repaired and re-tested. Magnetic particle tests shall be carried out using alternating current. Direct current may be used with the explicit written permission of the Engineer.

11.3 Dye Penetration Test
Where welds are required to be examined by dye penetration inspection method, such tests shall be carried out in accordance with IS: 3658.

11.4 Radiographic Inspection
Whether instructed by Engineer, or not, all ‘Butt’ welds shall be fully inspected by radiographic examination method. Such examination shall be done in accordance with the recommendations of IS: 1182.

11.5 Test Failure
At any stage, in the event of any material or work failing to meet an inspection or test requirement, which is not overseen by the Engineer, the Contractor shall notify the Engineer immediately. The Contractor must obtain permission from the Engineer before repair is undertaken. The quality control procedures to be followed to ensure satisfactory repair shall be subject to approval by the Engineer. The Engineer has the right to specify
additional inspection or testing as he deems necessary, and the additional cost of such testing shall be borne by the Contractor. The Contractor shall maintain records of all inspection and testing which shall be made available to the Engineer on demand.

11.6 Shop Matching
Some steel Contractor shall comply with such instructions without claiming any extra cost.

11.7 Shop Assembly
a) The steelwork shall be temporarily shop assembled, as necessary, so that the accuracy of fit may be checked before dispatch. The parts shall be shop assembled with a sufficient number of parallel drifts to bring and keep the parts in place
b) Since parts drilled or punched, with templates having steel bushes shall be similar and, as such, interchangeable, such steelwork may be shop erected in part only, as agreed by the Engineer.

d) Trial assemblies shall be carried out at the fabrication stage to ensure accuracy of workmanship, and these checks shall be witnessed by the Engineer/Authorised inspecting agency. Such trial assemblies shall be at the cost of the Contractor.

e) Field Bolts
i) Requirements stipulated under bolting shall apply for field bolts also. Field bolts, nuts and washers shall be furnished by the Contractor in excess of the nominal numbers required. He shall supply the full number of bolts, nuts and washers and other necessary fittings required completing the work, together with the additional bolts, nuts and washers totaling to 10% of the requirement subject to minimum of 10 Nos.

ii) At the time of assembly, the surfaces in contact shall be free of paint or any other applied finish, oil, dirt, loose rust, loose scale, burrs and other defects which would prevent solid seating of the parts or would interfere with the development of friction between them.

iii) If any other surface condition, including a machined surface, is specified, it shall be the responsibility of the Contractor to work within the slip factor specified for the particular case.

iv) Each bolt and nut shall be assembled with washers of appropriate shape, quality and number in cases where plane parallel surfaces are involved. Such washers shall be placed under the bolt head or the nut, whichever is to be rotated during the tightening operation. The rotated nut or bolt head shall be tightened against a surface normal to the bolt axis, and the appropriate tapered washer shall be used when the surfaces are not parallel. The angle between the bolt axis and the surface under the non-rotating component (i.e. the bolt head or the nut) shall be 90 + 3 degree. For angles outside these limits, a tapered washer shall be placed under the non-rotating component. Tapered washers shall be correctly positioned.

v) No gasket or other flexible material shall be placed between the holes. The holes in parts to be joined shall be sufficiently well aligned to permit bolts to be freely placed in position. Driving of bolts is not permitted. The nuts shall be placed so that the identification marks are clearly visible after tightening. Nut and bolts shall always be tightened in a staggered pattern and where there are more than four bolts in any one joint, they shall be tightened from the centre of the joint outwards.
vi) If, after final tightening, a nut or bolt is slackened off for any reason, the bolt, nut and washer or washers shall be discarded and not used again.

11.9 Marking of Members

a) After checking and inspection, all members shall be marked for identification during erection. This mark shall correspond to distinguishing marks on approved erection drawings and shall be legibly painted and stamped on it. The erection mark shall be stamped with a metal dye with figures at least 20 mm high and to such optimum depth as to be clearly visible, even after a member is galvanized.

b) All erection marks shall be on the outer surface of all sections and near one end, but clear of bolt-holes. The marking shall be so stamped that they are easily discernible when sorting out members. The stamped marking shall be encircled boldly by a distinguishable paint to facilitate easy location. Erection marks on like pieces shall be at identical location. Members having lengths of 7.0 m or more shall have the erection mark at both ends.

c) Each fabricated member, whether assembled prior to dispatch or not so assembled, shall bear an erection mark, which will help to identify the member and its position in respect of the whole structure, to facilitate re-erection at site. This erection mark shall be incorporated in the shop detail and erection drawings.

11.10 Errors

Any error in shop work which prevents proper assembling and fitting up of parts in the field by moderate use of drift pins or moderate amount of reaming will be classified by the Engineer as defective workmanship. All charges incurred by the Engineer either directly or indirectly because of the poor workmanship will be deducted from the amount due to the Contractor before payment is made. The amount of such deduction will consist of the sum total of the costs of labour direct or indirect, material, plant, transportation, equipment rental and overhead expenses. In case the Engineer chooses to reject the material because of poor workmanship, the cost of all handling and returning the material to the Contractor, if he so desires, shall entirely be to the Contractor’s account. All the replacement materials shall be supplied free and in all such cases, the cost of handling, transport and delivery to site shall be borne by the Contractor.

12. ERECTION

12.1 Erection of structural steel fabricated components shall be done generally in accordance with provisions of IS: 800.

12.2 Before starting of erection work, the contractor shall ensure the fulfillment of the following activities:

a) The contractor shall submit, for examination by the Engineer, detailed particulars of his proposed methods of erection of the superstructure steelwork, together with complete calculations relating to strength and deflection. If the erection scheme necessitates the attachment of strength steelwork to the permanent steelwork, the contractor shall submit, for approval of the Engineer, the methods he proposes for making good the permanent steelwork after removing the temporary work. The contractor shall also submit the design and fabrication drawings including detailed calculations of temporary nose, counter weight, all temporary support, staging, braces etc. required for safe erection, for approval of the Engineer.

b) The contractor shall provide all construction and transport equipment, tools, tackle, and consumables, materials, labour and supervision required for the erection of the structural steelwork.

c) Handling, assembling, bolting, welding and satisfactory installation of all fabricated structural steel materials in proper location, according to approved erection drawings and/or as directed by the Engineer.

d) Setting out, aligning, plumbing, leveling, bolting, welding and securely fixing the fabricated steel structures in accordance with the erection scheme, or as directed by the Engineer.
12.3 Grouting under base plates shall be done after erection of the structural steel, unless otherwise approved by the Engineer. All bearing plates and bearing assemblies shall be set level and to the elevations shown on drawings. These shall be shimmed with approved means and grouted to ensure full bearing on the supporting substrate regardless of the tolerances otherwise permitted. The grout to be used in superstructure or stanchion bases shall be shrink resistant grouting compound of approved make and manufacture and shall have a 28 days compressive strength of at least 30 N/sqmm. The surfaces which have to receive the grout shall be thoroughly cleaned immediately prior to the grouting operation. The grout shall be carefully worked under the base plates and shall completely fill the space under the base plates. After the grout has had its initial set, the grout shall be cut back flush with the base plate as shown in drawings and surplus grouting material removed. The surplus material thus removed shall not be re-used. If inserts in concrete are required, the contractor shall furnish all inserts including any reinforcement required for embedding in the concrete to the concrete contractor. It should include providing layout drawings to the concrete contractor for placement of such inserts into concrete.

12.4 Erection Tolerances
Erection tolerances shall be as per code IS 12843.

13. QUALITY CONTROL & TESTING REQUIREMENTS

13.1 Quality Control through established testing norms of the welded structural steelwork or Engineer in charge.
   a) The Contractor shall submit the following:
      □ □ Proposed overall schedule for documentation of shop drawings, plan/procedures and records, submission of procedure of fabrication.
      □ □ The contractor shall himself inspect all materials and shop work to satisfy the specified tolerance limits and Quality norms before the same are reinspected by Engineer.

   b) The contractor shall through appropriate planning and continuous measurements in the workshop and the erection at site, ensure that the tolerance specified in IS 12843 are strictly adhered to.

13.2 Fabricating agency shall have in house facilities for all testing of weld.

13.3 Visual Examination
The contractor shall conduct visual examination and measurement of the external dimensions of welds for all joints. Before examining the welded joints, areas close to it on both sides of the weld for a width not less than 20 mm shall be cleaned of slag and other impurities. Examination shall be done by a magnifying glass which has a magnification power of ten (10) and measuring instrument which has an accuracy of + 0.1 mm or by weld gauges. Welded joint shall be examined from both sides. The contractor shall examine the following during the visual checks.

   a) Correctness and shape of the welded joints
   b) Incomplete penetration of weld metal.
   c) Influx
   d) Burns
   e) Unwelded craters
   f) Undercuts
   g) Cracks in welded spots and heat affected zones
   h) Porosity in welds and spot welds
   i) Compression in welded joints as a result of electrode impact while carrying out contact welding
   j) Displacement of welded element
The contractor shall, document all data as per sound practices.

13.4 In order to exercise proper control of the quality of the welding, Contractor shall enforce methods of control as tabulated below:
### Purpose

<table>
<thead>
<tr>
<th>Control subjects</th>
<th>Methods of control</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

#### (i) Control of welding materials and basic metal quality
- Quality control of electrodes, welding wire, flux and protective gases.
- Checking of quality and Weldability of the basic metal and welded members
- Weldability test to determine the technological properties of materials.
- Mechanical test of weld metal.
- Metallographical investigations of welds macro-structure and microstructure.
- Checking of weld metal resistance for inter crystalline corrosion
- Study if weld metal solidity by physical control methods

#### (ii) Checking of welders qualifications
- Welding of specimens for quality determination
- Mechanical tests, metallographical investigation & checking of welded joints by physical control methods
- Checking of assembly quality & centering of welded members

#### (iii) Control of welded joint quality
- Control of assembly accuracy and technological welding process
- Checking of welding equipment conditions.
- Checking correctness of welding procedure. Visual examination of welds

### 13.5 Mechanical Test
The Contractor shall carry out various mechanical tests to determine weld-ability, metal alloy ability, and nature of break, correct size and type of electrodes, degree of pre-heat and post-heat treatment. The type, scope and sample of various mechanical tests shall be determined in agreement with the purchaser. The number of tests conducted shall depend on the result obtained to satisfy the Engineer that the correct type and size of electrode, degree of pre-heating and post-heating and weld-ability of metal are being followed.

### 13.6 Dye Penetration Test
All welds (100%) shall be tested by “Dye Penetration test” as per current practices.

### 13.7 Radiography Test
Radiography test shall be conducted by the contractor to determine gas inclusion (blow holes, hollows) slag inclusion, shallow welds and cracks for 100 % length of all butt joints. Before conducting the examination the welded joints shall be cleaned of slag and scales and visually examined. The welds shall be marked into separate portions depending on the length of photograph. The length of photograph shall be such as to ensure that there are no distortions and shall reveal the defect correctly. The length shall not be more than 0.75 of the focal distance and the width of the photograph would depend on the width of the welded joint plus 20 mm on either side of the weld. The cassette with film shall be protected by sheet of lead or equivalent of proper thickness against incidental, diffused and secondary radiation. The direction of the ray with relation to the film shall be as specified hereunder.

Welds of butt joints without edge slopes with edge processing shall be examined by central ray directed at right angles to the weld. In special cases examination of welds with inclined rays directed along edges slopes may be permitted by the Engineer/Authorized inspecting agency. Lap joints shall be examined by directing rays at 45 degree to the bottom plate. Welds in T-joints, without any edge preparation shall be examined by rays directed at 45 degree to the weld. Angle welds in lap and tee-joints shall be examined by the rays in opposite direction, i.e. the film will be on the side of the weld. Weld in angle joints shall be checked by directing ray along the bisector of the angle between the welded elements. Opposite direction of the ray and location of the film may also be permitted by the Employer.

13.8 Ultrasonic Test
Ultrasonic test shall be conducted by the contractor to detect gas inclusion (pores), slag inclusion, shallow welds, cracks, lamination and friability etc for the fillet joints. Prior to starting of ultrasonic test the welded joint shall be thoroughly cleaned of slag and other material. Surface of the basic metal adjacent to welded joint on both sides shall be mechanically cleaned by the grinder or a metal brush to provide the contact of the whole ultrasonic probe surface with surface of basic metal. The width of the clean surface shall be as directed by the Engineer/Authorized inspecting agency. The welded joint then shall be covered with a thin coat of transformer oil, turbine or machine oil to ensure acoustic contact. The joints so treated shall be marked and the marks shall be entered into the documentation, subsequent to this, ultrasonic test shall be carried out as directed by the Engineer. Unless otherwise directed by the Engineer 10% of welds shall be subjected to ultrasonic testing. Engineer may at his discretion reduce the frequency of such tests depending on the performance record of earlier tests.

13.9 Magnetic particle Test
Based on other test results, or considerations that raises doubts on welded joints at important locations in the structure, the Engineer may call for Magnetic Particle Tests of joints. The Contractor shall comply with such requirements, and arrange for such tests at his own cost.

14. PAINTING OF STRUCTURAL STEEL WORK
14.1 Paint
a) All paint delivered to the fabrication shop shall be ready mixed, in original sealed containers, as packed by the paint manufacturers. Addition of thinners shall not be permitted.
b) Opened containers of Paint shall be stirred frequently to keep the pigment in suspension.
c) Apoxi paint shall be used on steel structure as well as on Puff panels to protect it from damage due to Chemicals like in anodizing plant etc.

14.2 Storage of Paints
a) All paints shall be stored strictly in accordance with the requirements laid down by the paint manufacturers. The storage area shall be well ventilated and protected from sparks, flame, direct exposure to sun or excessive heat, preferably located in an isolated room or in a separate building.
b) All paint containers shall be clearly labeled to show paint identification, date of manufacture, batch number, order number and special instructions in legible form. The containers shall be opened only at the time of use. Paints that have delivered, gelled or otherwise deteriorated during storage, shall not be used. Paints, for which the
shelf life specified by the supplier has expired, shall not be used without inspection and approval by the Engineer.

14.3 Execution
Paint System
a) In general, except where specified otherwise in approved shop drawings Sand blasting of steel surfaces shall be carried out in accordance with SSPC SP 10 or SA 2.5, near to white metal blast.
b) All steel sections used in elevated stations shall be painted with Intumescent Fire Paint rated for minimum of 30 minutes as mentioned below. Any primer and finish applied on the structure to be Fire Proofed shall be compatible with the Intumescent Fire Paint. The approved Fire Paint manufacturer must submit certification to this effect. All the paints used shall be from the same manufacturer to avoid compatibility related problems. The finish paint shall be Acrylic Polysiloxane finish. The Intumescent Fire Paint which will be applied on the steel structure will confirm to BS 476 Part 20-22 1987. The Painting Specifications shall comprise of the following:

<table>
<thead>
<tr>
<th>DESCRIPTION</th>
<th>GENERAL SURFACE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fabrication Shop</strong></td>
<td><strong>External Surfaces</strong></td>
</tr>
<tr>
<td><strong>Surface Treatment</strong></td>
<td>Abrasive Blast to minimum SA 2.5 (ISO 8501-1:1988) or SSPC SP-10 near to white metal blasting</td>
</tr>
<tr>
<td><strong>1st Coat</strong></td>
<td>Two Component Zinc Phosphate Epoxy Primer (self curing solvent type) with approximate volume solids 63%. The primer shall be applied by spray only over blasted surfaces. The DFT in a single coat shall be minimum 75 microns.</td>
</tr>
<tr>
<td>2nd Coat</td>
<td>Solvent Based Acrylic Intumescent Paint with approximate Volume Solids 68-74% confirming to BS 476 Part 20-22:1987. This product shall have a Certifier Approval. This product shall have a product weight of approximately 1.3 to 1.5 kg/liter. This product should give a rating of 30 minutes. The thickness determined should be in accordance to the Hp/A given by approved manufacturer. Airless spray of minimum pump ratio 66:1 shall apply the Intumescent Paint. The rating will be for minimum 30 minutes.</td>
</tr>
<tr>
<td>3rd Coat</td>
<td>Two components Fast Curing Epoxy Tie Coat with approximate volume solids of 45 to 60%, compatible with previous PFP coat with initial drying of 30 minutes at 250C. DFT-40 microns.</td>
</tr>
</tbody>
</table>
## Finish Paint

Two components hi Gloss Hybrid Polysiloxane Finish Paint with Approximate volume solids of 70% or above. The product should exhibit Gloss retention of a minimum 90% after 3000 hrs exposure to UVA Florescent lamp, as per ASTM D 523. The product hard dry time should not be more than 6 hrs @ 250 C and 50% RH. DFT-60 microns

**INTERNAL SURFACE** = Internal surface are those which will become inaccessible after fabrication and are not prone to humidity and moisture from the atmosphere.

**EXTERNAL SURFACE** = All other surfaces which are prone to humidity and moisture from the atmosphere.

1. DFT measurement should be done in accordance with Specifications SSPC PA.
2. The entire paint system shall be from the same manufacturer.

### Touch-up

Surfaces to be touched up shall be cleaned as per ST2 and primed with a Surface Tolerant Epoxy and the entire system of paint excluding the primer to be replace thereafter.

### 14.4 Surface Preparation

a) All surfaces shall be cleaned of loose substances and foreign materials. e. g. dirt, rust, scale, oil, grease, welding flux etc so that the prime coat adheres to the original metal surface. The work shall be carried out in accordance with IS: 1477(Part I). Any oil, grease, dust or foreign matter deposited on the surface after preparation shall be removed and care shall be taken to ensure that the surface is not contaminated with acids, alkalis or other corrosive chemicals. The primer coat shall be applied immediately after the surface preparation is completed.

b) Before the application of any paint the surfaces to be treated shall be thoroughly cleaned freed from all scale, loose paint, rust and other deleterious matters. Oil and grease shall be removed from the surface by washing with solvents or with a detergent solution before blast cleaning operation of metal polish with metal pellets. If any traces of oil or grease remain after blasting they shall be removed by solvent cleaning and the area will be re-blasted thereafter.

c) All welding areas shall be given special attention for removal of weld flux slag, weld metal splatter, weld head oxides, weld flux fumes, silvers and other foreign objects before blasting. If deemed necessary by the Engineer, acid washing and subsequent washing with clean water shall be used.

d) Any rough seams will have to be ground and must be inspected and approved by the Engineer before application of the coatings.

All structural steel to be painted shall be cleaned. Blast cleaning in accordance with SA 2 1/2 Near- White Blast cleaning (equivalent Swedish Standard SIS055900). For SA 2 1/2 the profile should be in the range of 40-70 microns and shall be measured with comparator. Mill scale, rust and foreign matter shall be removed to
the extent that the only traces remaining are light stains in the form of spots or stripes. Finally the surface shall be cleaned with a vacuum cleaner or clean dry compressed air.

e) The blast cleaning shall produce a surface roughness complying with the onespecified by the paint manufacturer for the primer concerned. If, cleaned surfaces are rusted or are contaminated with foreign material before painting is accomplished they shall be re-cleaned by the Contractor at his own expenses.

f) The surface shall be cleaned by impingement of abrasive materials, such as grit of cast iron, malleable iron, steel or synthetic material, at high velocity created by clean and dry compressed air blast. Prior to application of the blast, heavy deposits of oil and grease shall be removed by solvent cleaning and excessivesurface scale removed by hand tool or power tool cleaning.

14.5 Mixing and Thinning

a) All ingredients in a paint container shall be thoroughly mixed to break-up lumps and disperse pigments, before use and during application, to maintain homogeneity. All pigmented paints shall be strained after mixing to remove skins and other undesirable matters.

b) Dry pigments, pastes, tinting pastes and colours shall be mixed and/or made into paint so that all dry powders get wetted by vehicles and lumps and particles are uniformly dispersed.

c) Additives that are received separate such as curing agents, catalysts, hardeners etc. shall be added to the paint as per the manufacturer’s instructions. These shall be promptly used within the pot life specified by the manufacturers and unused paint thereafter shall be discarded.

d) Thickeners shall not be used unless essential for proper application of the paint. Where thickeners are used, they shall be added during the mixing process and the type and quantity of thinner shall be in accordance with the instructions of paint manufacturer.

14.6 Paint Application

a) Paint shall be applied in accordance with the manufacturer recommendations, as supplemented by these Specifications. The work shall generally follow IS: 1477-(Part II). Prior approval of the Engineer shall be taken in respect of all primers and/or paints before their use in the works.

b) Paint shall generally be applied by brushing except that spraying may be used for finish coats only when brushing may damage the prime coats. Roller coat or other method of paint application shall not be used unless specifically authorized.

c) Spraying paint shall not be adopted on red lead or zinc rich paints. Daubers maybe used only when no other method is practicable for proper application in difficult accessible areas.

d) Paint shall not be applied when the ambient temperature is 10°C and below. For paints which dry by chemical reaction the temperature requirements specified by the manufacturer shall be met with. Also, paint shall not be applied in rain, wind, fog or at relative humidity of 80% and above or when the surface temperature is below dew point, resulting in condensation of moisture. Any wet paint exposed to damaging weather conditions shall be inspected after drying and the damaged area repainted after removal of the paint.

e) Each coat of paint shall be continuous, free of pores and of even film thickness without thin spots. The film thickness shall not be so great as to detrimentally affect either the appearance or the service life of the paint.

f) The first coat of paint shall be applied within 4 hours after cleaning and/or before rusting or contamination occurs.

g) Each coat of paint shall be allowed to dry sufficiently before application of the next coat, to avoid damages such as lifting or loss of adhesion. Undercoating glossy surface shall be roughened by mild sand papering to improve adhesion of subsequent coats. Successive coats of same colour shall be tinted. Whenever practical, to produce contrasts and help in identifying the progress of the work.

14.7 Brush Application

a) Proper brushes shall be selected for a specific work piece. Round or oval brushes which conform to IS: 487 are better suited for irregular surfaces, whereas flat brushes which conform to IS: 384 are convenient for large flat areas. The width of flat brushes shall not generally exceed 125mm.

b) Paint shall be applied in short strokes depositing a uniform amount of paint in each stroke followed by brushing the paint into all surface irregularities, crevices and corners and finally smoothening or leveling the
paint film with long and lightstrokes at about right angles to the first short strokes. All runs and sags shall be brushed out. The brush marks left in the applied paint shall be as few as practicable.

14.8 Spray Application
a) The spraying equipment shall be compatible with the paint material and provided with necessary gauges and controls. The equipment shall be cleaned of dirt, dried paint, foreign matter and solvent before use.

b) The paint shall be applied by holding the gun perpendicular to the surface at a suitable distance no closer than 200mm or more than 600mm and moved in a pattern so as to ensure deposition of a uniform wet layer of paint. All runs and sags shall be brushed out immediately. Areas not accessible to spray shall be repainted by brush or dauber.

c) Water trap acceptable to Engineer/ Authorised inspecting agency shall be furnished and installed on all equipment used in spray painting.

14.9 Shop Painting
a) The painting system specified in Table shall be followed. Surfaces, which will be inaccessible after field assembly, shall receive the full-specified protectivetreatment before assembly.

b) Surfaces in contact during shop assembly shall not be painted. Surfaces which cannot be painted but require protection shall be given a rust inhibitive grease conforming to IS: 958 or solvent deposited compound conforming to IS: 1153 or IS: 1674 or treated as specified in the drawing.

c) Surface to be in contact with concrete shall not be painted.

d) The shop coats shall be continuous over all edges, including ends meant for jointing at site by bolting, except where the paint could be detrimental to bolting. In such cases, no paint shall be applied within 50mm, and the unprotected surface shall be given a coat of corrosion inhibitive compound.

e) The unpainted area shall be cleaned prior to welding. The welded joint shall be cleaned and deslagged, and immediately after covered by the same paint as has been used for the remaining surface.

14.10 Protection of Paintwork
a) The Contractor shall provide measures as necessary to prevent damage to the work and to other property or persons from all cleaning and painting operations. Paint or paint stains which result in other unsightly appearance on surfaces not designated to be painted shall be removed or obliterated by the contractor at his cost.

b) All painted surfaces that in the opinion of the Engineer/ Authorized inspecting agency are damaged in anyway, shall be repaired by the contractor at his cost with materials and to a condition equal to that of the requirements specified in these specifications.

c) Upon painted surfaces that in the opinion of any other work that would caused dust, grease or foreign materials to be deposited upon the painted surfaces, the painted surfaces shall be thoroughly cleaned.

d) The areas for high-strength bolts shall be protected by masking tape against undercoat application at the fabrication shop. Immediately prior to erection any rust in the paint area shall be removed by power wire brushing to a standard equivalent to SA3.

14.11 Contractor shall make provision for requisite site painting to all fabricated steelwork, as per requirements of related specifications of the painting.

14.12 Repair of Paint Defects
All damage to the previous paint shall be repaired. All loose paints shall be removed back to firm edge. Surface irregularities and contaminants shall be removed. Hard, glossy surfaces may require abrading to obtain a suitable surface for painting. Surfaces, which are to be over coated and which have become contaminated shall
be either be solvent cleaned in accordance with SSPC-SP-1 “Solvent Cleaning” or high pressure fresh water washed and if required, a suitable detergent may be used.

14.13 Inspection

Testing

The final paint shall be free from obvious defects and shall be tested by the contractor as follows:

a) Film Thickness: All dry-film thickness limits as specified shall be strictly adhered to. It is recommended that, in order to achieve the specified dry-film thickness, frequent checks of wet-film thickness are to be carried during the paint application with wet-film thickness gauges such as the Elcometer wheel or comb type wheelgauge. The dry film thickness of individual coats and of the total coating system shall be checked at random over an area representative of the total work. A minimum of 5 readings shall be taken for each 10 m² of coated surface. For a surface area less than 10 m², a minimum of 3 readings shall be taken. Additional readings shall be taken if there has been any changes in application of equipment, spray nozzle size, thinning of paint, etc.

b) Inspection: The application work to be inspected at all stages and finished paintwork shall have the correct shade, degree of gloss and evenness and be free from defects such as cracks, holidays, runs, sags, wrinkles, patches, brush or roller marks, or other defects that may be detrimental to the quality of the coating. Prior to acceptance of the paintwork a final inspection shall be made.

15. MEASUREMENT

Measurement for payment shall be the plan area of the building calculated on the center lines of peripheral columns. For variation of height increasing/decreasing by 0.5 m over the stipulated height of building, no extra payment shall be made.

16. HEALTH, SAFETY AND ENVIRONMENT

All relevant requirements of the Operational Safety Standards shall be met. Of particular importance are the requirements for blasting and power tool cleaning, for scaffolding access platform and ventilation in enclosed areas. The recommendation for personal protection and for protective equipment, as given in the Publication “Personal Protection advice for the use of Marine Paint and Composition” (Published by the paint makers Association of Great Britain) shall be followed. Storage, handling, mixing and application of the paints and coating material shall be done strictly in accordance with the manufacturers recommended procedures and hardware for assurance of personal safety. Safety precautions shall be clearly described on the technical data sheets of paints and coating materials supplied, as well as on the paint containers. Spray guns and accessories shall be earthed to prevent them from the removal of charged paint caused by the movement of the paint. Procedure approved by the client shall be available for the removal of spillage, collection and disposal of surplus paints, used brushes, scaffolding, equipment, waste etc upon completion of painting/coating activities.

17. HANDLING AND STORAGE

a) Proper storage of steel (sections and fabricated members) at the job site shall be the responsibility of the Contractor.

b) Structural steel shall be stored out of mud and dirt. Proper drainage of the storage area shall be provided. These shall be protected from damage or soil by adjacent construction operations.

c) Fabricated steel shall not be handled until the paint has thoroughly dried. Care shall be taken to avoid paint abrasions and other damage. Steel work shall be transported in such a way so as not to over stress the fabricated sections. All pieces bent or otherwise damaged shall be rejected and shall be replaced by the contractor at his own cost.
d) Checking and inspection of fabricated structural steel work by the Engineer shall be done at various stages of completion of fabrication work. The contractor is required to ensure that fabricated steel work is properly stacked such that all joints of all members are either visible or accessible for inspection at all stages of inspection work. Care should also be taken to ensure that fabricated members are not subjected to stresses due to defective stacking.

**Mode of Measurement**

The finished work shall be measured correct to a centimetre in respect of length and breadth nearest to two places of decimal and calculating in kg. The rate shall include the cost of all operations described above including the cost of materials, labors, designs of drawings, erection and testing, fabrication, erection, finishing, scaffolding, etc. No other claims of any kind pertaining to this work shall be entertained.

**PRE-COATED STEEL SHEETING FOR ROOFS**

1. **SCOPE OF WORK**
   Coated steel profiled sheet of approved colour shall be installed at roof and side cladding on steel framing or on any other location as directed by the Engineer, and shall be executed as per the details shown on the approved Shop drawings and as per specialist manufacturers recommendation, complete in all respects. The work shall be executed in flat, tapered, and curved from both in plan and section as required.

2. **MATERIALS**
   The Sheets shall have hot-dipped metallic Zinc Aluminium alloy coating (150gr/sqm, Zinc 43.5 %, Aluminium 55%, Silicon 1.5%). Coating mass total on both sides AZ-150 or equivalent as per IS 1397-1993. Minimum 300 Mpa yield strength with super durable Polyester Colourbond XRW of approved colour.

3. **COATING**
   Coating shall be as per AS/NZS-2728-1997, Category 3-4. Total coating thickness of 35 microns exterior coat of Super Durable Polyester XRW on topsurface and 5 micron polyester reverse on back surface over 5 micron primer coats on both surfaces including side and end laps.

4. **SHEETING PROFILE**
   Sheets shall be single profile sheeting 1000-1020 mm cover width, 28-32 mm high crests @ 183-205 mm c/c manufactured out of 0.5 mm BTM (base metal thickness) Hi-tensile Zincalume steel Sheets shall be factory cut and supplied in required sizes based on approved shop drawings. The steel manufacturer’s test certificates for the chemical and mechanical properties of steel must be submitted for approval by the concerned authority prior to installation.

5. **FIXING**
   Sheets shall be fixed to roof purlins and side rails/runners at crest as per manufacturer’s recommendation and water-tightness provisions using min 25µm Zinc-Tin alloy coated hex head self-drilling self-tapping (SDST) screws with sealing tapes and screw fasteners with following properties
   - Case Hardened Carbon steel AISI1018/10B21
   - Screw diameter 5.5mm (In case of Stitching 4.8mm)
   - Metal Bonded EPDM Washer 2-3 mm width 16MM Diameter (In case of stitching 14mm diameter)
   - Organic/Geomet/Dorken/Xylin coating insuring 1000 hour salt spray life
   - EOTA approved.

Before laying the sheets the purlin spacing shall be verified. The sheets shall be laid starting from the eaves, or from bottom upward in case of cladding (IS 3007). The sheets shall be laid from the end of the building away from prevailing wind so that exposed edge face down wind. The laps shall be as shown in the approved shop drawings.

The sheets shall be bend to required curved profile and fixing Trimdek or equivalent rib & flute. The sheets shall have wide pans with stiffening subtle flute patterns. Special male/female ends with full return legs on side laps for Purlin supports and anticapillary flute in side lap.
The contractor shall ensure that panel erector is familiarized with erection procedure and all the supporting members are straight, level, plumb and true (according to AISC) before starting panel erection. Panels shall be erected according to approved shop drawings.

6. SHOP DRAWINGS AND APPROVALS
Shop drawings shall be prepared for all sheeting work by the contractor and show the entire installation system including purlin layout, sheet layout, sizes, and color, fixing details etc. Shop drawings shall be submitted to the Engineer for his approval.

The Contractor shall submit catalogues, design calculations for sheet profile confirming safe distributed load capacity, sample of all items to be used and samples of workmanship for approval of the Engineer-in-Charge.

7. ACCESSORIES
The specification for capping, flashing and trims materials shall be same as that for sheeting and shall be factory formed to required shape and profile based on shop drawings. Roofing accessories like flashings (straight or crimp curved), capping etc. shall be provided from similar coating as used for sheets and shall be fixed by means of self-drilling self-tapping screws with EPDM washers.

8. TOLERANCES
Length : + 0 - 10mm
Cover width : + or - 6mm

9. STRUCTURAL STABILITY AND GUARANTEE AGAINST RUSTING/CORROSION
The contractor shall provide design calculations for sheeting taking into account wind loads, seismic, solar panels load and other code requirements and guarantee structural stability. The contractor shall also give guarantee for the sheets against rusting/corrosion, leakages through laps and fasteners, colour fading etc. for a period of twenty years.

10. RAIN WATER GUTTER
Gutter shall be fabricated out of 0.50 mm BMT/.58mm TPT, precoated zincalume steel sheet and accessories of the same raw material as roofing sheeting. All arrangements for incorporating outlets for rainwater down takepipes shall be incorporated in the fabrication, as per approved drawings and instructions. Fixing using self-drilling/self-tapping screws with EPDM seal, bitumen and GI limpet, washer, up to any pitch in horizontal/vertical or curved surfaces excluding cost of purlin, rafters and trusses and including cutting to size and shape.

11. ROOF TERMINATION
The roof sheeting to extend beyond the last portal as per layout design. Aluminum Composite Panel (ACP) shall be fixed to roof purlins and siderails/runners as per approved shop drawings. All ACP joints to run perpendicularly to the portal as per manufacturer’s recommendation and shall be filled with silicone sealant for watertightness.

APPROVED MANUFACTURERS/SUPPLIERS
All materials and products shall conform to the relevant standard specification, BIS codes and other relevant codes etc. and shall be of make as approved by Engineer. The list of approved makes for products and materials is given below. Other equivalent manufacturers may also be considered with prior approval of the Engineer, if found conforming to all standards. Such requests should be made with all documents to the Engineer at least 45 days before the material is required and any order shall be placed only after receiving the written approval of the Engineer.
<table>
<thead>
<tr>
<th>S.No.</th>
<th>Details of Materials / Products</th>
<th>Manufacturer’s Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Anchor Fastener</td>
<td>HILTI, FISHER, BOUN Group, MUNGO, UIP, Rawlplug, Bossong</td>
</tr>
<tr>
<td>2</td>
<td>Structural Steel</td>
<td>TATA, SAIL, ESSAR, Maharashtra Pipes, Jindal Steel &amp; Power Ltd., JSW, Steel Works &amp; Power Engineers, SKS Ispat&amp; Power, Topworth</td>
</tr>
<tr>
<td>3</td>
<td>Steel Structural Fasteners</td>
<td>Pooja Forge, Sundram Fasteners, Unbrako, Nelson, Panchsheel, LPSEJOT, Trutek, Rawlplug, UIP</td>
</tr>
<tr>
<td>4</td>
<td>Corrosion Protection Paints</td>
<td>Berger, Johnson Nicholson, Nerolac, Asian, Akzo Nobel, PPG, Jotun, Shalimar, 3M Fosroc</td>
</tr>
<tr>
<td>5</td>
<td>Fire Resistant Paints</td>
<td>Akzo Noble, PPG, Jotun</td>
</tr>
<tr>
<td>6</td>
<td>Pre-Coated profiled Metal Sheetings</td>
<td>Blue Scope Steel, Multicolor, Essar Steel, Bhushan Steel, Ispat Profile India</td>
</tr>
</tbody>
</table>

**Mode of Measurement**

The finished work shall be measured correct to a centimetre in respect of length and breadth nearest to two places of decimal. The rate shall include the cost of all operations described above including the cost of materials, labors, designs of drawings, erection and testing, fabrication, erection, finishing, scaffolding, etc. No other claims of any kind pertaining to this work shall be entertained.

**POLYCARBONATE SHEET**

Polycarbonate sheet (minimum 8 mm Thick) confirming to details mentioned below. The system shall consist of:
- Width of each panel shall not be less than 600 mm to ensure best performance for wind uplift, vibration, oil canning and visual appearance.
- The panels shall be uniform in color with an integral Multi-layer core.
- Panels shall be manufactured with Vertical Standing Seam at both sides of the panel.
- Welding or gluing of up stands or standing seam is not acceptable.
- Upper panel shall be co-extruded UV protected on the side facing the Sun End-cap/Aluminium U-Profile (mill finish) for end closure
- Panel Manufacture shall submit 3rd Party test certificates for:-
  1. Weathering (color change, Yellowing Index and Light Transmission).
  2. Water Penetration
  3. Impact
  4. U. V. Filtration
- Panel manufacturer should have project reference in India which is at least 10 years old for a single project not less than 1,500 m2.
- The panel system shall be fixed to the required profile (linear or curvilinear) and fixed in position to the structural steel framework, using self-driving self-tapping screws, accessories and Aluminium profiles etc. as per the approved architectural drawings, direction of Engineer in charge

**Mode of Measurement**

The finished work shall be measured correct to a centimetre in respect of length and breadth nearest to two places of decimal. The rate shall include the cost of all operations described above including the cost of materials, labors, designs of drawings, erection and testing, fabrication, erection, finishing, scaffolding, etc. No other claims of any kind pertaining to this work shall be entertained

**Door and window Stainless fittings**

Stainless steel grade 304 bright/ satin finished with stainless steel screws etc. complete as per approved sample and direction of Engineer-in-charge
- Hanging type floor door stopper (Weight should be not less than 200 gms without nuts and bolts)
- Tower bolts (barrel type)

**EPOXY COATING**

Epoxy primer FosrocNitoprime 25, as per manufacturers specification. Laying 2 mm thick epoxy underlay: Providing and laying the FosrocNitoflor EU5, high strength self-smoothing underlay, having the compressive strength 70N/mm2 at 7 days, BS6319 part 2, 1983, tensile strength BS 6319 part 3, 1983 13N/mm2 at 7 days, Flexural strength as per BS 6319 part 3 19 N/mm2 at 7 days. Application as per manufactures specification for laying in 2 mm thickness. The system should have the adhesion to concrete greater than strength of concrete. 1mm thick epoxy topping: Providing and laying the FosrocNitoflor SL1000 / Nitoflor SL2000 in 1 mm thick topping over the above underlay of EU5 system, as per required color shade, the material should have the following properties: specific gravity: 1.5-1.6, Compressive strength as per BS 6319 pt2 : 55 N/mm2, Flexural strength as per BS 6319 pt 3: 30 N/mm2, and Tensile strength as pr BS 6319 pt 7 :15 N/mm2. Also having the abrasion strength as per ASTM D412 1.5 N/mm2 and shore hardness >80.Material should be resistance to as per ASTM D1308 Cl.3.1.2. All application should be done as per manufactures specification for 1 mm thickness. All works shall be completed as per manufacturers specification and instructions of Engineer-in-charge.
Mode of Measurement

The finished work shall be measured correct to a centimetre in respect of length and breadth nearest to two places of decimal. The rate shall include the cost of all operations described above including the cost of materials, labors, finishing, scaffolding, etc. No other claims of any kind pertaining to this work shall be entertained.
SPECIFICATIONS FOR ELECTRICAL WORKS

1.0 GENERAL

To provide a complete electrical system for the distribution of electric power from the point of supply (SEB), D.G.s to the utilization equipment, all as shown in the drawings and described in these specifications. The quantities mentioned in BOQ are tentative. It will be the bidder’s responsibility to work out the exact quantities from drawings or from work site, which trade provides said equipments, materials, tools and labour.

2.0 SCOPE

The bidder shall supply, install and commission along with requisite spare, maintenance tools and tackles the following equipments and system in the Building. The scope also covers the detailed engineering and calculations of the various equipments/system mentioned hereunder and the same shall be approved by the Owner /Architect prior to execution of the job.

- Laying and termination of L.T. cables.
- Distribution Boards / Sub-Distribution Board.
- Complete internal building wiring as per specification.
- Safety to personnel and equipment during both operation and maintenance.
- Reliability of Service.
- Minimum fire risk.
- Case of maintenance and convenience of operation.
- Automatic protection of all electrical equipment through selective relaying system.
- Electrical supply to equipment and machinery within the design operating limits.
- Adequate provision for future expansion and modification.
- Maximum interchange ability of equipment.
- Fail-safe feature.
- Suitability for applicable environmental factors.

This specification defines the basic guidelines to develop a suitable electrical system as necessary for the Non residential campus. All data required in this regard shall be taken into consideration to develop a detailed engineering of the system. Site conditions as applicable are mentioned elsewhere.

Compliance with these specifications and/or approval of any of the Contractor’s documents shall in no case relieve the Contractor of his contractual obligations. All work to be performed and supplies shall be affected as a part of contract requires specific approval/review of Owner or his authorised representative. Major activities requiring approval/review shall include but not be limited to the following:

The engineering activities shall comprise the submission for approval of the following:
- Basic engineering documents e.g. overall single line diagram, area classification drawing, overall cable layout, testing, type test report, guaranteed particulars of all equipments and maintenance manuals.
- Quality assurance procedures.
- Field testing and commissioning procedures.
- Basic engineering calculations viz. load analysis; load flow, fault level calculations, and voltage drop calculations during motor start-up/re-acceleration etc.
- Control and protection schemes.
- Load sharing and annunciation scheme,
- Sizing calculation for cable trays/cable trenches.
Area-wise illumination level calculation and preparation of power supply distribution drawing.
Calculation for earthing system and lightning protection.

Bidder shall be responsible for:

Detailed co-ordination with other services, shop drawings for various electrical layouts such as equipment layout, lighting layouts, cabling layouts, earthing and lightning protection layouts, including equipment installation and cable termination details etc. prior to start of work.
Preparation of bill of materials for cabling, lighting, earthing and miscellaneous items etc.
Cable schedule.
Lighting/power panel schedule.
Interconnection drawing.
Protection co-ordination drawings/tables for complete power system.
Shop inspection and testing procedures.
Field testing and commissioning procedures.
Preparation of as built drawings for all services.

Bidder shall also be responsible for:

Any other work/activity which is not listed above however is necessary for completeness of electrical system.

3.0 CODES & STANDARDS

The design engineering manufacturing and the installation shall be in accordance with established codes, sound engineering, practices, and specifications and shall conform to the statutory regulations applicable in the country. Contractor shall obtain all approvals from statutory authorities’ e.g. Electrical inspector, pollution control boards, SEB as applicable before commissioning of electrical/DGs.
Indian Electricity Act.
Indian Electricity Rules.
Factory Act.
Pollution Control Act.

IS-732 : Code of practice for electrical wiring installation system voltage not exceeding 650V.
IS-3043 : Earthing.
IS-2309 : Code of practice for the protection of buildings and allied structure against Lightning
IS-7689 : Guide for control of undesirable static electricity.
IS-3716 : Insulation co-ordination application guide.
IS-8130 : Conductors for insulated electrical cables and flexible cords.
IS-5831 : PVC insulation and sheath of electric cables.
IS-3975 : Mild steel wire, strips & tapes for armouring cable.
IS-3961 : Current rating of cables
IS-694 : PVC insulated (heavy duty) electric cables for working. Voltage up to and including 1100 volts.
IS-424-1475 (F-3) : Power cable flexibility test.
IEC-439/IS-7098 : Specification for cross linked polyethylene insulated PVC sheathed cable for working voltage up to 1.1 KV.
IS-1554 : PVC insulated cables up to 1100 volts.
IS-10810: Test procedures for cables.
IS-6121: Cable glands.
IS-10418: Cable drums.
IEC-754(1) : FRLS PVC insulated cable.
ASTM-D-2863 : Standard method for measuring minimum oxygen concentration to
support candle-like combustion of plastic (oxygen index).

ASTM-D-2843 : Standard test method for measuring the density of smoke from burning or decomposition.
ASTM E-662/IEC 754(A)
Standard test method for specific optical density of smoke generated by solid materials.
IEEE-383: Standard for type test class-IE, electric cables, field splicers and connections for power generation station.
IS 13947/IEC 947 : Air circuit breaker/moulded case circuit breaker.
IS-8623: Specification for factory built assemblies of switch gear and control gear for voltage up to and including 1000vac/1200vdc
IS 1018: Switchgear and control gear selection/installation and maintenance
IS-1248 :Direct acting indicating analogue electrical measuring instruments and testing accessories.
IS-13779: Digital measuring instruments and testing accessories.
IS-3156 : Voltage transformer
IS-2705: Current transformer for metering and protection with classification burden and insulation.
-IS -2147 : Degree of protection provided by enclosures for low voltage.
PART 1,11,111 Switchgear and control gear
IS-3427 : Metal enclosed switchgear and controlgear
BS-162 : Safety clearance
IS-3202 : Code of practise for climate proofing of electrical equipment.
IS-375 : Marking and arrangement for switchgear, busbars, main connections and auxiliary wiring.
IS-722 : Ac electric meters
IS-3231 : Electrical relays for power system protection.
IEC-255
IS-5082 : Electrolytic copper/aluminium bus bars
IS-2834 : Capacitors
IS-2713 : Steel tubular pole
IS-335 : Specification for insulating oil
IS-3837 : Specifications for accessories for rigid steel conduit for electrical wiring.
IS-2026&335 : Distribution transformer
(PART I,II,III)GI/STEEL /PVC conduit pipe for electrical wiring.
IS-2274 : Code of practise for electrical wiring installation system voltages exceeding 650 volts.
IS-6665 : Code of practise for industrial lighting
IS-3646 : Interior insulation part 1&2
IS-1944 : Code of practise for lighting of public through fares.
IS-7752 : Guide for improvement of power factor consumers installation.
IS-13346 : General requirement for electrical for explosive gas atmosphere.
IS-13408 : Code of practise for the selection, installation and maintenance of electrical apparatus for use in potentially explosive atmospheres
IS-12360 : Voltage and frequency for ac transmission & distribution system.
IS-5572 : Classification of hazardous area for electrical installations.
IS-5571 : Guide for selection of electrical equipment for hazardous area.
IS-4201 : Application guide for Current Transformer
IS-4146 : Application guide for Voltage Transformer
IS-10028: Code of practise for installation and maintenance of transformer
IS-8478 : Application guide for on load tap changer
IS-10561: Application guide for power transformer
IS-1646 : Code of practise for fire safety of buildings electrical installation
IS-3034 : Code of practise for fire safety of industrial building-electrical generating and distribution station
IP-30 : National electrical code (NEC) BIS publication.
IS-4722: Rotating electrical machines.
IS-4889: Method of determination of efficiency of rotating electrical machines.
IS-325: Three phase induction motors.
IS-4729: Measurement and evaluation of vibration of rotating electrical machines.
IS-900: Installation and maintenance of induction motors.
IS-4029: Air break switches.
IS-2208-9224: HRC cartridge fuses.
IS-2959: Contactors.
IS-9537: Rigid steel conduit.
IS-1601/BS-649: Performance & testing of Internal Combustion (IC) engines for general purpose.
AIEE-606(1959): Recommended specification for speed governing of I.C. engine generator units.
BS-5514/IS-3046 8528(Part-2): Reciprocating IC engine driven A.C. generators.
Any other standard may be followed provided it is equivalent or more stringent than the standards specified above.

In case of any deviation/conflict of this specification with the codes & standards, the following order of precedence shall govern.

a) Specification, particular specification if any, and drawings.

b) Indian regulations/codes and standards.

SITE

4.0 CONDITIONS

i) Design ambient 50 Deg.C. maximum 2 Deg. C. minimum

ii) Relative Humidity 85% maximum

iii) Site environment Normal

DESIGN

5.0 CRITERIA

5.01 DELETED

5.02 L.T. Power Distribution System

a) Voltage 415 V / 240 V

b) Frequency 50 Hz

c) Neutral Earthing Grounded

d) Short Circuit Fault withstand Capacity 10 KA - 45 KA (1 Sec.) as per B.O.Q. and specification.

5.03 Emergency Lighting (Battery Operated With Self Charger)
a) Voltage 12 V, DC
b) Source Mains/D.G. Set

5.04 Control Supply for Electrical System

The various supply voltage to be used in the control panels for main equipments are:

- a) Spring Charge Motor 230 Volt A/C
- b) Closing/Trip Coil 24 V DC / 230V AC
- c) Alarm/Indication/Relay 24 V DC/ 230 V AC
- d) Heaters 230 V AC

<table>
<thead>
<tr>
<th>5.05</th>
<th>POWER SUPPLY LOAD CONTROL/DISTRIBUTION PANEL.</th>
<th>433 V TPN / 240 V 1 phase A.C. (other supply if required shall be derived by package vendor).</th>
</tr>
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<tr>
<td>5.06</td>
<td>PAINTING OF PANEL.</td>
<td>Powder coating of approved shade.</td>
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<tr>
<td>5.07</td>
<td>PAINTING OF CABLE TRAY AND STRUCTURE STEEL.</td>
<td>Powder coated of approved shade.</td>
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6.0 CABLE DETAILS

<table>
<thead>
<tr>
<th>6.01</th>
<th>INTERNAL WIRING.</th>
<th>Copper conductor PVC insulated 1.1 KV grade as called for in BOQ.</th>
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<tr>
<td>6.02</td>
<td>POWER CABLES (L.T.).</td>
<td>XLPE insulated Al. Armoured/ Unarmoured Cable as called for in BOQ.</td>
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<td>6.03</td>
<td>POWER CABLES (H.T.) 6.6 KV.</td>
<td>Aluminium conductor XLPE insulated armoured cable.</td>
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<td>6.04</td>
<td>GROUNDING CONDUCTOR.</td>
<td>Copper/G.I. strip as called for in BOQ.</td>
</tr>
<tr>
<td>6.05</td>
<td>LIGHTNING CONDUCTOR.</td>
<td>G.I. Strip.</td>
</tr>
</tbody>
</table>

7.0 ACCURACY CLASS OF METERS
Alimco Auxiliary Production Center Kanpur (UP)

a) Revenue Metres. Class-0.5 or as per SEB approved.
b) Ammeter Voltmeter and Other Instrument. Class – I Digital Analogue as called for in BOQ.

SPECIAL CONDITIONS

1.0 GENERAL

The design and workmanship shall be in accordance with the best engineering practices, to ensure satisfactory performance and service life. The requirement offered by the contractor shall be complete in all respects. Any materials or accessories which may not have been specifically mentioned, but which are usual and necessary for the satisfactory and trouble free operation and maintenance of the equipment shall be provided without any extra cost of the purchaser. This shall also include spares for commissioning of the equipment.

2.0 PRICES

The rates quoted by bidder shall include supply, installation, Octoroi all taxes, Excise duty & levies work contract tax, testing & commissioning charges. Laid, shall not be responsible for omission of any item party or fully by the bidder Quantity can be increased or decreased by any level.

3.0 The contractor shall obtain all sanctions (electrical loads, approval of drawing/ESS/D.G.’s estimator/approval of meter room etc. from the concerned authorities and permits required for the electrical installation work. All actual fee payable in this regard will be reimbursed against receipt/documentary evidence. On completion of work, the contractor shall obtain NOC from SEB & Director of Safety of the concerned state; a copy of the same shall be delivered to the Owner through consultant. Contractor shall be responsible for handing over to SEB (BSES) and other authorities shall be responsibility of contractor till commissioning and getting electricity in the complex.

The Owner shall have full power regarding the materials or work got tested by independent agency at the electrical contractor’s expenses in order to prove their soundness and adequacy. The contractor will rectify the defects/suggestions pointed out by independent agency through Owner at his own expenses.

The installation shall comply in all respects with the requirements of Indian Electricity Act 1910, Indian Electricity Rules (IER) 1956 and other related Laws and Regulations (for F.F. etc.) as amended up to date, thereunder and special requirements, if any, of the State Electricity Boards etc. The bidder is liable to furnish the list of authorized licensed persons/employed/deputed to carry out the works/perform the assigned duties to fulfill the requirement of Rule No.3 of IER 1956 as amended up to date.

4.0 DRAWINGS

i) The list of drawings along with these specifications is given in Annexure. These drawings are meant to give general idea to bidder regarding the nature of work covered by these specifications.
ii) Any information/data shown/not shown in these drawings shall not relieve the contractor of his responsibility to carry out the work as per the specifications. Additional information required by the bidder for successfully completing the work shall be obtained by him.

iii) Shop Drawings
The contractor shall prepare detailed coordinated electrical shop drawing indicating lighting/lighting fixtures, convenience outlets, D.G.’s, H.T., Transformer, M.V. Panel Boards/Relay Panel, PCC, DB’s, Rising Mains, Cable Schedule with other relevant services and submit to the Owner for approval or the Engineer-in-Charge before commencing the work. The shop drawings shall indicate all setting out details and physical dimensions of all components with wiring and cable details including system operating write up in the system Control and Relay Panel Package Substation, D.G.’s, PCC’s, MCC’s, cable schedule and routes, manhole trap and fixing details as well as for conduit indicating run and size of wire/cables, outlet/pull/junction boxes etc. with fixing details etc. for the above mentioned work. All work shall be carried out on the approval of these drawings. However, approval of these drawings do not relieve the contractor of his responsibility for providing maintenance free and fool proof system including any missing component/accessories to meet with the intent of the specifications. Contractor will submit 2 prints for preliminary approval and finally six prints for distribution.

iv) Completion Drawings/As Built Drawings
On completion of the work and before issue of certificate of virtual completion, the contractor shall submit to the consultant 4 sets along with soft copy of ‘As Built’ drawings of the work along with 01 Nos. cloth tracing originals including write up (trouble shooting, installation, operation and maintenance manual with instructions) incorporating all such changes and modifications during engineering and execution along with warrantee & guarantee certificates from manufacturers.

These drawings must provide:

- Run and size of conduit, inspection and pull boxes including routing and locations.
- Number and size of conductor in each conduit.
- Locations and rating of sockets and switches controlling the light and power outlet.
- A complete wiring diagram as installed and schematic drawings showing all connections in the complete electrical system.
- Location of outlets of various services, junction boxes, light fixtures.
- Location of all earthing stations route and size of all earthling conductors.
- Layout and particulars of all cables.
- Location and details of PCC’s, MCC’s, Feeder Pillars, capacitor control panels, PLC D.G. set panel, UPS panel, and relay panels with description detailed control wiring diagram.
- Location of transformer and its details and control wiring diagram.
- Location of Hume pipe and manhole including HT/LT cable layout and scheduling.
- Location of D.G.’s, exhaust and auxiliary equipments with schematic drawings.
Layout of cable trays with support and their fixing details.

Location of all earthing station, route and size of all earthing conductor.

Layout and particulars of rising mains with fixing details.

v) Position of HT/LT Switch Boards/Transformer & D.G.’s

The recommended position of the switch boards transformer & D.G.’s as shown on the layout drawings will be adhered to as far as practicable.

The contractor shall submit 2 sets of samples of each type of accessories and apparatus, proposed to be used in the installation at site for approval (drawings or samples) as required shall be submitted by contractor and the choice of selection out of the approved list lies with the Owner. For all non- specified items, approval of the Owner/Consultant shall be obtained prior to procurement of the same. Owner shall in no way be liable for rejection of the any material due to poor quality, poor workmanship, poor material etc.

5.0 MANUFACTURER'S INSTRUCTIONS

Where manufacturers have furnished specific instructions, relating to the material/equipments to be used on this job, covering points not specifically mentioned in this document, manufacturers’ instructions should be followed.

6.0 MATERIALS AND EQUIPMENTS

All the materials and equipments shall be of the approved make and design. Unless otherwise called for any approval by Owner’s Engineer-in-Charge, only the best quality materials and equipment shall be used.

The contractor shall fill in the data sheet for capital equipment as attached elsewhere in this document. The Tender shall be rejected due to not giving / filling in the details of the said equipment.

7.0 GENERAL DETAILS

7.01 Space Heaters & Lighting.

One of more adequately rated heaters thermostatically controlled with On-Off switch and fuse shall be provided to prevent condensation in any panel compartment. The heaters shall be installed in the lower portion of the compartment and electrical connections shall be made from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation. CFL lamp shall be provided in any panel compartment.

7.02 Fungistatic Varnish

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on parts, which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

7.03 Ventilation Opening

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass to prevent the entry of insects and to reduce to a
minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds.

7.04 Degree of Protection

The enclosures of the Control Cabinets, Junction Boxes and Marshalling Boxes, Panels etc. to be installed shall provide degree of protection as called for in specification / BOQ whenever it is not mentioned it shall be as given below.

Installed out door: IP-55.
Installed indoor in air-conditioned area: IP-52.
Installed in covered area: IP-52.
Installed indoor in non air-conditioned area where possibility of entry of water is limited: IP-42.

The degree of protection shall be in accordance with IS: 13947 (Part-I)/IEC-947 (Part-I). Type test report for degree of protection test, on each type of the box shall be submitted for approval.

7.05 Rating Plates, Name Plates and Labels

Main PCC, PCC’s, MDB and auxiliaries items installed in the building are to permanently attach to it in a conspicuous position. A rating plate of non-corrosive material with engraved manufacturer’s name, year of manufacture, equipment name, type or serial number together with details of the loading conditions of equipment in question has been designed to operate and such diagram plates as may be required by the purchaser. The rating plate of each equipment shall be according to IEC requirement.

All such nameplates, instruction plates, rating plates shall be bilingual with Hindi inscription first followed by English. Alternatively two separate plates one with Hindi and the other with English inscriptions may be provided.

7.06 First Fill of Consumables, Oil and Lubricants

All the first fill of consumables such as oils, lubricants, filling compounds, touch up paints, welding/soldering/brazing material for all copper/G.I. earthing and essential chemicals etc. which will be required to put the equipment/scheme covered under the scope of the specifications, into successful operation, shall be furnished by the Contractor unless specifically excluded under the exclusions in these specifications and documents.

8.0 DESIGN IMPROVEMENTS

The bidder shall note that the equipment offered by him in the bid only shall be accepted for supply.

If for any reason, Contractor wishes to deviate from specification, prior permission from Owner will be sought.

If any such agreed upon change is such that if affects the price and schedule of completion, the parties shall agree in writing as to the extent of any change in the price and/or schedule of completion before the Contractor proceeds with the change.
Following such agreement, the provision thereof, shall be deemed to have been amended accordingly in the specification.

9.0 QUALITY ASSURANCE PROGRAMME

To ensure that the equipment and services under the scope of this Contract whether manufactured or performed within the Contractor’s works or at his sub-contractor’s premises or at the Purchaser’s site or at any other place of work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points necessary. Such programme shall be outlined by the Contractor and shall be finally accepted by the Purchaser after discussions before the award of Contract. A quality assurance programme of the contractor shall generally cover the following:

His organization structure for the management and implementation of the proposed quality assurance programme.

Documentation control system.

Qualification data for bidder’s key personnel.

The procedure for purchases of materials, parts components and selection of sub-contractor’s services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.

System for shop manufacturing and site erection controls including process controls and fabrication and assembly control.

Control of non-conforming items and system for corrective actions.

Inspection and test procedure both for manufacture and field activities.

Control of calibration and testing of measuring instruments and field activities.

System for indication and appraisal of inspection status.

System for quality audits.

System for authorizing release of manufactured product to the Purchaser.

System for maintenance of records.

System for handling storage and delivery.

A quality plan-detailing out the specific quality control measures and procedures adopted for controlling the quality characteristics relevant to each item of equipment furnished and/or services rendered.

The Purchaser or his duly authorized representative reserves the right to carry out quality audit and quality surveillance of the system and procedure of the Contractor/his Vendor’s quality management and control activities.

10.0 QUALITY ASSURANCE DOCUMENTS

The Contractor shall be required to submit the following Quality Assurance Documents within three weeks after dispatch of the equipment.

All Non-Destructive Examination procedures, stress relief and weld repair procedure actually used during fabrication and reports including radiography interpretation reports.

Welder and welding operator qualification certificates.
Welder’s identification list, listing welders and welding operator’s qualification procedure and welding identification symbols.

Raw material test reports on components as specified by the specification and/or agreed to in the quality plan.

Stress relief time temperature charts/oil impregnation time temperature charts.

Factory test results for testing required as per applicable codes/mutually agreed quality plan/standards referred in the technical specification.

The quality plan with verification of various customer inspection points (CIP) as mutually and methods used to verify the inspection and testing points in the quality plan were performed satisfactorily.

11.0 INSPECTION, TESTING AND INSPECTION CERTIFICATE

The Purchaser and the Consultant or duly authorized representative shall have at all reasonable times free access to the Contractor’s premises or works and shall have the power at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection, if part of the works is being manufactured or assembled at other premises or works, the Contractor shall obtain permission to inspect as if the works were manufactured or assembled on the Contractor’s own premises or works. Inspection may be made at any stage of manufacture, dispatch or at site at the option of the Purchaser and the equipment if found unsatisfactory due to bad workmanship or quality, material is liable to be rejected.

All equipment being supplied shall conform to type tests and shall be subject to routine tests in accordance with requirements stipulated under respective sections. Bidder shall submit the type tests reports for approval. The Contractor shall intimate the Owner/Consultant the detailed programme about the tests at least three (3) weeks in advance in case of domestic supplies. If for any item type test is pending payment would be made on successful completion of type/routine test(s) actually carried out as per Consultant/Owner instructions.

The Contractor shall give the Consultant/Owner thirty (30) days written notice of any material being ready for testing. Such tests shall be to the Contractor’s account. The Consultant/Owner unless witnessing of the tests is virtually waived will attend such tests within thirty (30) days of the date of which the equipment is notified as being ready for test/inspection, failing which the Contractor may proceed with the test which shall be deemed to have been made in the presence of Owner/Consultant and he shall forthwith forward to the Consultant duly certified copies of tests in triplicate.

The Consultant/Owner shall within fifteen (15) days from the date of inspection as defined shall inform in writing to the Contractor of any objection to any drawings and all or any equipment and workmanship which in his opinion is not in accordance with the Contract. The Contractor shall give due consideration to such objections and make the necessary modifications accordingly.

When the factory tests have been completed at the Contractor’s or Sub-contractor’s works, the Consultant/Owner shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are not witnessed by the Consultant/Owner, the certificate shall be issued within fifteen (15) days of receipt of the Contractor’s Test certificate by the Consultant/Owner. Failure of the issue such a certificate shall not
prevent the Contractor from proceeding with the works. The completion of these tests or
the issue of the certificate shall not bind the Purchaser to accept the equipment should,
it, on further tests after erection, is found not to comply with the Specification. The
equipment shall be dispatched to site only after approval of test reports and issuance of
clearance by the Owner/Architect.

The contractor shall arrange all necessary instruction and testing facilities free of cost
for this purpose including air travel, lodging and boarding expenses.

For tests whether at the premises or at the works of the Contractor or of any Sub-
Contractor, the Contractor except where otherwise specified shall provide free of charge
such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments
as may be required by Owner/Consultant or this authorized representative to carry out
effectively such tests of the equipment in accordance with the Specification.

The inspection by Owner/Consultant and issue of Inspection Certificate thereon shall in
no way limit the liabilities and responsibilities of the Contractor in respect of the agreed
quality assurance programme forming a part of the Contract.

The Consultant/Owner will have the right of having at his own expenses any other
tests(s) of reasonable nature carried out at Contractor’s premises or at site or in any
other place in addition of aforesaid type and routine tests to satisfy that the material
comply with the specifications.

The Owner/Consultant reserves the right for getting any field tests not specified in
respective sections of the technical specification conducted on the completely
assembled equipment at site. The testing equipments for these tests shall be provided by
the Contractor.

12.0 TESTS

12.01 Charging

On completion of erection of the equipment and before charging, each item of the
equipment shall be thoroughly cleaned and then inspected jointly by the
Owner/Consultant and the Contractor for correctness and completeness of installation
and acceptability for charging, leading to initial pre-commissioning tests at Site. The
pre-commissioning tests to be performed as per relevant I.S. given and shall be included
in the Contractor’s quality assurance programme.

12.02 Commissioning Tests

The available instrumentation and control equipment will be used during such tests and
the Contractor will calibrate all such measuring equipment and devices as far as
practicable. However, unmeasurable parameters shall be taken into account in a
reasonable manner by the Contractor for the requirement of these tests. The tests will be
conducted at the specified load points and as near the specified cycle condition as
practicable. The Contractor will apply proper corrections in calculation, to take into
account conditions, which do not correspond to the specified conditions.

All instruments, tools and tackles required for the successful completion of the
Commissioning Tests shall be provided by the Contractor, free of cost.
Pre-commissioning test shall be carried out as per relevant IS and/or as specified in the relevant clause.

The Contractor shall be responsible for obtaining statutory clearances from the concerned authorities for commissioning of the equipment. However necessary fee shall be reimbursed by Owner on production of requisite documents.

13.0 PACKAGING

All the equipments shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. While packing all the materials, the limitation from the point of view of availability of Railway wagon/truck/trailer sizes in India should be taken account of by the Contractor. The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. Owner takes no responsibility of the availability of any special packaging/transporting arrangement.

14.0 PROTECTION

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves and pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner.

15.0 FINISHING OF METAL SURFACES

15.01 General

All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use unless otherwise stated elsewhere in the specification or specifically agreed, shall be hot-dip galvanized after fabrication. High tensile steel nuts and bolts and spring washers shall be electro galvanized. All steel conductors used for earthing/grounding (above ground level) shall be galvanized according to IS:2629.

15.02 Hot Dip Galvanizing

The minimum weight of the zinc coating shall be 700 gm/sq.m and minimum thickness of coating shall be 85 microns.

The galvanized surfaces shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discolored patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

After galvanizing drilling or welding shall be performed on the galvanized parts of the earthing materials. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.
The galvanized steel shall be subjected to six one minute dips in copper sulphate solution as per IS-2633.

Sharp edges with radii less than 2.5mm shall be able to withstand four immersions of the Standard Preece test. All other coatings shall withstand six immersions. The following galvanizing tests should essentially be performed as per relevant Indian Standards.

- Coating thickness,
- Uniformity of zinc,
- Adhesion test,
- Mass of zinc coating.

Galvanized material must be transported properly to ensure that galvanized surfaces are not damaged during transit. Application of zinc rich paint at site shall not be allowed.

15.03 Painting

All sheet steel work shall be degreased, pickled, phosphate in accordance with the IS-6005 “Code of practice for phosphating iron and sheet”. All surfaces which will not be easily accessible after shop assembly shall beforehand be treated and protected for the life of the equipment. The surfaces, which are to be finished painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. Oil, grease, dirt and swaf shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.

After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying. The phosphate coating shall be sealed with application of two coats of ready mixed, staving type zinc chromate primer. The first coat may be “flash dried” while the second coat shall be shoveled.

Powder coating/electrostatic painting of approved shade shall be applied.

The exterior color of the paint shall be as per shade no.697 of IS-5 or as approved by Architect and inside shall be white or as approved by Architect. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipments, if required. In case the Bidder proposes to follow his own standard surface finish and protection procedures or any other established painting procedures like electrostatic painting etc. the procedure shall be submitted along with the Bids for Owner’s review and approval.

16.0 HANDLING, STORING AND INSTALLATION

In accordance with the specific installation instructions as shown on manufacturer’s drawings or as directed by the Purchaser or his representative, the Contractor shall unload, store, erect, install, wire, test and place into commercial use all the equipment included in the contract. Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, square and properly aligned and oriented.

Contractor shall follow the unloading and transporting procedure at site, as well as storing, testing and commissioning of the various equipment being procured by him separately. Contractor shall unload, transport, store, erect, test and commission the equipment as per instructions of the manufacturer’s Engineer(s) and shall extend full cooperation to them.
In case of any doubt/misunderstanding as to the correct interpretation of manufacturer’s drawings or instructions, necessary clarifications shall be obtained from the Owner/Consultant. Contractor shall be held responsible for any damage to the equipment consequent for not following manufacturer’s drawings/instructions correctly.

Where assemblies are supplied in more than the one section, Contractor shall make all necessary connections between sections. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the Contractor at his own expense.

The Contractor shall submit to the Owner every week, a report detailing all the receipts during the weeks. However, the Contractor shall be solely responsible for any shortages or damages in transit, handling and/or in storage and erection of the equipment at Site. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.

The Contractor shall be fully responsible for the equipment/material until the same is handed over to the Owner in an operating condition after commissioning. Contractor shall be responsible for the maintenance of the equipment/material while in storage as well as after erection until taken over by Owner, as well as protection of the same against theft, element of nature, corrosion, damages etc.

The Contractor shall be responsible for making suitable indoor storage facilities, to store all equipment, which require indoor storage.

The words ‘erection’ and ‘installation’ used in the specification are synonymous.

Exposed live parts shall be placed high enough above ground to meet the requirements of electrical and other statutory safety codes.

The minimum phase to earth, phase to phase and section clearance along with other technical parameters for the various voltage levels shall be maintained as per relevant IS.

17.0 PROTECTIVE GUARDS

Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards with necessary spares and accessories shall be designed for easy installation and removal for maintenance purpose.

18.0 DESIGN CO-ORDINATION

The Contractor shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic design requirements are detailed out in this Specification. The design of various components, sub-assemblies and assemblies shall be so done that it facilitates easy field assembly and maintenance.

19.0 DESIGN COORDINATION MEETING

The Contractor will be called upon to attend design co-ordination meetings with the Engineer, and the Consultants of the Owner during the period of Contract. The Contractor shall attend such meetings at his own cost at New Delhi or at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during those discussions.
20.0  TOOLS AND TACKLES

The Contractor shall supply with the equipment one complete set of all special tools and tackles for the erection, assembly, dis-assembly and maintenance of the equipments.
SPECIFICATIONS FOR ELECTRIFICATION

1. 6.6 KV H.T. SWITCHBOARD

This specification covers the ‘General Requirements’ for the design, manufacture, supply performance, inspection, testing and commissioning including supply of indoor type high voltage switch boards upto 6.6 KV including necessary termination, cabling, bus work required for satisfactory operation.

Specific requirements shall be in accordance with single line diagram/specification/data sheet. In case of conflicting requirement between the Technical Data and General Specification the former shall prevail.

The technical parameters of switchgear equipments, transformers etc. shall be submitted by the Contractor for approval by the consultant/client.

This specification shall cover both 6.6 KV and Single Panel as well as 3 Panel Board.

STANDARDS

All equipment, material and components shall comply with the requirements of the latest editions of Indian Standards with updated amendments. Standards and Regulations applicable in the area where equipment is to be installed shall also be followed.

The equipment offered complying with other standards, these standards shall be equal to or superior to those specified and full details of the differences shall be furnished along with the tender.

Some of the relevant Indian and British Standards are listed below:

- IS 13947 - A.C. Circuit Breakers (Relevant Parts/SCC)
- IS 13941 - High voltage Circuit Breaker (Relevant Parts/SCC) IS13118 - Gas insulated Switchgear
- IS 3427 - Metal enclosed Switchgear & Control Gear
- IS 2705 - Current Transformers (Parts 1 to 4) IS 3156 - Voltage Transformers (Parts 1 to 4)
- IS 3202 - Code of Practice for climate proofing of electrical equipment
- IS 375 - Marking & Arrangement for Switchgear Bus Bars, main connections and auxiliary wiring.
- IS 722 - A.C. Electric Meters
- IS 1248 - Direct acting Electrical Indicating Instruments
- IS 3231 - Electrical Relays for Power System Protection
- IS 2544 - Epoxy Cast Resin Insulators
- IS 5082 - Electrolytic Copper and Aluminium IS 5792 - High Voltage HRC fuses
- IEC 60694- High Voltage Switchgear
- IEC 60947- High voltage Circuit Breaker IEC 60056- Gas insulated Switchgear
- IEC 60298- Metal Enclosed High Voltage Switchgear

DETAIL OF DESIGN
CONSTRUCTION

The switchboards shall be cubicle type, suitable for indoor/outdoor installation, floor mounting and free standing. The design shall be totally enclosed, dust-tight, dam proof and vermin proof offering degree of protection not less than IP-42 for Indoor Application & IP-54 for Outdoor application.

Separate segregated compartments shall be provided for circuit breakers, bus bars, cable box, voltage transformers, wire ways, relays, and instrument and control devices. Switchgear cubicles/modules shall be provided with hinged doors in front with facility for padlocking door handles.

Vent openings shall be covered with grills so arranged that hot gases cannot be discharged through them in a manner that can injure the operating personnel. These vent openings shall be vermin proof.

All the High Voltage compartments i.e. Circuit Breaker, Bus Bar, and Cable Compartments shall be separated from each other by metallic partitions in line with IEC-600298. These compartments must have pressure relief flaps for exit of gas due to internal arc to ensure operators safety. All the HV design must ensure conformity to IEC -600298 and must be Type tested for Internal Arc Test. The supplier shall submit Type Test report from CPRI or other independent agency to prove the above.

All panels shall be of same height, width and depth. Panels shall be bolted together to form a continuous flush front switch board, suitable for front of board operation.

The switchgear cubicles shall be rigid and robust in design and construction, fabricated out of CRCA sheet steel. Cubicles shall be made from rigid welded structural frames made of structural steel sections or of pressed/formed sheet steel of not less than 2mm thickness. The frames shall be enclosed by sheet steel of at least 2mm thickness, smoothly finished, leveled and free from flaws. Stiffeners shall be provided wherever necessary. Height of the operating handle, push button etc. shall be restricted between 300 mm to 2000 mm from the finish floor level. Fixing screws and nuts shall be used. Self-tapping screws shall not be used in the construction.

All doors, panels, removable covers shall be provided with non deteriorating (neoprene) gaskets all around the perimeter.

All doors shall be removable and supported by concealed type hinges. The hinges shall be strong and braced to ensure freedom from sagging, bending and general distortion of panel or hinged part.

Floor mounted cubicles with minimum 75 mm high channel and 5 mm thick channel base frame. Approx 200 mm-blank space between the floor of the switchboard and bottom most unit shall be provided. The total height of the cubicle shall not exceed 2400mm.

BUSBARS & BUSBAR CHAMBER

Three phase bus bars shall be of high conductivity electrolytic copper as stated in B.O.Q. The bus bars shall be air insulated and housed in a separate compartment, which segregated from all other compartments, in case of Vacuum Circuit Breaker. In case of
Gas Insulated Circuit Breaker the Bus Bars shall be housed in separate SF6 gas filled stainless steel tank. Current density of **Cu. Bus-Bar** shall not exceed 1.5 Amps / mm$^2$

Bus bars & bus bar connections shall be of uniform cross section shall be suitable for carrying rated current continuously and short circuit current for specified duration without overheating. The bus bars connections shall be adequately supported on insulators to withstand dynamic stresses due to short circuit current specified. Normal operating temperature for bus bars shall be 85 Deg. C. Short circuit rating of the bus bars shall be 35 KA for 1 sec.

All bus bar joints and bus tap joints shall be silver or tin plated. Joints shall be bolted type and shall be insulated. Spring/Lock washers shall be provided to ensure good contact the joints.

Direct access to accidental contact with bus bars and primary connections shall be avoided by providing shrouds. All apertures and slots shall be protected by barriers to prevent accidental shorting of bus bars. To provide a tight seal between cubicles, bushings or insulating panels shall be provided for bus bars crossing from one cubicle into another.

All insulating materials used shall be non-hygroscopic and shall be treated for preventing fungus growth. Surface of insulators shall be highly glazed and treated with silicone compounds to minimize accumulation of dust, condensation and tracking.

**CIRCUIT BREAKERS**

The circuit breakers shall be Triple Pole double break type and the Insulation and Arc interruption medium shall be either Vacuum or SF6 gas medium. The Breaker shall be enclosed in a sealed Vacuum Tank or SF6 gas filled Stainless Tank. A pressure relief device along with Manometer shall be provided with the Tank in case of SF6 CB to release and monitor any excessive pressure and for testing purpose.

The circuit breakers shall be of horizontal draw out construction with horizontal/vertical isolation. The circuit breaker including its operating mechanism shall be mounted on a wheeled carriage moving on guides, designed to align correctly and allow easy movement on the circuit breaker. There shall be three discrete positions viz. Service, Test and Isolated. Locking facility in all three positions shall be available. Position indicator shall be provided on the panel to indicate the position of the circuit breaker. Test position shall offer testing of circuit breaker operation/interlocks without energizing the power circuit.

Circuit breakers shall have stored energy spring mechanism charged by manually operated handle as well as electrically operated mechanism. The closing mechanism of the circuit breakers shall be Motor operated, spring charged with a provision for manual charging.

The operating mechanism shall be mechanically and electrically trip free and non-pumping. Anti-pumping feature may be built in or separate anti-pumping relay may be provided. In case spring charged mechanism, spring charged indication shall be provided.

Local manual trip device shall be provided on the operating mechanism. The trip device shall be suitable for front operation and positive mechanical ‘ON-OFF’ indication shall be provided.
Main contacts of circuit breaker shall have ample area and adequate contact pressure to carry the rated and short time current without excessive temperature rise. The contacts shall be adjustable for wear and easily replaceable. Main contacts shall open before and close after the arcing contacts when these are provided. Arcing contacts shall be easily accessible for inspection and replacement in case of VCB.

Each breaker shall normally be provided with auxiliary contacts of 6 NO+6NC directly operated from breaker operating mechanism. These contacts shall be in addition to those used in circuit breaker internal wiring. These contacts shall be rated for 10 Amps at 240V AC and 20 Amp (inductive breaking) at 220V D.C. If more breaker auxiliary contacts are required latching relay shall be used to multiply the contacts.

Shunt trip coil as called for shall be provided for tripping the circuit breaker. The trip coil/s shall operate satisfactorily between 50% - 110% of rated control voltage. Wattage of trip coils
will be sufficiently high to prevent it from picking up or holding on with specified number of trip circuit supervisory indicating lamps wired in series.

It shall be possible to trip the breaker, in case of failure of control supply

Circuit breaker type duty and rating shall be submitted in Data Sheet by the Contractor.

Circuit breakers of similar rating shall be interchangeable.

**CURRENT TRANSFORMERS**

Current transformers shall be of ratio, burden (shall be worked out by panel supplier), class/accuracy as specified in Single Line Diagram/BOQ.

Current transformers shall conform to latest edition to relevant standards. Current transformers shall be epoxy resin cast with bar Primary or ring type.

CT core laminations shall be of high grade silicon steel. The design and construction shall be sufficiently robust to withstand thermal and dynamic stresses due to the maximum short circuit current of the circuit.

The current transformer shall preferably be capable of being left open circuited on the secondary side with primary carrying rated full load current, without overheating or damage. Short time current rating and rated withstand time shall be same as corresponding C.B.

Secondary terminals of CT shall be brought out to a terminal block which will be easily accessible for testing and external connections. Facility shall be provided for short circuiting and earthing of CT secondary leads through a removable and accessible link with provision for attaching test link.

Rating plate details and terminal markings shall be according to the latest edition of relevant Indian Standard specification.

Current transformers (core) shall be used for metering and protection. Each CT shall be provided with rating plate indicating: Name and Make, Serial number, Transformer Ratio, Rated burden, Rated voltage and Accuracy class.

**POTENTIAL TRANSFORMERS**

Potential Transformers shall conform to latest edition of “IS-3156 (Part I, II & III) as applicable relevant standards.

Potential transformers shall be dry, cast epoxy resin type. The PTs shall be of single phase construction.

The PT shall be capable of operating continuously at 110% of the rated voltage without any damage. When star - star connection is required in non-effectively or ungrounded system, the PTs shall be suitable for continuous operation with a persistent phase to ground fault.

Maximum temperature rise of the transformer at rated burden and with rated primary voltage and frequency shall not exceed 40 Deg.C above an ambient of 45 Deg.C.

The PT’s shall be fixed at rear bottom / top of the panel as called for. An interlock or automatic shutters shall be provided to prevent access to live HV parts when PT is withdrawn.
HRC Fuses shall be provided both primary & secondary side. It shall be possible to replace PT fuses easily without having to de-energize the main bus bars. Prospective interrupting current rating of the fuses shall be same as the system fault level.

Voltage transformer ratio, output and class shall be as specified in the BOQ and shall be stated in data sheet by the Vendor/Contractor. Nameplate as per relevant standards shall be provided on the PT.

**PROTECTIVE RELAYS**

Relays type and numbers shall be in accordance with the protective scheme required or as per drawings and B.O.Q.

Relays shall be digital microprocessor based or analogue type, as called for in BoQ. It shall be enclosed in rectangular shaped cases, suitable for flush mounting only, dust tight covers projecting from the front cover panel. The case shall be dust tight, damp proof and tropicalised. The relays shall be either self-powered or a 24V DC Power-pack of suitable capacity with charging device shall be provided within the HT panel.

Relays shall be accessible for setting from the front. Access to setting devices shall be possible only after removal of front cover.

Protective relays shall be drawing out type. Where it is not possible to provide protective relays of the drawout pattern, fixed type relays with facilities for plugging in a portable test plug shall be provided. Necessary test plugs shall be furnished along with the relays.

Relays shall be provided with positive action self reset type with indicator. The indicator/s shall be visible from the front.

Relays conform to relevant standards in all respects. Relays shall be provided with minimum two pairs of self or hand reset type contacts as specified. Auxiliary relays shall have the number of NO and NC contacts as required and shall be in data sheet by the Vendor / Contractor.

**SAFETY/PROTECTION INTERLOCKS/FEATURES**

Following interlocks and features shall be incorporated for equipment protection and personnel safety under mal-operation. No deviations on these interlocks and safety features are allowed. These interlocks and safety features shall be fail-safe, positive and full-proof.

a) It shall not be possible to plug-in or isolate a closed circuit breaker. An attempt to do so shall trip the breaker. (In case of breakers with vertical isolation, this will apply to raising and lowering). There shall be a positive locking facility to prevent closing of circuit unless it is in Service or Test position.

b) Closing and opening operations shall be possible only in discrete, well defined Test and Service positions and not in any position midway. An extension adapter cable with plugs and sockets shall be preferably be provided so that the closing and opening operation of the circuit breaker can be done in fully withdrawn position outside the cable.

c) Slow operation of circuit breakers shall be possible only in the circuit breaker in Test or Isolated position.
d) Isolating switches if provided shall be interlocked with respective circuit breakers to prevent them making or breaking the current.

e) 1 no. bus earthing truck shall be supplied with each panel to earth the outgoing cable of the VCB.

f) Automatic safety shutters for all openings which will lead to access to the live parts of the switchgear upon withdrawal or any operation the switchgear components/parts shall be provided, preferably with a padlocking facility.

g) Spring of motor operated spring charged mechanism shall not discharge until they are fully charged and charging means are fully disconnected.

h) Where key interlocking is employed, tripping of a closed circuit breaker shall not occur if any attempt is made to remove the trapped key from the mechanism.

i) Annunciation window shall be provided for winding temperature trip/alarm as required.

j) Any other interlocks which manufacturer may deem to be required for safety and specifically specified separately required for the system shall be included.

k) All terminals, connections which may be live and exposed for accidental contact shall be adequately shrouded.

l) Components within cubicles shall be properly labelled to facilitate testing.

**EARTHING**

The switchboard shall be provided at the bottom throughout its entire length with a earth bus of copper of adequate size to carry the fault current for the duration same as short time rating of the circuit breaker. Earth bus shall have two earthing connection facility at its both ends of earthing conductor.

All non-current carrying metal parts, frames and equipment mounted in the switchboard shall be bonded to earth bus.

Earthing of moving carriage of drawout equipment shall be achieved by scraping earthing device. The earthing device shall maintain positive earth continuity in all Service Test and Isolated positions.

It shall be possible to connect each circuit or set of three phase bus bars to earth either through earthing trucks or through the circuit breakers.

One earthing trolley suitable for earthing of cables or bus bars and common for all circuit breakers of the same type/rating shall be provided.

**INSTRUMENT & METERS**

Electrical indicating instruments shall be digital type with zero adjustment, probe from outside the cover.

Multi function meter of CL 1.0 accuracy with RS 485 port shall be provided.

Instruments/meters shall be suitable for flush mounting on the panel with flanges protecting outside the panel.

All meters shall be industrial grade with accuracy of class 1.0 unless specifically indicated.

**CONTROL WIRING**
All wiring for control, protection, alarm, indicating circuits and remote tripping mechanism on all equipment shall be carried out with at least 650V grade, PVC insulated, stranded, copper, 2.5 Sq.mm conductors.

All wiring shall be run on the sides of the panels and shall be neatly bunched and cleated without affecting access to equipment mounted in the panel. Where wiring enters or passes through compartments containing HT apparatus then they shall be in earthed metallic conduits or ducts.

All wiring shall be taken to terminal blocks without joints or tees in their run.

All wiring shall be colour coded as follows:

<table>
<thead>
<tr>
<th>Circuit Type</th>
<th>Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Instrument Transformer AC</td>
<td>Red, Yellow &amp; Blue determined by the phase with which the wire is associated.</td>
</tr>
<tr>
<td>AC Phase Wire</td>
<td>White</td>
</tr>
<tr>
<td>AC Neutral</td>
<td>Black</td>
</tr>
<tr>
<td>DC Circuits</td>
<td>Grey</td>
</tr>
<tr>
<td>Earth connections</td>
<td>Green</td>
</tr>
</tbody>
</table>
Engraved core identification ferrules, marked to correspond with the wiring diagram shall be fitted to each wire. Ferrules shall fit tightly on the wires, without falling off when wire is removed. Ferrules shall be of white colour with black lettering. Each wire shall be identified by letter to denote its function followed by a number to denote its identity at both ends.

All wiring for external connections shall be brought out to individual terminals on a readily accessible terminal block.

All unused auxiliary contacts of the circuit breaker and relays shall be wired upto terminal block.

**FITTINGS AND ACCESSORIES**

**Indicating Lamps:**

Neon type indicating lamps or LED indicators shall be provided everywhere except where low voltage filament type with series resistor called for.

Lamp covers shall be provided with interchangeable colored lenses of Perspex or equivalent unbreakable material. The lenses shall not discolor in course of time due to heat of the lamp.

Bulbs and lenses shall be interchangeable and replaceable from the front.

Following colors shall be used for the function indicated:

<table>
<thead>
<tr>
<th>Color</th>
<th>Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>Circuit Breaker ‘ON’</td>
</tr>
<tr>
<td>Green</td>
<td>Circuit Breaker ‘OFF’</td>
</tr>
<tr>
<td>White</td>
<td>Continuous trip supply supervision</td>
</tr>
<tr>
<td>Amber</td>
<td>Auto trip</td>
</tr>
<tr>
<td>Blue</td>
<td>Spring charged</td>
</tr>
<tr>
<td>R.Y.B</td>
<td>Potential indication</td>
</tr>
<tr>
<td>Green</td>
<td>Earth</td>
</tr>
</tbody>
</table>

**Push Buttons:**

All push buttons shall be push to actuate the contact type.

Start & Stop push buttons shall be colored green and red respectively. Reset push buttons shall be yellow in color and test push buttons shall be blue in color. All other push buttons shall be black in color.

Emergency stop push buttons shall be lockable in the operated position, i.e. push to operate and key to release type. Push buttons for emergency stop shall be recessed/shrouded type to avoid accidental operation.

**Control & Selector Switches:**

Control and Selector switches shall be of rotary type, having enclosed contacts accessible only after removal of cover.

All control and selector switches for circuit breakers and instruments shall be mounted on the front of the panel. Control switches for space heater/s and control supplies shall be mounted inside the panel.
Circuit Breaker control switches shall be provided with pistol grip handles. Selector switches shall be provided with round, knurled handles. All handles shall be black in colour. Properly designated escutcheon plates clearly marked to show the operating positions shall be provided on all switches.

All other instruments and selector switches shall have stay put contacts.

Circuit breaker control switches shall normally have three positions close - Normal -Trip with spring return to normal position. Switch operating mechanism shall prevent the switch from being operated twice successively in the same direction. Circuit breaker control switch shall have one NO-NC contact along with other contacts as required.

Contacts of all control and selector switches shall be rated for 10 Amps at 240V AC or 20 Amps at 220V dc (inductive break). Switch for space heater supply and control voltage supply shall normally be two pole rated for 25A A.C.

**Control Terminal Blocks:**

Box - clamp type, 650V grade line up terminals of minimum 2.5 Sq.mm size shall be provided.

Connection to terminals shall be from front.

Not more than one wire on each side shall be connected on any terminal. Where duplication of terminals block/s is necessary, suitable solid bonding links shall be incorporated. Terminal blocks at different voltage shall be segregated into groups and distinctly labelled. Current transformer secondary leads shall be brought to terminal blocks having facility for short circuiting and grounding the secondary.

Terminals shall be numbered for identification and grouped according to function. Engraved back on white PVC labels shall be provided on the terminal blocks describing the function of the circuit.

Separate terminal stems shall be provided for internal and external wiring.

Control terminal blocks shall be so located that control cables are fully segregated from power cables. Suitable insulated or earthed metal race ways shall be provided for control wiring. Separate undrilled removable gland plate shall be provided for the control cables at the bottom of each panel.

Minimum 10% of total number spare terminals shall be provided for future use.

**NAME PLATES AND LABELS**

One Name plate giving designation of the HV switchboard shall be affixed prominently on top of the switch board. Details of designation will be specified.

Labels giving following details shall be affixed on each feeder panel:

1. Feeder Name.
2. Equipment reference no. & Description
3. Rating (KVA/Amp.)

All components whether mounted inside or on the door shall be permanently and clearly labelled with reference number/letter or their function. Rating of fuse shall be part of fuse designation. Paper labels, stickers or labels fixed with adhesives are not acceptable. All labels shall be properly fixed by screws with provision to prevent distortion due to expansion.

All labels shall be non-corroding, preferably laminated plastic or rear engraved perspex with white letters on black background.
Labels for feeder panel designation fixed on front side shall be fitted with chrome plate, self tapping, and counter sunk head screws. These labels shall be of identical size to permit interchange.

SPACE HEATERS:
Adequately rated anti-condensation space heaters shall be provided in each cubicle.
Space heater/s shall be trip type, rated with operation voltage of 240V, 50 Hz. AC supply.
Each space heater shall be complete with a 2P MCB, 10KA and a control thermostat.
The space heater shall be rated for maintaining the panel inside temperature 10 Deg.C above outside ambient temperature.

CUBICLE LIGHTING:
Each cubicle shall be provided with interior lighting by means of CFL light fixture. An ON/OFF switch/door switch shall be provided. The lighting fixture shall be suitable for operation from a 240V single phase, 50 Hz. A.C. supply.

AUXILIARY SUPPLY:
Auxiliary supply for control, indication, space heater etc. shall be made available at one point on the switch board. Vendor shall provide suitable auxiliary supply in the switch board.

FUSES:
All fuses in control, indication and metering circuit shall be HRC link type of approved make. Mounting of fuse fitting shall ensure adequate dissipation of heat generated and shall facilitate inspection and easy replacement of fuse.

CABLE TERMINATION:
The switch board panel shall be provided with separate compartment for cable termination complete with suitable cable end termination for XLPE insulated cables suitable for bottom entry. Cable and sealing box shall preferably be mounted inside the panel. Cable compartment doors shall be self–locking type, interlocked and shall have Arc withstand capability due to short circuit. The compartment shall be provided with cable testing facility in case of gas insulated medium. For XLPE cables adequate space and clearances shall be made for heat/cold shrinkable termination e.g. Reychem or cold flowing stress grading joints.
Two earthing terminals shall be provided in each panel in cable box/cabling chamber for earthing armour/screen.

Where more than one core is terminated on each phase, links suitably designed and properly supported shall be provided to avoid unnecessary bending of cable cores without decreasing the length of insulated cable tail. Electrical clearances which would normally be required when using one core per phase shall be maintained.

Where core balance type current transformers are provided on switchgear feeder circuit cable/s for earth fault protection sufficient space, clearance and support, mounting arrangement shall be provided for the CT.

PAINTING:
All steel work shall be pretreated in tanks and finally powder coated of approved shade of the levels not less than 100 microns.

**TESTING & INSPECTION**

Four copies of all test certificates and certificates from sub-vendor shall be furnished. After completion of all work at the manufacturer’s works the switchboards shall be inspected and tested in presence of Purchaser’s/Consultant’s representative. However, stage inspection may be carried out from time to time to check progress of work and workmanship. The following tests shall be carried out:

i) All routine tests specified in relevant Indian/British Standards shall be carried out on all circuit breakers.

ii) Test for protective relay operation by secondary injection method.

iii) Operation of all meters.

iv) Secondary wiring continuity test

v) Insulation test with 1000 Volts megger, before and after voltage test.

vi) HV test on secondary wiring and components on which such test is permissible (2 KV for one minute)

vii) Simulating external circuits for remote operation of breaker, remote indicating lights and other remote operations, if any.

viii) Measurement of power required for closing/trip coil of the breaker.

ix) Pick up and drop out voltages for shunt trip and closing coils.

x) CT Polarity test.

xi) Power frequency voltage withstand test.

Vendor shall provide all facilities such as power supply, testing instruments and apparatus required for carrying out the tests. Required copies of test certificates for all the tests carried out along with copies of type test certificates and certificates from Sub-Vendor for the components procured from them are to be submitted before dispatch of switch boards.

**DRAWINGS AND INFORMATION**

The Vendor shall furnish following drawings/documents in accordance with enclosed requirements:

i) General Arrangement drawing of the Switchboard, showing front view, plan, foundation plan, floor cut-outs/trenches for external cables and elevations, transport sections and weights.
ii) Sectional drawings of the circuit breaker panels, showing general constructional features, mounting details of various devices, bus bars, current transformers, cable boxes, terminal boxes for control cables etc.

iii) Schematic and control wiring diagram for circuit breaker and protection including indicating devices, metering instruments, alarms, space heaters etc.

iv) Terminal plans showing terminal numbers, ferrules markings, device terminal numbers, function etc.

v) Relay wiring diagrams.

vi) Equipment List.

vii) Bus bar sizing calculations.

Vendor shall furnish required number of copies of above drawings for Purchaser’s review, fabrication of switch boards shall start only after Purchaser’s clearance for the same. After final review, required number of copies and reproducibles shall be furnished as final certified drawings.

The information furnished shall include the following:

i) Technical literature giving complete information of the equipment.

ii) Erection, Operation and Maintenance Manual complete with all relevant information, drawings and literature for auxiliary equipment and accessories, characteristics curves for relays etc.

iii) A comprehensive spare parts catalogue.

TOOLS

One complete set of all special or non-standard tools required for installation, operation and maintenance of the switchboard shall be provided. The manufacturer shall provide a list of such tools individually priced with his quotation.

SPARES

Contractor shall also quote separately for the maintenance spares for 2 years normal operation for owner to decide for placement of order at a later date. The quote shall remain valid at least for 6 months. The manufacturer/tenderer shall also supply a complete list of commissioning spares and tools. The same shall be included in the bid price. No extra payment shall be made on account of non-availability of spares during commissioning.

QUALITY ASSURANCE

Quality Assurance shall follow the requirements of Owner/Consultant as applicable. Quality Assurance involvement will commence at enquiry and follow through to completion and acceptance thus ensuring total conformity to Purchaser’s requirements.

DEVIATIONS

Clause wise deviation for the specification must be stated in writing at the quotation stage. In absence of such a statement, it will be assumed that the requirements of the specifications are met without exception.
SPECIFICATION OF 6.6 KV / 433V, 3 PHASE, 50 Hz DRY TYPE TRANSFORMER

1.0 SCOPE
Covers the detailed requirements regarding design, manufacturing and testing & commissioning of resin cast transformer required for sub-station.

2.0 CODES AND STANDARDS
Transformers shall comply with the latest editions of Indian Standards no. IS: 2026 Part-I to Part-V (Power Transformers) and IS-11171 (Dry Type Power Transformers). In case the provision of Indian Standards is not directly applicable to Dry Type Transformers, the provision of latest IEC – 726 and any other relevant IEC shall apply. Latest Standards as applicable shall be followed for Insulating Materials, Bushing, Installation and Maintenance of Transformers.

3.0 SERVICE CONDITIONS
Altitude : Less than 1000 meters
Maximum Ambient Temp. : 50° C
Minimum Ambient Temp. : 0° C
Installation : Highly corrosive, dusty, humid and tropical

4.0 RATING AND TYPE
The transformer shall have core type construction, 3 phases and shall be suitable for Indoor / Outdoor service under the climatic conditions prevailing at site. The transformer shall be capable of withstanding thermal and mechanical effects of Short circuit at terminals of any winding with full voltage maintained on other winding as per IS – 2026.

5.0 WINDINGS
The windings shall be manufactured from high quality electrolytic grade copper conductor and fully insulated for rated voltage by nomex-calendered paper. The high and low voltage windings shall be totally encapsulated and should be Cast under vacuum in moulds with fiber glass reinforced epoxy resin laminate. Both HV & LV windings of each phase shall be separately cast as a rigid tubular coil with no mechanical & electrical connection between their co-axial arrangements. The transformer shall be free of partial discharges at least up to 1.1 times the rated voltage. The windings shall absorb no moisture under the worst tropical conditions.

6.0 CORE
The core shall be built up with high quality, non-ageing, low loss & high permeability CRGO (Cold reduce Grain Oriented) Silicon Steel Lamination of very high magnetic properties. CRGO sheet shall be coated with inorganic material like carlite or equivalent insulation to reduce eddy current to minimum. After shearing, the laminations shall be treated to remove all burrs and shall be annealed to remove all the residual stresses.

Core framework and clamps shall be arranged and tightened to securely hold laminations in order to prevent any settling or displacement in case of heavy shocks during transport, handling or short circuits. All the iron parts, except the core shall be galvanized and treated with high temperature resistant paint. Core fastening bolts shall be insulated to reduce losses and avoid
hot spots. Transformer shall be designed to withstand 10% over fluxing corresponding to rated voltage.

Suitable lugs shall be provided for lifting the complete core & coil assembly of the transformer.

7.0 INSULATION
Inter-turn and inter coil insulation shall be designed such that the dielectric stress is uniformly distributed throughout the windings under all operating conditions. The windings shall be provided with Class ‘H’ insulation or better.

8.0 TEMPERATURE RISE
The temperature rise of the windings shall not exceed 90°C by resistance on continuous full load above maximum ambient temperature of 50°C and in no case shall reach value that may damage the core itself or other adjacent parts.

9.0 PARALLEL OPERATION
The transformers shall be suitable to operate in parallel among themselves.

10.0 VECTOR GROUP
Transformer shall have vector group of Dyn 11.

11.0 IMPEDANCE
The desired impedance shall be as mentioned in the IS – 2026.

12.0 FLUX DENSITY
The maximum flux density at any point in the core and the winding shall not exceed 1.6 Tesla on the normal rated tap voltage & frequency.

13.0 CURRENT DENSITY
The maximum current density at any point in the winding shall not exceed 2.2 Amps per sq.mm. at the rated full voltage & frequency.

14.0 COOLING
The transformer shall be designed for natural cooling (AN).

15.0 ENCLOSURE
Transformers shall be provided with a sheet steel enclosure with adequate provision for ventilation. The degree of protection of enclosure shall be IP – 21 for indoor installations. The sheet steel thickness of enclosure shall be minimum 2 mm CRCA.

16.0 END TERMINATION
Cable box shall be provided on HV side suitable for 6.6 KV XLPE Cable & LV side suitable for termination of cables / bus trunking.

17.0 UNDER CARRIAGE
Transformers shall be supported on structural base equipped with bi-directional rollers suitable for moving the fully assembled transformers.
18.0  ACCESSORIES
The following fittings shall be provided on the Dry Type Transformers:

i) Rating & Terminal marking plate  
ii) 4 nos. bi-directional flat rollers  
iii) 2 nos. earthing terminals with lugs on the transformer base channel on diagonally opposite ends  
iv) Lifting arrangement  
v) Extra Neutral point  
vi) 1 no. PT-100 sensor in each LV windings wired upto the winding temperature indicator scanner. The instrument shall have two sets of adjustable contacts for alarm & trip. Instrument shall have scanner to read and show temperature of all the three phases sequentially.

19.0 TESTS
Transformers shall be subjected to routine and type tests as specified in IS: 2026, IS: 11171, IEC – 726 & given below:

19.1 Routine Tests:
All routine test shall be carried out as per IS / IEC at manufacturer work type test certificate shall be furnished by manufacture after award of work.

3.  L.T. PANELS & SWITCHGEARS
Medium voltage switch boards/distribution boards, the combination of both these and components shall conform to the equipments of the latest revision including amendments of the following codes and standards.

The drawings, specification and BOQ compliment each other and which is shown or called for one shall be interpreted as being called for on both. Material, if any, which may not have been specified but fairly required to make a complete assembly of switch gear as shown on the drawing, specifications shall be construed as being required and no extra charges shall be payable on this account.

CODES & STANDARDS
The design, manufacture and performance of equipment shall comply with all the currently applicable statues, safety codes, relevant Bureau of Indian Standards (BIS), British Standards (B.S.), International Dutro Technical Commission (IEC) Publication, NEMA, IDE & DEMA standard as amended upto date.

a) IS:13947- Air circuit breaker/moulded case circuit breaker.  
1993/IEC 60947-1989

b) IS:3156 Voltage transformers.
Current transformers for metering and protection with
classification
Part-I, II & III 1964

c) IS:2705 burden and insulation.

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The board shall be metal enclosed single front, indoor, floor mounted, free standing type or wall mounting type as mentioned in BOQ. The panel shall be designed for a degree of protection of IP-55. However bus bar chamber shall have IP: 42 degree of protection incase bus bar rating exceed 1600 Amps. Keeping in view the operating height of the top switch 1750mm from finish floor. 400mm clear space shall be left throughout the panel at bottom. The cold rolled sheet steel will be of 2mm thick. The structure shall be mounted on a rigid base frame of folded sheet steel of minimum 3mm thickness and 50mm height.

All cutouts and covers shall be provided with synthetic rubber gaskets (preferably neoprene).

The panel shall be divided into distinct vertical sections each comprising of:

i) Complete enclosed bus bar compartment for running horizontal and vertical bus bars.

ii) Complete enclosed switchgear compartment one for each circuit for housing air circuit breaker, MCCB/MPCB with starters etc.

iii) Compartment for power and control cables of at least 300mm width covering entire height provided.

iv) The panel shall have sufficient space at least 20% of outgoing feeders for future use.

The front of each compartment shall be provided with hinged single leaf door with locking facilities. Panel shall be provided with suitable lifting facilities. Isolators and MCCB/ACBs and accessories shall be of fixed/drawout type as per BOQ.
Each feeder shall have compartmentalised or non-compartmentalised for MCB feeders only. R-tall type with separate construction cable entry shall be from top/bottom (3mm thick gland plate with suitable numbers & sizes of knockout holes (as called for in schematic/ fabrication drawings) shall be provided.

The panel shall be provided with three phase buses & neutral bus bars of high conductivity electrolytic copper/Aluminium sections throughout the length of the panel & shall be adequately supported and braced to withstand the stressed due to the short circuit current of 35 KA rms. for 1 sec. as called for in BOQ/Data Sheet. Maximum temperature rise of bus bars and bus bar connection while carrying rated current shall not exceed 40 Deg.C over an ambient temperature of 50 Deg.C. The Current density of Bus Bar shall be 1.0 Amp/mm² for Aluminium and 1.5 Sq.mm/mm² for copper.

The minimum clearance in air between phases and between phases and earth for the entire run of the bus bar connections shall be 32mm minimum. Bus bars support insulators shall be made of non-hydroscopic non-combustible track resistant and high strength SMC or polyester fibreglass moulded material.

All bus bars shall be colour coded as per IS: 375.

Copper /G.I./Aluminium earth bus of suitable size shall be provided at the bottom of the panel throughout the length. Similarly suitable size of strip in each vertical section for earthing the individual equipment/accessories shall be provided and connected to main horizontal bus.

Sheet steel hinged lockable doors shall be interlocked with MCCB to prevent opening of the panel when MCCB is on position. Safety interlock with operating handle shall be provided.

Contactors shall be electro magnetic type with interrupted duty as per IS: 2959. The main contacts shall be of silver or silver alloy, provided with minimum 2 NO and 2 NC auxiliary contacts. The push button should be of shrouded type and each should be provided with 1 NO and 1 NC contact. Colour coding shall be as per IS: 6875 (Part-II).
ACB (IEC 60947-2; IS 13947)

The circuit breaker shall be of air break type in order to eliminate fire and explosion risk and shall comply with the IEC with a rupturing capacity of not less than 35 MVA at 415 volts or as specified elsewhere (The service short circuit breaking capacity shall be as specified and equal to the short circuit with stand value Ics = Icu). The breaker shall be provided with variable microprocessor based releases with in built fault differentiation for integral over load, short circuit and earth fault & other protection as called for in BOQ. LED indication for type of fault, CT’s for protection and measurement class as called for in BOQ, and LCD display of curves and parameters. Electrical endurance without maintenance shall be greater than 2000 cycles.

Mechanical & electrical anti pumping devices shall be provided in breaker, as required.

The breaker shall have memory for logging history for type of fault, load, time & date and the Vendor shall mention in the data sheet for no. of loggings available in the breaker memory.

The breaker shall consist of a horizontal draw out pattern triple/four pole, fully interlocked, independent manual/motorized spring operated mechanism. The mechanism should be such that the circuit breaker is at all times free to open immediately. The trip coil is energized. Current carrying parts should be silver plated and suitable arcing contacts shall be provided to protect the main contact arc-chutes for each pole shall be provided and shall be lifted out for the inspection of main and arcing contact.

Self-aligning cluster type isolating contacts shall be provided on breaker for interlocking protection metering and for any other purposes. The breaker should have 3 distinct positions - SERVICE/TEST/ISOLATED within the cubicle.

The ACB shall be with molded housing class II front fuse and shall be suitable for Isolation as per the annexure 7.1.2 in the standard.

Breaker shall be provided with automatic safety shutters to screen the main live contact when the breaker is withdrawn. The frame of the circuit breaker could be positively earthed when the breaker is racked into the cubicle.

The following safety arrangements shall be provided for the safety of the personnel to prevent mal-operation.

i) Interlock to prevent the truck from being withdrawn or replaced except in the fully isolated position.

ii) Interlock to prevent earth connection from being made by the earthing device except breaker is open.

iii) Interlock to prevent the breaker being closed unless it is fully raised.

iv) Interlock to prevent the breaker from being made alive without its rack in position.

Protection Releases

Self powered & true RMS sensing microprocessor based release with following features.
a) **Incomer ACB of Panels:**

Long time short circuit protection with time delay. Instantaneous and earth fault protection with LCD display to show RMS current in all three phases, neutral (for 4pole) simultaneously. The other features of the release to be as under.

- The release should display distinct fault indication for each type of tripping for faster fault diagnosis and reduce down time & should protect ACB from over temperature and Phase unbalance.

- Release should provide contact wear indication in display no. of operation seen by the breaker for case of maintenance.

- The release shall be self diagnosis & should provide fault history including cause of fault as well as level of fault current. It should be possible to store minimum 20 last trip data with nonvolatile memory.

- The protection setting of release should be accessible to change locally.

- LCD display should be at least 4 line display and should be able to display current is all the 3 phases and neutral (4 pole) simultaneously.

b) **For Outgoing ACB feeder:**

Long time Short circuit protection with time delay (for discrimination), instantaneous. The other features of the release to be as under.

The release should have distinct fault indication for each type of tripping for faster fault diagnosis and reduced down time and shall protect ACB from over temperature and phase unbalance.

- Operation counter
- Alarm and warning indication

Type test certificate : The ACB’s shall be type tested ad certified for coplion is to IS 13947/equivalent / EC standard from Indian / Internation testing authority, supplier to submit certificate of the same.

**MOULDED CASE CIRCUIT BREAKER (MCCB)**

MCCB shall confirm to the latest IS13947 -1993/IEC 60947. The Service Short Circuit Breaking Capacity (Ics at 415 VAC) should be as specified.

MCCB shall be Current Limiting and comprise of Quick Make – Quick Break switching mechanism & Double Break Contact system. The arc extinguishing device and the tripping unit contained in a compact, high strength, heat resistant, flame retardant, insulating molded case with high withstand capability against thermal and mechanical stresses. All MCCBs shall be capable of defined variable overload short circuit and earth fault adjustment with thermo-magnetic releases upto 250A and with electronic release above 250A onwards.

The Service Short Circuit Breaking Capacity (Ics at 415 VAC) should be as called for in BOQ and is the required minimum value for that feeders/ panel, however if the rating of feeder mentioned is not available, the contractor shall used next higher rating without any extra charges. The service short circuit breaking capacity shall be equal to ultimate breaking capacity of MCCB, i.e. Ics= 100%Icu
The trip command shall over ride all other commands. MCCB shall employ maintenance free double break contact system to minimize the let thru’ energies and capable of achieving discrimination upto the full short circuit capacity of downstream MCCB. The manufacturer shall provide both the discrimination tables and let thru’ energy curves. The MCCB shall not be restricted to Line/Load connections.

The handle position shall give positive indication of ‘ON’, ‘OFF’ or ‘Tripped’ thus qualifying to disconnection as per the IS/IEC indicating the true position of all the contacts. In case of 4 pole MCCB the neutral shall be defined and capable of offering protection upto full rating. The remote tripping coil should be of continuous duty. The general-purpose control switch shall be provided for ON/OFF Auto/Manual. The switch shall be provided with engraving plates on the front with the complete inscription.

The switch shall be normally a fixed control box type heavy-duty unit.

Indicating lamps shall be of the panel mounting, LED type and shall have execution plates marked with its function wherever necessary. The color of the lamp cover shall be red for ‘ON’ and green for ‘OFF’ indicating lamps shall be provided with series resistor. MCCB shall be provided with interlocking devise for interlocking the door of switchboard. Following shall be included if specified in the drawing or in the schedule of quantities:

- Under voltage trip
- Shunt trip
- Alarm Switch
- Auxiliary switch

CONTACTORS

The contactors should comply with the latest IEC947-4 and the corresponding IS13947-4 standards. They shall have UL and CSA approval. The contactors should be rated for AC3 duty at 415V and 50Hz. The contacts should be fast closing and fast opening type. The making and breaking capacity values of the contactors should be as follows (as per IEC947-4):

For AC3 Duty
- Making Capacity equal to or more than 10 Ie
- Breaking Capacity equal to or more than 8 Ie

For AC4 Duty
- Making Capacity equal to or more than 12 Ie
- Breaking Capacity equal to or more than 10 Ie

The contactors should be capable of frequent switching and should operate without derating at 600C for AC3 applications. They should be climate proof as standard. The coil of the contactor should have class H insulation to support frequent switching.

The rated voltage of the contactor shall be equal or superior at 690 V, and rated insulation voltage shall be 690 V. The rated impulse voltage of the contactor should be 8 KV.

The contactor should be modular in design with minimum inventory requirements and built in mechanically interlocked 1NO 1NC auxiliary contact up to 32A. They should be
suitable for the addition of auxiliary contacts and other electrical auxiliaries without any compromise on the performance or the operation of the contactors. The contactors from 4 KW to 400 KW will be associated with the same auxiliary contact block range.

Wherever D.C control is required, the contactor should have wide range (0.7 to 1.25Uc) D.C coil with built in interference suppression as standard.

The control and power terminals should be at separate layers preferably with colour coding (black for power and white for control)

All contactors power connection will be finger safe (IP2X) as standard.

They should be capable of being integrated into automated system (PLCs etc.) without any interposing components in minimum operating conditions.

The thermal over load relay if used will be directly mounting under the contactor without any specific connections.

NAME PLATES & LABELS

i) Panel and all modules shall be provided with prominent engraved identification plates. The module identification designation. For single front switchboards, similar panel and board identification labels shall be provided at the rear also.

ii) All nameplates shall be of non-rusting metal or 3-ply laminoid, with white engraved lettering on black background. Inscription and lettering sizes shall be subject to Owner’s approval.

iii) Suitable stencilled paint marks shall be provided inside the panel/module identification of all equipments in addition to the plastic sticker labels. These labels shall be partitioned so as to be clearly visible and shall have the device number, as mentioned in the module wiring design.

PAINTING

All steel work shall be pretreated in tanks and finally powder coated of approved shade.

WIRING

Control and protective wiring shall be done with copper conductor PVC insulated 1100 volts grade multi-stranded flexible wire of 2.5sq.mm cross section. The colour coding shall be as per latest edition of IS: 375.

Each wire shall be identified by plastic ferrule. All wire termination shall be made with type connection. Wire shall not be taped or spliced between terminal points.

Terminal blocks shall preferably by grouped according to circuit function and each terminal block group shall have at least 20% spare capacity.

Not more than one wire shall be connected to any terminal block. All doorframe of L.T. switchboard shall be earthed with bare braided copper wire.

TESTING & INSPECTION

After completion of all work at the manufacturer’s works the switchboards shall be inspected and tested in presence of Purchaser’s representative. However, stage
inspection may be carried out from time to time to check progress of work and workmanship. The following tests shall be carried out:

i) All routine tests specified in relevant Indian/British Standards shall be carried out on all circuit breakers.

ii) Test for protective relay operation by primary or secondary injection method.

iii) Operation of all meters.

iv) Secondary wiring continuity test.

v) Insulation test with 1000 Volts megger, before and after voltage test.

vi) HV test on secondary wiring and components on which such test is permissible (2 KV for one minute)

vii) Simulating external circuits for remote operation of breaker, remote indicating lights and other remote operations, if any.

viii) Measurement of power required for closing/trip coil of the breaker.

ix) Pick up and drop out voltages for shunt trip and closing coils.

x) CT Polarity test.

Vendor shall provide all facilities such as power supply, testing instruments and apparatus required for carrying out the tests. Required copies of test certificates for all the tests carried out along with copies of type test certificates and certificates from Sub-Vendor for the components procured from them are to be submitted before despatch of switchboards.

**DRAWINGS AND INFORMATION**

The Vendor shall furnish following drawings/documents in accordance with enclosed requirements:

i) General Arrangement drawing of the Switchboard, showing front view, plan, foundation plan, floor cutouts/trenches for external cables and elevations, transport sections and weights.

ii) Sectional drawings of the circuit breaker panels, showing general constructional features, mounting details of various devices, bus bars, current transformers, cable boxes, terminal boxes for control cables etc.

iii) Schematic and control wiring diagram for circuit breaker and protection including indicating devices, metering instruments, alarms, space heaters etc.

iv) Terminal plans showing terminal numbers, ferrules markings, device terminal numbers, function etc.

v) Relay wiring diagrams.

vi) Equipment List.

Vendor shall furnish required number of copies of above drawings for Purchaser’s review, fabrication of switch boards shall start only after Purchaser’s clearance for the
same. After final review, required number of copies and reproducibles shall be furnished as final certified drawings.

The information furnished shall include the following:

i) Technical literature giving complete information of the equipment.

ii) Erection, Operation and Maintenance Manual complete with all relevant information, drawings and literature for auxiliary equipment and accessories, characteristics curves for relays etc.

iii) A comprehensive spare parts catalogue.

TOOLS
One complete set of all special or non-standard tools required for installation, operation and maintenance of the switchboard shall be provided. The manufacturer shall provide a list of such tools with his quotation.

SPARES
The manufacturer/tenderer shall also supply a complete list of commissioning spares and tools. The same shall be included in the bid price. No extra payment shall be made on account of non-availability of spares during commissioning.

QUALITY ASSURANCE
Quality Assurance shall follow the requirements of Owner/Consultant as applicable.

Quality Assurance involvement will commence at enquiry and follow through to completion and acceptance thus ensuring total conformity to Purchaser’s requirements.

DEViations
Deviation from specification must be stated in writing at the quotation stage.

In absence of such a statement, it will be assumed that the requirements of the specifications are met without exception.

5. BATTERY & BATTERY CHARGER

1. SCOPE

The specifications give details of the Battery Charger suitable for HT/ LT Panels. The batteries are housed in the Bottom Compartment of the Battery Charger. Sealed maintenance Free Batteries upto 24V – 200AH or Lead Acid Batteries upto 24V – 150AH can be housed in the Battery Compartment. The Battery Charger is a composite Battery Charger cum DC Distribution Board.

2. GENERAL

The Battery Charger shall be Float cum Boost type, Thyristor controlled. The Charger shall have selector switch for Auto Float – Boost/Manual Float/Manual Boost Mode of operation. During Auto Float – Boost Mode, Automatic Changeover shall take place from Float Mode to Boost Mode and vice – versa. This means that when the Batteries are fully charged the charging shall automatically change from Boost charge to Trickle charge.
**Construction Feature**

Float cum Boost Charger and DC Distribution Board shall be housed in Sheet Steel Cubicle with Panels of 1.6mm thickness, louvers for ventilation, gland plate will be provided for cable entry from bottom. The cubicle shall be painted in Siemens Grey Shade. The Battery Charger shall be divided into two Compartments. The Upper Compartment shall house the Battery Charger & DCDB with all the necessary controls. The Lower Compartment shall be suitable for housing the Batteries.

**PERFORMANCE**

a. The D.C. Output Voltage of Float/Boost Charger shall be stabilized to within $\pm 2\%$ for A.C. Input variation of $\pm 10\%$, frequency variation of $\pm 5\%$ and D.C. Load variation of $0$– $100\%$. The Voltage Regulation shall be achieved by a constant voltage regulator having fast response SCR controlled. The ripple content in output shall be within $3\%$ of D.C. Output Nominal Voltage.

b. There shall be provision to select Auto Float/Manual Float /Manual Boost Modes. During Auto Float Mode the Battery Charging shall automatically changeover from Boost Mode to Float Mode and vice – versa. During Manual Float/Boost Modes it shall be possible to set the output volts by separate potentiometers.

The Battery Charger shall have automatic output Current Limiting feature.

**COMPONENTS**

The Battery Charger shall essentially comprise of the following:

a. 1 No. Double Pole ON/OFF MCB at A.C. Input.

b. 1 No. Pilot Lamp to indicate Charger ON.

c. 1 No. MAIN TRANSFORMER: Double Wound, naturally air – cooled, having Copper winding.

d. 1 Set Single Phase full wave Bridge Rectifier consisting of 2 nos. Diodes and 2 nos. SCR’s, liberally rated, mounted on Heat Sinks and complete with Resistor/Condenser network for surge suppression.

e. 1 No. Rotary Switch to select AUTO FLOAT/MANUAL FLOAT/MANUAL BOOST. During Auto Float Mode Automatic Changeover shall take place from Float Mode to Boost Mode and vice – versa.

f. 1 Set Solid state constant potential controller to stabilize the DC Output Voltage of the Float cum Boost Charger at $\pm 2\%$ of the set value for AC Input Voltage variation of $\pm 10\%$, Frequency variation of $\pm 5\%$ from 50Hz and simultaneous Load Variation of 0 - 100% and also complete with Current Limiting Circuit to drop the Float Charger Output Voltage upon overloads to enable the Battery to take over.

g. 1 No. Electronic Controller to automatically changeover Battery Charging from Boost to Float and vice – versa.

h. 1 No. DC Ammeter and Toggle Switch to read Charger Output Current and Battery Charge / discharge current.

i. 1 No. Moving Coil DC Voltmeter to read the DC Output Voltage.
j. 2 Set Potentiometer to adjust the output Voltage during Manual / Auto Float and Boost Modes.

k. 1 No. Double Pole ON/OFF MCB at Charger Output.

l. DC Distribution Board:

<table>
<thead>
<tr>
<th>INCOME</th>
<th>1 No. DP MCB, as called for in BOQ.</th>
</tr>
</thead>
<tbody>
<tr>
<td>R</td>
<td>63A</td>
</tr>
<tr>
<td>OUTGOIN</td>
<td>Suitable No. 16A/20A DP MCB, as called for in BOQ</td>
</tr>
</tbody>
</table>
Alarm Annunciation:

Visual and Audible Alarm with Manual Accept/Reset Facility shall be provided for the following:

a) A.C. Mains Fail.
b) Charger Fail.
c) Load/Output overvolt.

RATING:

A C INPUT: 230V ±10% AC 50 Hz Single Phase

D C OUTPUT: To Float/Boost charge 24V / 100AH Batteries and also supply a continuous load

CURRENT RATING: 15.0 Amps

FLOAT MODE: 27.0 V Nominal (Adj. between 24.0 – 28.0V)

BOOST MODE: 28.0 V

Voltage Regulation: □ 2% of the set value

RIPPLE: Less than 3%. 
For 24V / 100 AH Batteries the Charger Rating is given in the Specification for Batteries of other capacities refer to the Table as given below:

<table>
<thead>
<tr>
<th>BATTERY CAPACITY</th>
<th>CHARGING RATING</th>
</tr>
</thead>
<tbody>
<tr>
<td>24V / 40AH</td>
<td>10.0 Amp.</td>
</tr>
<tr>
<td>24V / 60AH</td>
<td>15.0 Amp.</td>
</tr>
<tr>
<td>24V / 100AH</td>
<td>15.0 Amp.</td>
</tr>
<tr>
<td>24V / 120AH</td>
<td>20.0 Amp.</td>
</tr>
<tr>
<td>24V / 150AH</td>
<td>25.0 Amp.</td>
</tr>
<tr>
<td>24V / 200AH</td>
<td>30.0 Amp.</td>
</tr>
</tbody>
</table>

6. EARTHING

All electrical equipment is to be earthed by connecting two earth tapes from the frame of the equipment to a main earth ring. The earthing ring will be connected via several earth electrodes. The cable armour will be earthed through cable glands. Earthing shall be in conformity with provision of rules 32, 61, 62, 67 & 68 of Indian Electricity Rules 1956 and as per IS-3843-1966.

The following shall be earthed:

1. Transformer & D.G. Set neutrals.
2. Transformer Housing.
3. H.T. Panels.
4. Non-current carrying metallic parts of electrical equipment such as switchgear, bus ducts, rising mains, panel boards, motor control centres, power panels, distribution boards, cable trays, metal conduits, welding sockets etc.
5. Generator & motor frames.
6. All fixtures, sockets outlets, fans, switch boxes and junction boxes etc. shall be earthed with PVC insulated copper wire as specified in item of work. The earth wires ends shall be connected with solderless bottle type copper lugs.
7. The third pin of Outlets on UPS shall be provided with a separate PVC insulated Cu. Wire (green with yellow stripe) as Isolated ground earth wire apart from the earthing of box.

The earth connections shall be properly made. A small copper loop to bridge the top cover of the transformer and the tank shall be provided to avoid earth fault current passing through fastened bolts, when there is a lightning surge, high voltage surge or failure of bushings.

The shop drawing for earthing system shall be prepared by the contractor and be got approved by Owner/Architect. The work shall be done in accordance with approved drawings.
All earth electrodes shall be given to a depth sufficient to reach permanently moist soil. Their location shall be marked and approval taken from Engineer-in-Charge before excavation for the same.

The earth electrodes shall be tested for earth resistance by means of a standard earth test ohms meter. All tests shall take place during the dry months, preferably after a protected dry spell.

The resistance between earthing system and the general mass of earth shall not be greater than 1 ohm. The earth loop resistance to any point in the electrical system shall not be in excess of 1 ohms in order to ensure satisfactory operation of protective devices. The resistance to earth shall be measured at the following:

a) At each electrical system ground or system neutral ground.

b) At one point on each grounding system used to ground electrical equipment enclosures.

c) At one point on each grounding system used to ground wiring system enclosures such as metal conduits and cable seaths or armoured.

All earthing conductors shall be of high conductivity copper/ G.I. as per B.O.Q. and shall protected against mechanical damage. The cross-sectional area of earth conductors shall not be smaller than half that of the largest current carrying conductor. However, the contractor shall use the sizes specified in the bill of quantities of the Tender.

**Pipe Earth Electrode**

G.I. pipe shall be of medium class and of the size and dia as specified in BOQ. G.I. Pipe electrode shall be cut tappered at bottom and provided with holes of 12mm dia drilled not less than 7.5cm from each other upto 2m of length from bottom. The electrode shall be burried in the ground vertically with its top not less than 20cm below ground level.

**Plate Earth Electrode**

The plate earth electrode shall consist of copper plate or G.I. plate as per item of work. The plate electrode shall be burried in ground with its faces vertical and top not less than 2.5m below Ground level. The plate shall be filled with charcoal dust and common salt filling, extending 15cm around it on all sides.

A watering pipe as specified in BOQ, of medium class G.I pipe shall be provided. The top of the pipe shall be provided with a funnel and a G.I. mesh screen for watering the earth. In the case of pipe electrode a removable plug shall be provided as per drawing. This will be housed in a masonry sump (with cement plastering) of not less than 40 cm square and 40 cm deep. A C.I. frame with hinged cover of 10mm thickness and locking arrangement shall be suitably provided over the sump. The earthing lead from electrode onwards shall be suitably protected from mechanical injury by a suitable dia medium class PVC/ HDPE pipe. The overlapping in G.I. strips in joints shall be rivetted with revets and welded in approved manner. The protection pipe within ground shall be burried at least 30 cm deep (to be increased to 60cm in case of road crossing and pavements). The portion within the building shall be recessed in walls and floors to adequate depth. In the case of plate earth electrode, two nos. 50mm x 6mm GI/Cu. Strip the earthing lead shall be securely bolted to the plate with two zinc passivated bolts, nuts, checknuts and washers. In case of pipe electrode, it shall be connected by means of a through bolt, nuts and washers and cable socket. Main earthing conductor is taken from the earth electrode with which the connection is to be made.
No earth pit shall be fixed within 2.5M of a wall of foundation. The location of the earth electrode will be such where the soil has reasonable chance of remaining moist. Effort shall be made to locate them in grass lawns or near flowerbeds or water taps. The distance between two earthing stations shall be at least 3.0 meters.

**Testing and Commissioning**

Testing and commissioning shall be done as per the programme/ instructions to be given by Owner’s authorised representative. All testing equipments necessary to carry out the tests shall be arranged by the electrical Contractor.

Before the electrical system is made live, the electrical Contractor shall carry out suitable tests to the satisfaction of Owner that all equipment wiring and connections have been correctly done and are in good working condition and will operate as intended.

All tests shall be conducted in the presence of the Owner authorised representative by the electrical Contractor and shall be notified one week before tests are to take place.

All measurements shall conform to establish minimum acceptable test values. Owner’s Engineer reserves the right to approve all test results before circuit or equipments are energised for the first time.

7. **LIGHTNING PROTECTION SYSTEM**

Protection of buildings against lightning shall generally be done in accordance with latest IS-Code. The installation shall be done as per routes and location of equipment indicated on the drawing and bill of quantities. The conductors and the earth electrode conductor shall be fixed so that they are free to expand and contract. Special care shall be taken in the fixing of support to allow free movement.

The materials of lightning conductors, down conductors, earth termination etc. shall be reliably resistant to corrosion or be adequately protected against corrosion. All air terminations shall be GI and the conductors shall be GI.

The entire lightning protection system should be mechanically strong to withstand the mechanical forces produced in case of a lightning strike. The system shall be installed such that it does not spoil the architectural or aesthetic beauty of the buildings but on other hand at should meet IS code/safety code.

Horizontal air terminations should be so interconnected that no part of the roof is more than 9 metres away from the nearest horizontal conductor. For a flat roof horizontal air termination along the outer perimeter of the roof is used. For a roof of larger area a network of parallel horizontal conductors shall be installed. Horizontal air terminations shall be laid along contours such as ridges, parapets and edges of flat roofs and where necessary area flat surfaces in such a way as to connect each air termination to the rest and shall, they form a closed network.

All metallic finials, chimneys, ducts, vent pipes, railings, gutters, metallic flag staff, on or above the main surface of the roof of the structure shall be bonded to and form part of the air termination network. All air terminations shall be effectively recessed against over turning either by attachment to the object to be protected or by means to substantial braces and fixing which shall be permanently and rigidly attached to the buildings.

Down conductors shall be distributed around the outside walls of the structure. They shall preferably be run along the corners and other projection, due considerations being given to the locations of air terminations and earth terminations. Lift shafts shall not be used for fixing down conductors. Metal pipes leading rainwater from the roof to the
ground may be connected to the down conductors but cannot replace them. Such conductors shall have disconnecting joints. All vertical conductors shall be plumbed before fixing. Insulation shall be provided between down conductors and wall.

The lightning protective system shall have as few joints in it as possible. Wherever joints in the down conductor above ground level are necessary they shall be mechanically and electrically effective. The joint overlap shall not be less than the width of the tape. In the down conductor below ground level there shall be no joint. The joints may be clamped, screwed, bolted, riveted, sweated, braced or welded. The bonding of the external metal forming part of a structural or drain water pipe shall have a cross sectional area not less than that employed for the main conductors. Gas pipe, however, in no case shall be bonded to the earth termination system.

Conductors shall be securely attached to the building to be protected by fasteners, which shall be substantial in construction, not subject to breakage and shall be of steel. The conductors shall be secured at not more than 900mm apart for horizontal run and 750mm for vertical run.

Where tape are required to pass through roof asphalting or other waterproofing membranes, a special seal shall be used comprising a 38mm diameter plastic, copper or aluminium tube with 100mm diameter flange 50mm from the top of the tube. The tube length shall suit the thickness of the roof through which the conductor passes, allowing for the tube to protrude 50mm above the membrane. The seal is to be asphalted in position and the conductor shall be sealed in the tube by a setting waterproof compartment.

Each down conductor shall have an independent earth termination. The interconnection of all the earth termination shall be preferable. It should be capable of isolation for testing purpose by “testing joints” at position approachable easily for the meggar testing. The whole of the system could have a combined resistance to earth not exceeding 2 ohm before any bonding has been affected to metal in or on structure or two surfaces below ground.

8. CAPACITORS & CAPACITOR CONTROL PANEL

Power factor correction capacitors shall conform in all respects to IS 2834-1964. The capacitors shall be suitable for 3 phases 415V at 50Hz. frequency and shall be available in units as per B.O.Q. to form a bank of capacitors of desired capacity. All these units shall be connected in parallel by means of high conductivity electrolytic copper busbars of adequate current carrying capacity having S.C rating of 25 KA for 1 sec. Each capacitor bank shall be for PVC insulated aluminium conductor armoured cables. Two separate earthing terminals shall be provided for each bank for earth connection. The capacitor bank shall be housed indoor.

The capacitor bank shall be subject to routine tests as specified in relevant Indian Standard and the test certificate shall be furnished. The capacitor shall be suitable for indoor use upto 45 Deg.C over and above ambient temperature of 50degree C. The permissible overloads shall be as given below:

a) Voltage overload shall be 10% for continuous operation and 15% for 6 hours in a 24 hours cycle.

b) Current overloads 15% for continuous operation and 50% for 6 hours in a 24 hours cycle.

c) Overload of 30% continuously and 45% for 6 hours in a 24 hours cycle.
The capacitor banks shall be floor mounting type indoor housing using minimum floor space with protective guard or fencing. The capacitor bank shall be provided with 7% Detuned reactor filter to compensate third harmonics from being generated.

Capacitors shall be of aluminium foil and craft paper. Hermetically sealed in sturdy corrosion-proof sheet steel 2mm thick containers and impregnated with non-inflammable synthetic liquid and of low power loss version. Every element of each capacitor unit shall be provided with its own built in silvered fuse. The capacitor shall have suitable discharge device to reduce the residual voltage from crest value of the rated voltage to 50 V or less within one minute after capacitor is disconnected from the source of supply. The loss factor of capacitor shall not exceed 0.005 for capacitors with synthetic impregnants. The capacitors shall withstand voltage of 2500V AC supply for 1 minute.

The insulation resistance between capacitor terminals and containers when test voltage of 500V A.C. is applied shall not be less than 50 megohms.

- Capacitor bank and switching equipments shall be housed in a cubicle having degree of protection IP-51 and constructed with sheet steel of minimum 2mm thickness.
- Capacitors shall be unit type having non-PCB, non-flammable non-toxic dielectric.
- Necessary discharge resistor shall be provided externally to reduce the terminal voltage to or less then 50V in 60 seconds of disconnection from supply.
- Testing shall be done as per applicable standards for shunt capacitors.

**Capacitor Control Panel**

The capacitor control panel shall general comprise of the following:

a) Automatic power factor correction relay.
b) Step controller with reversing motor.
c) Time delay and no-volt relays.
d) Protection MCCB / MCB.
e) Contactor (AC-3 duty) for individual capacitors of suitable rating.
f) Change over switch for either automatic operation or manual operation with push button control.
g) C.T.s with ammeter and selector switch as asked for in BOQ.
h) Voltmeter with selector switch.
i) Indicating lights RYB.

All the capacitors and contactors shall be interconnected with PVC insulated copper conductor wires of adequate size in a neat and acceptable manner. Three phases and neutral bus bar shall be provided in panel as required.

The above control gear, P.F. meter, Digital Microprocessor based P.F. correction relay, push button station etc. shall be housed in a sheet steel metal enclosure cubical type, free standing front operated with lockable doors. The panel shall be fabricated from MS sheet steel 2mm thick and shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet steel shall be seam-welded. The panel shall be totally enclosed design completely dust tight and vermin proof. Gaskets between all adjacent units and beneath all covers shall be used to render the joints effectively.

All sheet steel material used in the construction of capacitor control panel should have undergone a rigorous rust proofing process comprising Alkaline Degreasing, descaling...
in dilute sulphuric acid and recognised phosphating process. The steel work should then receive two coats of primer before applying final coat of epoxy paint of approved shade.

**Quality Assurance**

Quality Assurance shall follow the requirement of Client/Consultant. Q.A. documents as applicable.

Q.A. involvement will commence at enquiry and follow through to composition and acceptable thus ensuring total conformity to purchaser’s requirement.

**Deviations**

Deviations from the specification must be stated in writing at the quotation stage.

In the absence of such a statement it will be assumed that the requirements of the specifications are met without exception.

**SPARES**

The manufacturer/tenderer shall also supply a complete list of commissioning spares and tools. The same shall be included in the bid price. No extra payment shall be made on account of non-availability of spares during commissioning.

9. **H.T. CABLE (XLPE) (6.6 KV)**

The cross-linked polyethylene (XLPE) cable shall be aluminium conductor PVC outer sheath steel strip armoured over inner sheath construction. XLPE cable shall conform to testing in accordance with IS: 7098 (Part-I) 1977 and (Part-II) 1973. The screening shall be done on individual cover. The armouring applied over the common covering shall be flat steel wires. Each and every length of cable shall be subjected to routine test.

The termination and jointing techniques for XLPE cables shall be by using heat shrinkable or push on cable jointing kits.

While laying underground cables in ducts care should be taken so that any underground structures such as water pipes, sewerage lines etc. are not damaged. Any telephone or other cable coming in the way shall be properly protected as per instructions of the Engineer-in-charge. The H.T. cable shall be laid at least 900mm for cable upto 3 KV (E) below the ground level in a trench 450mm wide.

Insulation tests shall be done before and after laying of cables.

After laying and jointing work is completed a high POT test shall be performed in presence of Engineer and test results submitted for approval in order to ensure that they have not been damaged during or after the laying operation. In case, the test results are unsatisfactory, the cost of all repairs and replacement and all extra work of removal and relaying will be made good by the contractor without any extra cost.

10. **L.T. CABLES & WIRE**

a) **Wires**

The design manufacture, testing and supply of single core FRLS PVC insulated 1.1 KV grade multi-stranded twisted wires under this specification shall comply with latest edition of following standards.

IS : 3961 Current rating for cables.
IS: 5831 PVC insulation and sheath of electric cables.
IS: 694 PVC insulated cables for working voltage upto and including 1100 volts.
IEC: 754(i) FRLS PVC insulated cable.

Copper multi-stranded twisted conductor FRPLS PVC insulated wires shall be used in conduit as per item of work.

The wires shall be colour coded R Y B, for phases, Black for neutral and Green for earth.

Progressive automatic in line indelible, legible and sequential marking of the length of cable in metres at every one metre shall be provided on the outer sheath of wire.

b) Cables

The design, manufacture, testing and supply of the cable under this specification shall comply with latest edition of following standards:

IS: 8130 Conductors for insulated electric cables and flexible cords.
IS: 7098 XLPE insulation and sheath of electric cables.
IS: 3975 Mild steel wires, strips and tapes for armouring cables.
IS: 7098 Current rating of cables.
IS: 7098 XLPE insulated (heavy duty) electric cables for working voltage upto and including 1100 volts.
IS: 424-1475(F-3) Power cable-flammability test.

Specification for cross-linked polyethylene insulated XLPE sheathed cable for working voltage upto 1.1 KV.

Specification for XLPE insulated (heavy duty) electric cables for working voltages upto and including 1100 volts.

ASTM-D: 2863 Standard method for measuring the minimum oxygen concentration to support candle-like combustion of plastics (Oxygen Index).

ASTM-D: 2843 Standard test method for measuring the density of smoke from the burning or decomposition.

IEEE : 383 Standard for type of test Class-IE, Electric cables, field splicers and connections for power generation station.
c) **Technical Requirements:**

i) The cables shall be suitable for laying in racks, ducts, trenches conduits and underground buried installation with uncontrolled back fill and chances of flooding by water.

ii) They shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating condition.

iii) The aluminium/copper wires used for manufacturing the cables shall be true circular/sector in shape before stranding and shall be of uniformly good quality, free from defects. The conductor used in manufacture of the cable shall be of H2 grade.

iv) The cable should withstand 25 KA for 0.5 sec with insulation armour insulated at one end. Bidder shall furnish calculation in support of capability to withstand the earth fault currents. The current carrying capacity of armour and screen (as applicable) shall not be less than the earth fault current values and duration.

v) The fillers and inner sheath shall be of non-hygroscopic fire retardant materials and shall be suitable for the operating temperature of the cable. Filler and inner sheath shall not stick to insulation and outer sheath.

vi) Progressive automatic in line indelible, legible and sequential marking of the length of the cable in metres at every one metres shall be provided on the outer sheath of all cables and at every 5 metre ‘FRLS’ marking in case of ‘FRLS’ cables.

vii) Strip/Wire armouring following method (b) mentioned in IS: 3975 shall only be acceptable. For single core cable aluminium wire armouring shall be used.

viii) Allowable tolerance on the overall diameter of the cables shall be + 2mm.

ix) The normal current rating of all XLPE insulated cables shall be as per IS: 7098.

x) A distinct inner sheath shall be provided by pressure extrusion process for all multicore armoured and unarmoured cables as per IS: 5831.

xi) Outer sheath shall be provided by extrusion process as per IS: 5831

xii) The breaking load of armour joint shall not be less than 95% of that armour wire. Zinc rich paint shall be applied on armoured joint surface.

xiii) In plant repairs to the cables shall not be accepted.

xiv) All the cables shall be supplied in non-returnable drums as per IS: 10418.

d) **In Case of FRLS Cables**

i) The outer sheath of cables shall have an oxygen index of not less than 29 as per ASIMD: 2863.

ii) The maximum acid gas generation by weight as per IEC: 754 (i) shall not be more than 20% for outer sheath material of all cables. Bidder shall also guarantee the maximum theoretical acid gas generation with 20% by weight of outer sheath.
iii) The cables outer sheath shall meet the requirement of light transmission of 40% (minimum and shall be tested as per ISTMD: 2843). In case the test for light transmission is conducted as per ASTM: 662. The bidder shall furnish smoke density values as per this standard and shall co-relate the anticipated light transmission when tested as per ASTM: 2843.

iv) The cable shall pass the fire resistance test as per SS: 42, 41, 475 (I) and flammability test as per EEE: 383.

e) Inspection:

All cables shall be inspected on receipt of the same at site and checked for any damage during transit.

f) Joint in Cables

The contractor shall take care that the cables received at site are distributed to various locations in such a manner as to ensure maximum utilisation and avoidance of cable jointing. Cable shall be rechecked before cutting in lengths, where the joints are unavoidable, and the location of such joints shall be got approved from the Owner/Consultant. The joints shall be done by qualified jointer strictly in accordance with manufacturer’s instruction/drawings.

g) Joint Boxes for Cables

The cable joint boxes shall be of appropriate size suitable for type of cable of particular voltage rating.

h) Jointing of Cables

All straight through joints shall be done in epoxy mould boxes with epoxy resins. Straight through joints shall not be permitted unless the length of run is in excess of cable drum.

End terminations of cables more than 1.1 KV grade shall be done with epoxy mould boxed and epoxy resin. Cable glands shall be 1.1KV grade double compression type and made to tin plated heavy-duty brass casting and machine finished. Glands shall be of robust construction capable of clamping cable and cable armour, firmly without injury of cable.

All washers and hardwares shall be made of brass tinned. Rubber components used in the glands shall be made of neoprene of tested quality.

Cable lugs shall be tinned copper/aluminium solderless crimping type conforming to IS: 8309 suitable for aluminium or copper conductor.

Crimping of terminals shall be done by using Corrosion inhabitory compound, with crimping tool.

Fire resistant paint has to be applied 1 Metre on either side of cable joint.

The contractor shall liaise fully with all other contractors to achieve an efficient and properly coordinated installation where equipment has to be re-positioned due to lack of site liaison; no extra cost shall be incurred by the client.
i) **Testing of Cables**

Cables shall be tested at factory as per requirement of IS: 7098 Part-I. The tests shall incorporate routine tests, type tests and acceptance tests. Prior to laying of cables, following tests shall be carried out:

i) Insulation test between phases and phase to earth for each length of cable before and after jointing.

On completion of cable laying work, the following test shall be conducted in the presence of Architect/Owner.

ii) Insulation resistance test (Sectional and overall) 1000/5000V depending upon the voltage grade of cable.

iii) Continuity resistance test.

iv) Sheathing continuity test.

v) Earth test.

j) **Laying of Cable**

The cable drum shall be placed on jacks before unwinding the cable. Great care shall be exercised in laying cables to avoid forming links. At all changes in directions in horizontal & vertical places, the cable shall be bent with a radius of bend not less than 8 times the diameter of cable.

The cable of 1.1KV grade shall be laid not less than 750mm below ground level in a 375mm wide trench (throughout), where more than one cable is to be laid in the same trench, the width of the trench shall be increased such that the interaxial spacing between the cables except where otherwise specified shall at least be 150mm minimum or as per site requirements or as approved by the Engineer-in-charge. Where single core cables are used in multiphase systems, the cables shall be installed in trefoil where possible.

In case the cables are laid in vertical formation due to unavoidable circumstance the depth per tier shall be increased by 200mm (minimum). Cable shall be laid in reasonably straight line, where a change in direction takes place a suitable curvature shall be i.e. either 12 times the diameter of the cable or the radius of the bend shall not be less than twice the diameter of the cable drum or whichever is less. Minimum 3-meter long loop shall be provided at both sides of every straight through joint & 3 meters at each end of cable or as directed at site.

Greater care shall be exercised in handling the cable in order to avoid forming ‘Kinks’. The cable drum shall in-verbally convey on wheels and the cable unrolled in right direction as indicated on the drum by the manufacturer. The cable shall be pulled over rollers in the trench steadily and uniformly without jerks and strains.

Cables laid in trenches in single tier formation, 10 cms. All around sand cushioning is provided below and above the cable before a protective cover is laid. For every additional vertical tier. The 30cm of sand cushion are provided over the initial tier. The cable shall be protected by 2nd class bricks of size not less than 230x115x75mm, stone tiles/RCC curved channel be placed on top of the sand breadth wise for the full length of the cable and where more than one cable is to be laid in the same trench the brick shall cover all cables and project at least 8 cms. Over the outer sides of the end cables.
Filling of trenches shall be done after the sand cushioning and laying of tiles or bricks are carried out to the satisfaction of the Engineer-in-charge (Refer drawing). Back fill for trenches shall be filled in layer not exceeding 150 mm. Each layer shall be properly rammed & consolidate before laying the next layer.

PVC pipe shall be provided for all road crossing. The size of the pipe shall be according to the cable and a minimum 100mm dia. pipe shall be provided. The pipe shall be laid in ground with special arrangement and shall be cement jointed and concreting with 1:5:10 shall be made as per relevant IS with latest amendment. Location of cables laid directly underground shall be indicated by cable marker at an interval of 30 meters & with change of direction. Aluminium strip cable tag of 20mm wide with engraved tag no. shall be provided at both ends of cable.

Where the cables are to be laid in ducts (pucca trenches) in side the building, they will have to be laid on MS rack/ on MS cable trays grouted in walls trenches. Cables sizing through floors shall be protected from mechanical damage by a steel channel to a height of one meter above the floor where cable pass through wall they shall be sleeved with PVC/steel conduit.

Where the cables are laid in open (in building) along walls, ceiling or above false ceiling, cable rack (ladder type) or cable tray shall be provided. The size of the cable tray or rack shall depend on the number of cables to pass over that rack. Cable tray/rack shall be properly supported through wall/ceiling according to the site conditions. Cable laid on tray & riser shall be neatly dressed &clamped at an interval of 1000 mm & 750mm for horizontal & vertical cable run respectively either side at each bend of cable. All power cables shall be clamped individually & control cables shall be clamped in groups of three or four cables. Clamps for multicore cables shall be fabricated of 25x3 GI flats. Single core power cable shall be laid in trefoil formation & clamped with trefoil clamps made of PVC/fibre glass.

Cable openings in wall/floor shall be sealed by the contractor suitably by hession tape & bitumen compound or by any other proven to prevent ingress of water.

After the cables are laid, these shall be tested as per IS and the results submitted to Architects/Engineer and in case the results found unsatisfactory, all the repairing/replacing of cables will be done by the contractor free of charge.

k) Fire Seal System

i) All the floor/wall opening provided for cable crossing shall be sealed by fire seal system.

ii) The fire proof sealing system shall fully comply with the requirements of relevant IS/BS: 476 Part-B. The fireproof seal system shall have minimum one hour fire resistance rating.

iii) The fire proof seal system shall be physically, chemically, thermally stable and shall be mechanically secured to the masonry concrete members. The system shall be completely gas and smoke tight, antirodent and anti-termite.

iv) The material used in fireproof seal system shall be non-toxic and harmless to the working personnel.

v) Type of fireproof seal system shall be foaming type or flamemastic type compound or approved equivalent.
After laying and jointing work is completed, high voltage test should be applied to all cables to ensure that they have not been damaged during or after the laying operation and that there is not fault in the jointing.

Cables for use on low and medium voltage system (1.1KV grade cables) should withstand for 15 minutes a pressure of 3000V DC applied between conductors and also between each conductor and sheaths. In the absence of pressure testing facilities it is sufficient to test for one minute with a 1000V insulation tester. In case the test results are unsatisfactory the cost of repairs and replacements and extra work of removal & laying will be made good by the contractor.

Cable shall be installed so that separation shown in the table below are observed.

| HV Cable (11 KV) - HV Cable (11 KV) | 50 mm |
| ELV & LV 230 V/433 V - ELV & LV cable 230 V/433 V | Equal to the diameter of the bigger cable. |
| HV cables (11 KV) - ELV & LV cables 230 V/433 V | 300 mm |
| LV cables 433 V - Telephone/Instrument cable | 350 mm |
| All cables - All hot pipe work | 200 mm |

l) **Quality Assurance**

Quality Assurance shall follow the requirements of Owner/Consultant as applicable. Quality Assurance involvement will commence at enquiry and follow through to completion and acceptance thus ensuring total conformity to Purchaser’s requirements.

m) **Deviations**

Deviation from specification must be stated in writing at the quotation stage.

In absence of such a statement, it will be assumed that the requirements of the specifications are met without exception.

n) **Spares for Commissioning Including Consumables**

The manufacturer/tenderer shall also supply a complete list of commissioning spares and tools and consumables. The same shall be included in the bid price. No extra payment shall be made on account of non-availability of spares during commissioning.

11. **CABLE TRAYS**

a. **Ladder type Cable tray** – for Power Cables only

Cable trays shall be ladder type fabricated out of mild steel/slotted angles and flats of required width as per design. Bends shall be prefabricated. The cable tray shall be hot dip galvanized or primed and painted with powder coating as asked for in BoQ or as approved by Owner/Consultant. The minimum weight of the zinc coating shall be 460 gm/sq.m and minimum thickness of coating shall not be less than 75 microns.

b. **Perforated Cable tray** – for Power Cables & Low current service both
The perforated cable trays are fabricated out of 1.6mm thick CRCA sheet steel having minimum 50mm depth or as called for in BOQ, hot dip galvanized or epoxy coated of approved shade. Perforations are maximum 10mm spaced at maximum 20mm distance. The cables shall be tied with the cable tray with nylon strip/aluminium clamps/M.S. clamps as per requirements.

Suitable provision shall be made where a tray crosses expansion joints. The width of the tray shall allow for a suitable separation between cables the design shall allow for adequate bending radius for the sizes of cables. No sharp bend to be allowed in cable tray. Joints between sections shall be bolted.

The tray shall be suspended from the surface of the concrete slab by means of approved steel hangers spaced at a distance of not more than 125cms. Suitable bushes shall be provided where cables pass through apertures in the tray. Cables must be securely fixed to the tray with clamps or cable ties. In routing necessary barrier and spacing shall be maintained for cables of different voltages in case they lie side by side. Telephone cables shall cross the power cables only at about right angle and these two shall not run in close proximity. Full details of the tray shall be approved by the Consultant/Site Engineer before fabrication. Earth continuity shall be maintained between each section of cable tray and each total run of tray shall be effectively bonded to the nearest earth conductor. All nuts and bolts used shall be of galvanised steel.

Depending on the size of cable trays space of 20-33% has to be maintained for future expansion.

Cable tray is manufactured to comply with the specifications of National Electrical Code (NEC) and National Electrical Manufacturer’s Association (NEMA).

12. INTERNAL ELECTRICAL WORKS

12.01 Conducting (M.S Conduit)
All conduits shall be of heavy gauge solid drawn ERW welded manufactured out of 16 (1.6mm) gauge MS Sheet up to 32mm dia and of 14 (2 mm) gauge for sizes higher than this. Both inner and outer surfaces shall be smooth without burrs, dents and kinks. Conduits shall be black stove enameled inside and outside. The cross section of conduit shall be uniform throughout. The welding shall be uniform such that welded joints do not yield when subjected to flattening test. Welded joint shall not break when threaded or bent at an angle. Conduit shall conform to specifications of IS: 9537 (Part-II) and the capacity of conduits shall be in accordance with the standards and shall never be exceeded. The minimum size of the conduit shall be 20mm dia. Care shall be taken to ensure that all conduits are adequately protected while stored at site prior to erection and no damaged conduit shall be used.

12.02 PVC Conduit
All conduits shall be high impact rigid 2mm thickness PVC heavy duty type and shall comply with I.E.E. regulations for non-metallic conduit 2mm thick as per IS-9537/1983 (Part-III). All sections of conduit and relevant boxes shall be properly cleaned and glued by using epoxy resin glue and the proper connecting pieces. Inspection type conduit fittings such as inspection boxes, drawn boxes, fan boxes and outlet boxes shall be M.S. or otherwise mentioned. Conduit shall be terminated with adopter/PVC glands as required.

12.03 Accessories
Conduit accessories such as normal bends, unions, circular junction boxes and pull boxes, locknuts etc. shall be heavy gauge type and approved make. Conduit accessories shall conform in all respects to IS: 3837-1966 with latest amendment. Wherever several
Conduits are running together, adequately sized adoptable boxes common to all runs shall be used to avoid inserting inspection boxes in the individual run. Where it is necessary to segregate wiring metal filler shall be fixed with in the box.

Conduits shall be laid before casting in the upper portion of a slab or otherwise, as may be instructed or in accordance with approved drawings, so as to conceal the entire run of conduits and ceiling outlet boxes. Vertical drops shall be buried in columns or walls. Wherever necessary, chases will be cut by the contractor with the help of chase cutting m/c or by hand. Nothing extra shall be paid to the contractor on this account. In case of exposed brick/ rubble masonry work special care shall be taken to fix the conduit and accessories in position along with the building work. Sufficient depth of the chases will be made to accommodate the required number of conduits. The chase will be filled with cement, coarse sand mortar (1:3) and properly cured by watering for one week.

If a chase is cut in an already finished surface the contractor shall fill the chase and finish it to match the existing finish. Contractor must not cut any iron bars to fix conduits. Conduits shall be kept at a minimum distance of 100mm from the pipes of other non-electrical services. Where the conduit is to be embedded in a concrete member it shall be adequately tied to the reinforcement to prevent displacement during casting, conduits in chases shall be held by steel hooks of approved design at maximum of 100 cm centres. The embedding of conduits in walls shall be so arranged as to allow at least 12mm plaster cover the same. All threaded joints of conduit pipes shall be treated with some approved ‘preservative compound’ to secure protection against rust.

Suitable expansion joints fittings of approved make and design shall be provided at all the points where the conduit crosses the expansion joint in the building. (Preferably with Pilca metallic watertight conduits). Conduits shall cross at right angles of the joints only.

Separate conduit shall be used for:

1) Normal light, fan call bell
2) 16 A power outlets
3) Emergency Light Point
4) Fire alarm System
5) Computer Outlets
6) P.A System
7) Telephone system
8) TV Network
9) Or any other services not mentioned here.

Wiring for short extensions to outlets in hung ceiling or to vibrating equipments, motors etc. shall be installed in flexible conduits. Flexible conduits shall be formed from a continuous length of spirally wound interlocked wire steel with a fused zinc coating on both sides. The conduit shall be provided with approved type adoptor. A separate and accessible earth connection shall bond across the flexible conduit.

Conduit runs on surfaces shall be supported with metal 1.2 mm thick saddles, which in turn are properly secured on to GI spacer to the wall or ceiling. Fixing screws shall be with round or cheese head and of rust proof materials. Exposed conduits shall be neatly run parallel or at right angles to the walls of the building and shall be painted in color matching the adjoining area. Unseemly conduit bends and offsets shall be avoided by using better appearance. Cross cover of conduits shall be minimum and entire conduit installation shall be clean and with good appearance. For surface work, the boxes shall be raised back pattern type, designed for use with distance saddles to give clearance of 6mm between the back of conduit and the fixing surface.
Where conduits are run on steel work, they will be fixed by means of purpose made GI Caddy clips in manner meeting with the approval of the Engineer prior to the installation being carried out. Other methods of fixing may be agreed in special circumstances, but approval must first be obtained from the site engineer.

The spacing of saddles shall be not more than 600mm centers for up to 32mm diameter conduits and at 750mm for conduit sizes of 40mm diameter and above in case of MS conduit and not more than 600 mm for PVC conduit. In addition, saddles shall be fixed at each side of any bend/Tee, or set at a distance of 200mm from the bend/Tee. The holes in the brickwork or concrete for fixing plugs shall be neatly drilled by means of a masonry drill of the appropriate size.

All the GI sheet steel /passivated boxes used for housing switches, plugs, fan regulator etc. shall be five sided conforming to IS: 5133 Part I-1969. Suitable size of boxes shall be provided a minimum of 2 adjustable fixing lugs on vertical sides. Suitable earth terminal inside each box shall be provided. All fixing lugs shall be threaded to receive standard machined chromium plated brass screws. Sufficient number of knockouts shall be provided for conduit entry. Conduits carrying wires of different circuit can terminate in common J.B having metal compartments. Necessary GI pull wires shall be inserted into the conduit for drawings wires. In case conduit pipe is required to cross any RCC beam special adopter boxes shall be provided for crossing & nothing shall be paid extra.

Where conduits are used for non air- conditioned space to air -conditioned space or into a fan chamber or duct, a junction box shall be installed to break the continuity of such conduit at the point of entry or just outside and conduit shall be sealed around the conductors.

Particular care shall be taken during the progress of the work to prevent the ingress of dirt and rubbish such as plaster droppings into erected conduits. Conduit which has become so clogged shall be entirely freed from these accumulations or will be replaced. Screwed plastic or metal caps or turned wooden plugs shall be employed to protect all open ends. Plugs of waste wood, paper, cotton or other fibrous matter shall not be used. All unused conduit entries shall be blanked off in an approved manner and where conduits terminate in adaptable boxes, all removable box covers shall be firmly secured to provide complete enclosure. If considered necessary by the Engineer-in-charge, the conduits shall be swabbed out by drawing swabs of rag through the conduit to remove moisture prior to any cables being drawn in.

All conduit installations must be completed and erected in their totality before they are wired and must be fully rewirable from outlets to distribution boards or trunking systems etc. to which they connect. No wiring of any part of the installation shall be commenced until instructions are received to do so by the Engineer-in-charge at such time as he is satisfied that the wiring will not be damaged due to building operations.

Conduits shall be installed so that they are self draining in the event of ingress of moisture due to condensation or any other reason. A suitable drainage hole shall be drilled at the bottom of the lowest conduit box in every 9-meter of horizontal run.

PVC bush of good quality shall be used in each conduit termination in a switch box, draw box, lighting fixtures and circular junction boxes.

Exposed conduits running above false ceilings shall be suitably clamped independently along with the dropped ceiling. Perforated straphangers or twisted attachment shall not be acceptable. In no case shall raceways be supported or fastened to other pipe for repair and maintenance. They shall be arranged symmetrically and in the cost compact design, in no way unduly criss- crossing each other. Proper spacing shall be maintained when
two or more conduits run side by side. The layout of the pipes shall be co-ordinated with other services if any. The junction boxes and conduits used in hazardous areas shall be flameproof type with cast iron construction complete with threaded covers. The conduit of each circuit or section shall be completed before conductors are drawn in. The entire system of conduit after erection shall be tested for mechanical and electrical continuity throughout and permanently connected to earth conforming to the requirements by means of special approved type of earthing clamp efficiently fastened to conduit pipe in a workman like manner for a perfect continuity between the earth and conduit.

The conduit system shall be so laid out that it will obviate the use of tees, elbows and sharp bends. No length of conduit shall have more than the equivalent of two-quarter bends from inlet to outlet. The conduit itself being given required smooth bend with radius of bends suiting to the site conditions but not less than 6 times overall diameter.

Outlet boxes shall be of heavy-duty sheet steel installed as to maintain continuity throughout. These shall be so protected at the time of laying that no mortar finds its way inside during concrete filling or plastering. For fluorescent fittings, the outlet boxes heavy duty shall be provided 300mm off centre for a 1200mm fitting and 150mm off centre for a 600mm fittings or as per B.O.Q.

Draw boxes of ample dimensions shall be provided at convenient points to facilitate pulling of long runs of cables. They shall be completely concealed with MS covers flush with plasterwork painted to match the wall. These boxes will be as few as possible and located where found suitable by the consultant.

12.04 Switch Boxes

The switch boxes shall be zinc passivated & shall not be less than 18 SWG thick or shall be as called for in BOQ. It will be so designed that accessories could be mounted on integral pedestals or on adjustable flat iron mounting straps with tapped holes by brass machine screw. Leaving ample space at the back and on the sides for accommodating wires and check nuts at conduit entries. These shall be attached to conduits by means of check nuts on either side of their walls. These shall be completely concealed leaving edges flush with wall surfaces. Earthing terminal inside box shall be provided.

Moulded plate switches screw less as specified in item of work shall be provided. No timber shall be used for any supports. Boxes, which come within concrete, shall be installed at the time of casting. Care shall be taken to fix the box rigidly so that its position is not shifted while concreting.

12.2.0 Wiring

All the wiring installation shall be as per IS: 732 with latest amendment. PVC insulated copper conductor cables as specified in bills of quantity shall be used for sub-circuit runs from the distribution boards to the points and shall be pulled into conduits. They shall be twisted copper conductors with thermoplastic insulations of 660/1100 volts grade. Colour Code for wiring shall be followed.

Looping system of wiring shall be used, wires shall not be jointed. Where joints are unavoidable, they shall be made through approved mechanical connectors with prior permission of the consultant. No reduction of strands is permitted at terminations. No wire smaller than 1.5 sq.mm shall be used and shall be as per B.O.Q. Wherever wiring is run through trunkings or raceways, the wires emerging from individual distributions shall be bunched together with cable straps at required regular intervals. Identification
ferrules indicating the circuit and DB number shall be used for submains sub-circuit wiring. The ferrules shall be provided at both end of each submain and sub-circuit.

Where single-phase circuits are supplied from a three phase and a neutral distribution board, no conduit shall contain the wiring fed from more than one phase. In any one room in the premises where all or part of the electrical load consists of lights, fans and/or other single phase current consuming devices, all shall be connected to the same phase of the supply. Circuits fed from distinct sources of supply or from different distribution boards or through switches or MCBs shall not be bunched in one conduit. In large areas and other situations where the load is divided between two or three phase, no two single-phase switches connected to different phase shall be mounted within one box.

All splicing shall be done by means of terminal blocks or connectors and no twisting connection between conductors shall be allowed.

Industrial sockets shall be of moulded plastic BoQ and deeply recessed contact tubes. Visible scraping type earth terminal shall be provided. Socket shall have self-adjustable spring loaded protective cap. Socket shall have MCB/ELCB/RCCB as specified in the schedule of work.

Maximum number of PVC insulated 650/1100 V grade/copper conductor cable conforming to IS: 694-1990.

<table>
<thead>
<tr>
<th>Conduit size</th>
<th>20mm</th>
<th>25mm</th>
<th>32mm</th>
<th>40mm</th>
<th>50mm</th>
<th>60mm</th>
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<tbody>
<tr>
<td>Wire size in sq.mm.</td>
<td>S</td>
<td>B</td>
<td>S</td>
<td>B</td>
<td>S</td>
<td>B</td>
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<td>7</td>
<td>5</td>
<td>12</td>
<td>10</td>
<td>20</td>
<td>14</td>
</tr>
<tr>
<td>2.50</td>
<td>6</td>
<td>5</td>
<td>10</td>
<td>8</td>
<td>18</td>
<td>12</td>
</tr>
<tr>
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<td>-</td>
<td>2</td>
<td>-</td>
<td>4</td>
<td>3</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

Notes:

1) The above table shows the maximum capacity of conduits for a simultaneous drawing in of cables.

2) The columns heads ‘S’ apply to runs of conduits which have distance not exceeding 4.25 m between draw in boxes and which do not deflect from the straight by an angle of more than 15 degrees. The columns heads ‘B’ apply to runs of conduit which deflect from the straight by an angle of more than 15 degrees.

3) Conduit sizes are the nominal external diameters.
13. **TELEPHONE SYSTEM AND LAN WIRING**

**Enhanced Category 5 UTP specifications**

a) The UTP shall be 4-pair, with 24 SWG solid or standard copper conductors.

b) The UTP-based cabling system shall have a 160 MHz channel channel bandwidth over a maximum distance of 100m (328 ft) and a channel power sum attenuation-to-crosstalk ratio (PSACR) of 9.6 dB@ 100 MHz using an interconnect or BIX cross connect configuration.

c) The UTP-based cabling system shall use matched components from a single manufacturer, certified to deliver system performance over the lifetime of the application that the cabling system was originally designed to support.

d) All component used in the UTP-based cabling system shall be warranted for a period of 25 years from date of installation against defects in materials and workmanship.

e) The UTP-based cabling system shall comply with the following standards:

   - Enhanced Category 5 – TIA/EIA Addendum
   - Category 5 – ANSI/TIA/EIA-568, TIA/EIA TSB67
   - Class D – CENELEC EN50173
   - Class D – ISO/IEC 11801

**UTP Outlets**

a) The outlet UTP connection module and its optional cover shall be available in the following colors: grey, almond, white, black, orange, red, yellow, green, blue, purple and brown.

b) The outlet UTP connection module shall be Power Sum rated, with a power Sum NEXT performance equal to or better than ANSI/TIA/EIA-568 Category 5 pair-to-pair NEXT performance specifications, and shall have a PS5 marking to indicate compliance.

c) The eight-position outlet UTP connection module shall accommodate six-position modular plug cords without damage to either the cord or the module.

d) It shall be possible to inspect and/or re-terminate the UTP cable at the outlet through front access at the face plate.

e) The faceplate housing the outlet UTP connection modules shall have aperture plugs to cover any unused openings in the faceplate.

f) The faceplate housing the outlet UTP connection module in wall mounted single and dual-gang electrical boxes, utility poles and modular furniture (cubical) access points using manufacturer – supplied faceplates and/or adapters, equipped with front, side or angled-entry options for modular cords.

**UTP System Testing**

a) There are two primary field test parameters for an UTP-based end-to-end cabling system. These are continuity/wire mapping and a visual inspection, both to be performed by the vendor.
b) Continuity/wire mapping is used to verify consistency pair-to-pin terminations at each end of a given cable. It also checks for faulty connections in the run. For each of the eight conductors in the cable, continuity/wire mapping indicates:

- Continuity of the channel to the remote end.
- Shorts between any two or more conductors.
- Crossed pairs.
- Reversed pairs.
- Split pairs.
- Any other mis-wiring.

**TELEPHONE TAG BLACK (TTB / IDF)**

CAT-5e (enhanced) unshielded twisted pair cable in MS conduit shall be used to have modern structured cabling network for telephone system, to have latest facilities for Internet and also data cabling. All the telephone Jack must terminated on RJ-11 jacks and installed onto a dual Jack faceplate. Telephone RJ-11 Jacks must be terminated with a **BLACK** Connector/Jack.

For LAN CAT 6 UTP cables shall be used for interconnecting the RJ 45 outlets to Intermediate Switch (Hub) or directly to IT room, if the running length limit permits. These Intermediate switch shall be installed in a rack/cabinet and located in electrical room of the respective floors. Fibre Optic cable or CAT-6 UTP cable shall be used for backbone to interconnect the Intermediate switch to IT room’s Server rack, as per the design requirement of the specialised Vendor. All the Data Jack must terminated on an 8 wire, 8-position Jack. Each RJ-45 Data Connection will be terminated with a **BLUE** Data Jack.

Only conduit routing & wiring shall be provided by the Electrical contractor and the configuration & wiring shall be done by the Vendor for the IT Networking.

EPABX system, with latest technology will be provided by a separate Vendor to provide Voice Mail & Call Accounting by costing of all calls made by telephones.

A small cabinet for Low current services shall be provided at the false ceiling level at entrance of guest room, to locate all the terminal points like Tel.Tag block, tap-off box for MATV etc., for interconnecting all the low current outlets (jacks) provided in the guest room. Each tel. outlet in guest room shall be provided a separate wire from the room tag block.

Similarly one CAT-5e wire from the floor TTB/IDF shall be provided for each Tel. Outlet proposed.

A Multi pair box as per BOQ Tel. Cable shall be laid from the Service gate to the Telephone switch room MDF for Direct lines from the Service provider. Some of the lines shall be bypassed to EPABX and shall be directly provided to Top management’s office & Telephone operators for direct communication to outside. Rest of the lines shall be routed through EPABX for the use of patrons & staff through extensions. The following area/desk shall have direct access to outside Tel. lines:
i. Telephone Operator’s room

ii. Telephone Switch room

iii. Security room

iv. Fire officer room

14. MATV SYSTEM

Co-Axial Cables

1.1 The co-axial cable shall be of wideband type with operation upto 860MHz capability, with PE dielectric and PVC jacket.

The cable shall meet or exceed the following specifications:

<table>
<thead>
<tr>
<th>Spec</th>
<th>RG-6</th>
<th>RG-11</th>
</tr>
</thead>
<tbody>
<tr>
<td>IS Standard IS:14131</td>
<td>5CA4</td>
<td>7CA4</td>
</tr>
<tr>
<td>Centre Copper Conductor Dia</td>
<td>1.02mm</td>
<td>1.63mm</td>
</tr>
<tr>
<td>Dielectric Dia</td>
<td>4.57mm</td>
<td>7.11mm</td>
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<tr>
<td>Dielectric Material</td>
<td>Cellular PE</td>
<td>Cellular PE</td>
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<tr>
<td>Outer Dia</td>
<td>7.0mm</td>
<td>10.03mm</td>
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<tr>
<td>Bending Radius</td>
<td>&gt;75mm</td>
<td>&gt;115mm</td>
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<tr>
<td>Impedance</td>
<td>75 Ohms</td>
<td>75 Ohms</td>
</tr>
<tr>
<td>Return Loss</td>
<td>&gt;23 dB</td>
<td>&gt;23 dB</td>
</tr>
<tr>
<td>Attenuation at 20°C</td>
<td>Max dB/100Mtr</td>
<td>dB/100Mtr</td>
</tr>
<tr>
<td>5 MHz</td>
<td>1.9</td>
<td>1.25</td>
</tr>
<tr>
<td>45 MHz</td>
<td>5.25</td>
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</tr>
<tr>
<td>300 MHz</td>
<td>11.65</td>
<td>7.38</td>
</tr>
<tr>
<td>450 MHz</td>
<td>14.45</td>
<td>9.02</td>
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<tr>
<td>550 MHz</td>
<td>16.1</td>
<td>9.97</td>
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<tr>
<td>860 MHz</td>
<td>20.1</td>
<td>12.52</td>
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</tbody>
</table>

15. DISTRIBUTION BOARDS & MCBs

15.1 General

Distribution boards shall be of standard make with MCBs as per approved make given. Distribution boards shall be constructed out of steel sheet all weld enclosure with double door IP42 protection and shall be powder coated. Ample clearance between the conductors of opposite pole, between conductors and sheet steel body shall be maintained in order to obviate any chance of short circuit. Removable conduits entry or knockouts plates shall be provided at top and bottom to facilitate drilling holes at site to suit individual requirements. Also on additional/separate adopter box of suitable length and size shall be provided to accommodate wires and cables. No. of conduits etc. and nothing shall be payable on this account. The MCBs shall be mounted on high-grade rigid insulating support and connected by electrolytic copper bus bars. Each incoming MCB isolator shall be provided with solderless cable sockets for crimping. Phase separation barriers made out of arc
resistant materials shall be provided between the phases. Bus bars shall be colour coded for phase identification.

Distribution boards shall be recessed in wall nitch or if required mounted on the surface of the wall with necessary clamp bolts etc. The mounting height shall not exceed 1200mm from finished floor level. Distribution board shall be provided with proper circuit identification nameplate and danger sticker/plate as per requirements.

All the distribution boards shall be provided with engraved nameplates with ‘lighting’, ‘power’ or ‘UPS’ with DB Nos., as the case may be. Each DB shall be provided with a circuit list giving details of each circuit. All the outgoing circuit wiring shall be provided with identification ferrules giving the circuit number & phase.

Each distribution board shall have a separate neutral connection bar and a separate earth connection bar mounted within the DB each having the same number of terminals as the total number of outgoing individual circuits from the distribution board. Conduit & cable armouring shall be bonded together & connected to the distribution board earth bar.

Where oversized cables are specified due to voltage drop problems, it shall be contractors responsibility to ensure that satisfactory terminal arrangements are provided without an extra cost.

15.02 Earth Leakage Circuit Breaker

ELCB shall be 4 pole 415 volts 50Hz, 30-300mA sensitivity. These shall be of approved make. The rating of the ELCB shall be as specified in BOQ. These shall be suitable for manual closing and opening and automatic tripping under earth fault circuit of 30-300mA as specified in item of work. The enclosure of the ELCB shall be moulded from high quality insulating material. The material shall be fire retardant, anti tracking, non-hygroscopic, impact resistant and shall withstand high temperature. All parts of switching mechanism shall be non-greasing, self-lubricating material so as to provide consistent and trouble free operation. Operation of ELCB shall be independent of mounting position and shall be trip free type. The RCCB shall be protected against nuisance tripping by protective device.

15.03 Miniature Circuit Breaker

1. The MCB shall be current limiting type and suitable for manual closing and opening and automatic tripping under overcurrent and short circuit. The MCB shall also be trip free type.

2. Single pole/three pole versions shall be furnished as required.

3. The MCB shall be rated for 10 KA/15 KA fault level.

4. The MCB shall be suitable for its housing in the distribution boards and shall be suitable for connection at the outgoing side by tinned cable lugs and for bus-bars connection on the incoming side.

5. The terminal of the MCBs and the open and close conditions shall be clearly and indelibly marked.

6. The MCB shall generally conform to IS: 8828. -1996

7. The MCB shall have 20,000 electrical operation upto 63A.
8. The MCB shall have minimum powerloss (Watts) asper I.S./IEC.

16. **SPECIAL CONDITIONS OF CONTRACT FOR D.G.SETS**

1.1 **DRAWINGS**

The drawings, specifications and bill of quantities shall be considered, as a part of this contract and any work or materials shown on the drawings and not called for in the specifications or vice-versa, shall be executed as if specification called for in both. The contract drawings indicate the extent and general arrangement of various equipments and their wiring, etc. and are essentially diagrammatic. The drawings indicate the point of termination for conduit runs and broadly suggest the routes to be followed. The work shall be done as indicated on the drawings. However, any minor change if found essential to co-ordinate the installation of this work with other traders shall be made without any additional cost to the owners. The data given herein and on the drawings is as could be secured but its complete accuracy is not guaranteed. The drawings and specifications are for the assistance and guidance of the contractor. The exact location, distances and levels etc. will be governed by the space conditions. The contractor shall examine all Architectural, structural, Plumbing and Sanitary, Air-conditioning and electrical drawings before starting the work and report to the architect any discrepancies, which in his opinion appear, on them, and get them clarified. He shall not be entitled to any extras, for omissions or defects in electrical drawings or when they conflict with other works.

1.2 **SHOP DRAWINGS**

The Contractor shall prepare and submit to the Consultants/Architect/Owner for their approval detailed shop drawings within 30 days of signing of the contact or before 7 days of particular work or whichever is earlier. The shop drawings shall clearly indicate.

a) The general arrangement and schematic diagram of main D.G Panel, PLC Panel, clearly stipulating the material, size of sheet steel, bus bar, inter connections detail, make and rating of switchgear and other equipment etc.

b) Number, size and route of the Cable Tray, and fixing details.

c) Total number of cable runs, size make, material and type of cables with clear routing, trenches / treys detail, installation mode, starting and termination point of each and individual cable etc.

d) The shop drawings shall also show all setting out details and physical dimensions of all equipments components used in the system, location of manholes fixing, cutout details etc.

1.3 **QUALITY**

The Employer’s / Consultants decision with regard to the quality of the material and workmanship will be final and binding, any material rejected by the Employer / Consultant shall be immediately removed by the Contractor from the site. The Employer / Consultant or their representative shall at all reasonable times have free access to the works and / or to the workshops, factories or other places where materials are being prepared or constructed for the contract and also to any place where the material lying or form which they are beingobtained, and the contractor shall give every facility necessary for inspection and examinations and test of the material and workmanship free of cost.

1.4 **COST OF SAMPLES AND TESTS**
The Contractor at his own cost shall supply all samples and the cost of making any test as per specifications shall be borne by the contractor. The Contractor shall submit four copies of all brochures, manufacturers’ description data and similar literature. One copy will be returned to the Contractor after approval.

1.5 COMPLETION DRAWINGS

The Contractors shall submit to the Owner / Consultant, layout drawings drawn at approved scale in six sets and a reproductive (original) copy clearly showing.

a) Location of distribution and PLC Panel
b) All types of cables (L.T. / Control etc.) layout.
c) Layout of DG Room and switchgears and associated equipments.
d) Layout of Diesel Generator Sets.
e) Location of Fuel Tank, Cooling Towers, Pumps and fuel and water piping layout.
f) As built drawing with equipments operation and maintenance literature.

After the completion of the work and before issuance of certificate of virtual completion.

1.6 FOREMAN / SUPERVISOR

The Contractor shall employ a competent, licensed qualified full time electrical engg./ foreman / supervisors to direct the work of electrical installations in accordance with the drawings and specifications. The foreman / supervisor shall be available at all times on the site to receive instructions from the Architect / Engineer in the day to day activities throughout the duration of the Contract and as long as there after as the consultants may consider necessary until the expiration of the “Defect Liability Period”. The Foreman / Supervisor shall correlate the progress of the work in conjunction with all the relevant requirements of the supply authority. The skilled workers employed for the work should have requisite qualifications and should possess competency certificate from the Electrical Inspectorate of the Local Government. The Contractor shall on the request of the consultants immediately dismiss from the works any person employed there on who may, in the opinion of the consultants, be unsuitable or incompetent or who may misconduct himself and such person shall not be again employed or allowed on the work without the permission of consultants/Employee.

1.7 INSPECTION AND TESTING

Contractor shall employ a full time qualified Engineer who shall be available at all working hours at site for taking instructions and to look after the quality of the work. Instructions given to the Engineer of the contractor shall be construed as issued to the contractor.

Contractor shall maintain at site the following tools and instruments, but not limited to the list below in working conditions.

a) Clip-on Ammeter and voltmeter
b) 1000 V Meggar and 5 KV Meggar
c) Steel tapes of various lengths
d) Spirit Level
e) Hydraulic Crimping Tool
f) Earth Testing Meggar
g) Pipe bending Tool, thread-cutting die, bench vice etc.
h) Cable jointing kit
The contractor shall provide at least four permanent benchmark at site, which shall be preserved till the completion of works. These are essential for laying of cables at correct levels.

1.8 CLEARANCE FROM LOCAL AUTHORITIES

The Contractor shall get the entire installation tested inspected and approved by Local Authorities like Electrical inspectorate pollution control explosive clearance and any other agency required to take permission for commissioning of the installation. He will also undertake the Liaison work with local Electricity Supply Company for obtaining the Electrical Service Connection.

1.9 SCOPE

In general, the contractor shall supply, store, erect test and commission all the equipment required for electrical installation. The contractor shall furnish all the materials, labour, tools and equipment for electrical work, as shown in the accompanying drawings and in the bill of quantities and specifications hereinafter described.

1.10 CONTRACTOR

The contractor shall be a licensed electrical contractor, possessing a valid electrical contractor’s in the state, employing licensed supervisors and skilled workers having valid permits as per the regulation of Indian Electricity Rules and Local Electrical Inspector’s requirements.

17. Preamble to BOQ for D.G. Set:

1. All items of work under this Contract shall be executed strictly to fulfill the requirements laid down under the specifications. Type of equipment, material specifications, methods of installation and testing, and type of controls shall be in accordance with the Specifications, approved shop Drawings and the relevant Indian Standards, however, capacity of each component and their quantities shall be such as to fulfill the above mentioned requirement.

2. The rate for each item of work included in the Bill of Quantities shall, unless expressly stated otherwise, include cost of:

a. All materials, fixing materials, accessories, appliances, tools, plants, equipment, transport, labour and incidentals required in preparation for and in the full and entire execution, testing, balancing, commissioning and completion of the work called for in the item and as per Specifications and Drawings.

b. Wastage on materials and labour.

c. Loading, transporting, unloading, handling / double handling, hoisting to all levels, setting, fitting and fixing in position, protecting, disposal of debris and all other labour necessary in and for the full and entire execution and to fully complete the job in accordance with the contract documents, good practice and recognized principles.

d. Liabilities, obligations and risks arising out of Conditions of Contract.

e. All requirements of specifications, whether such requirements are mentioned in the item or not. The specifications and drawings where available, are to be read as complimentary to and part of the Schedule of Quantities and any work called for in one shall be taken as required for all.
f. In the event of conflict between Bill of Quantities and other documents including the specifications, the most stringent shall apply and the interpretation of the consultants shall be final and binding.

3. The unit rate for each equipment or materials shall include cost in Rupees for equipment and material including the excise duty, and also including forwarding, freight and insurance up to Contractor’s store at site, storage, installation, testing balancing, commissioning and other works required.

The extension for (total) amounts against each item shall be based on the quantities indicated in this Schedule.

4. All equipment, quantities and technical data indicated in this Schedule are for the Contractors guidance only; these are based on the documents prepared by the Consultants. The contractor shall assess the required quantity of cables, cable trays, piping etc that are required for completion of the work. This schedule must be read in conjunction with these documents. The Contractor shall be paid for the actual quantity of work executed by him in accordance with the approved shop drawings at the contract rates.

5. The quantities given in this schedule are provisional, the Owner reserves the right to increase or decrease the quantities of work or to totally omit any items of work and the Contractor shall not be entitled to claim any extras or damages on these grounds. These variations shall be permitted until such time Contractors shop drawings are approved.

6. This schedule shall be fully priced and the extensions and totals duly checked. The rates for all items shall be filled in INK.

7. No alteration whatsoever is to be made to the text or quantities of this Schedule unless such alteration is authorized in writing by the Consultants. Any such alterations, notes or additions shall unless authorized in writing be disregarded when tender documents are considered.

8. In the event of an error occurring in the amount column of the Schedule, as a result of wrong extension of the unit rate and quantity, the unit rate quoted by the tenderer shall be regarded as firm and the extensions shall be amended on the basis of the rates.

9. Any errors in totaling in the amount column and in carrying forwarded totals shall be corrected. Any error, in description or in quantity or commission of items from this schedule shall not vitiate this contract but shall be corrected and deemed to be a variation required by the Consultants.

18. D.G. SET

750 KVA

The D.G. set shall be provided with Diesel Engine of Model no. & no. of Cylinder as given below, vertical 4 stroke cycle, **Air cooled radiator** having turbo charged after cooled Engine at 1500 RPM under NTP conditions of BS: 5514. The D.G. set shall be provided with electrical starting arrangement and shall give the electrical output of as given below at 0.8 power factor, 415 Volts at the alternator terminal.

<table>
<thead>
<tr>
<th>ELECTRICAL OUTPUT</th>
<th>Cumminium Engine Model no. or equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>□ 750 KVA</td>
<td>CJ250D5P</td>
</tr>
<tr>
<td></td>
<td>10</td>
</tr>
</tbody>
</table>
Other accessories of the engine would be as under:

**COOLING SYSTEM**
- Thermostat
- Corrosion Inhibitor
- Self contained piping

**FUEL SYSTEM**
- PT fuel pump
- Injectors
- Fuel filters
- Self contained piping

**LUBRICATING SYSTEM**
- Oil pump
- Strainer
- Lub oil cooler
- Oil filter
- Bypass filter
- Self contained piping

**AIR INTAKE SYSTEM**
- Dry type filter
- Air intake manifold with necessary connections
- Turbo charged after Cooled

**EXHAUST SYSTEM**
- Exhaust manifold
- Flexible piping
- Silencer (Hospital)

**GOVERNING SYSTEM**
- Electronic Governor

**STARTING SYSTEM**
- Starter, 24V, DC
- Battery charging Alternator
- With in-built Regulator

**ENGINE CONTROL PANEL (ECP) (it will display)**
- Lub oil pressure
- Jacket water temperature
- Engine RPM
- Battery voltage
- Engine Running Hours

**SAFETY SYSTEM**
- Low lub oil pressure
- High water temperature
- Over speed

**OTHER SYSTEM**
- Flywheel
- Flywheel housing
ALTERNATOR:

Output: 750 KVA

Power factor: 0.8

Rated Generating Voltage: 415 Volts

Voltage regulation: +/- 1% all load between no load to full load & factor 0.8 to unity

Frequency: 50 Hz

Speed: 1500 RPM

Class of insulation: H

Winding connection: Star connection (all six leads will be brought out of stator frame)

Overload capacity: 10% for one hour in any 12 hours of operation without exceeding temperature rise limits specified in BS:2613 or BS:5000 when corrected to ambient temperature at site.

Bearings: Long life single bearing

Enclosures: Drip proof & screen protected IP-23

Parallel operations: All machines shall be suitable for operation in parallel. Damper winding shall be provided to facilitate parallel operation

Power Command Paralleling Genset Controls (PCC3.3 of Cummins or equivalent)

The features shall be given as below:-

- Digital governing
- Digital Voltage regulation
- Amp Sentry Protection for true alternator O/C protection on PCC 3.3 for solo / paralleling applications.
- Analog/ Bargraph/ Digital AC output Metering
- Battery Monitoring System to sense and warn against a weak battery condition
- Digital Alarm and Status Message Display
- Genset Monitoring: Displays status of all critical engine and generator set functions
- Smart Starting Control System: Integrated fuel ramping to limit black smoke and frequency over shoot
- Advanced serviceability
- Synchronizers and load sharing controls
- KVAR and power factor controls
- Import / Export controls for paralleling with utility / main bus.

The alternator shall be of self-excited, self regulated, self ventilated in brush less design, provided with suitable automatic voltage regulator and shall conform to BS:2613 or BS: 5000 and shall give rated output at NTP conditions.

ESSENTIAL ACCESSORIES:

One set of essential accessories shall be supplied with each D.G. Set. This set of accessories shall comprise of the following:

BASE FRAME:

One no. MS Fabricated adequately machine Channel Common Base Frame with lifting facility, pre-drilled foundation holes suitable for permanent installation on concrete
foundation for direct grouting or on anti-vibration mountings which will be suitable to receive the offered engine and alternator duly coupled through a flexible coupling. A suitable coupling guard shall also be provided.

**FUEL TANK:**

One no. Daily fuel tank of 990 LITRES capacity / or as per OEM Supplier Specification for each DG set made out of 3 mm thick MS sheet complete with inlet and outlet connections, drain plug, manhole, etc. & suitable for mounting on floor with mounting pedestals. Wire-braided hoses shall also be supplied with fuel tank.

**BATTERIES:**

For electrical control circuit of 24 volt DC, 2 Nos. batteries of 12 volts 180 AH for each set respectively (dry and uncharged) of approved make with battery leads for electrical starting of each DG Set.

19. **DIESEL GENERATING SET**

1. **DESIGN**

1.1. The engine alternation set shall be capable of working at ambient temperature between 0°C to 50°C and relative humidity upto 95%.

The operating capacity of each set shall be arrived at after considering a load with power factor of 0.8 lagging, and after taking into consideration suitable derating on account of above parameters of the station.

1.2. The engine/alternator set shall be capable of taking 10% over-load for a period of one hour during any 12 hours period, while operating continuously at full rated load.

1.3. Nominal output voltage of engine/alternator set shall be 415 volts 50 Hz AC Supply with manual adjustment at all conditions of load with coarse and fine controls with a range of ± 5%.

The frequency shall be maintained at 50 Hz ± 2% for the set.

1.4. The output wave-form shall be sinusoidal at all load conditions.

1.5. The engine/alternator set shall be selected for a high degree of performance with over all low fuel consumption for the normal life of the alternator set.

1.6. The engine/alternator set shall meet the requirements of all linear & non-linear loads, but over-sizing of the alternator in order to meet the non-liner characteristics of loads in not envisaged.

1.7. The Engine shall be capable to minimum 60% bulk load of the rating during transfer of the load from NO Load postion without tripping.

2. **SYSTEM OPERATION**

The set may be idle for a long time except for periodical test whenever there is a electrical supply failure, the set may required to run continuously for period even exceeding 24 hours.

3. **SYSTEM FEATURE**

The entire work shall confirm to Bureau of Indian Standards safety standards; British Standards, and C.P.W.D. specifications.
DETAILS OF ENGINE/ALTERNATOR Scope

The scope of this section covers general requirement for reciprocating diesel engine and alternator complete with drive, safety controls, lubricating system, cooling system, instruments etc., including erection, testing and successful commissioning on load.

Diesel Engine

Diezel engine shall be multi-cylinder, 1500 RPM reciprocating, 4-stroke internal combustion conforming to BS 649 and shall be of welded construction or of fine grain cast iron. The crank case shall be of iron alloy, casting, crank shaft shall be of high tensile forging corresponding to medium carbon steel of 1045 (AISI) grade, Main B.E bearing shall be of high grade bearing material, connecting rod shall be of 1 beam high grade of drop forged steel corresponding to carbon steel of 1139 grade, cylinder liner shall be wet type cast alloy iron with specially machined groomed in the bores to serve as oil retaining surfaces, piston shall be of low expansion aluminum alloy with machined surfaces.

The engine shall be equipped with all required standard accessories:
- Fly wheel & housing
- Oil bath air cleaner
- Exhaust turbo charger & after coolers as called for.
- Flexible coupling and coupling guard
- Flexible connection between heat Exchanger and water pipe.
- Lubricating pump and fuel injection pump
- Nozzles
- Electronic / hydraulic Governor as called for in BOQ.
- Oil pressure gauge and water temp gauge
- Fuel filter, fuel tank and fuel lines
- Turbo charged aspiration
- Water-cooled radiator/ Heat Exchanger as called for in BoQ.

6 cylinders or as required.

Other fittings as recommended by the manufacturer.

The lubricating system shall be positive pressure type for all moving parts. No moving parts shall require lubricating by hand, either prior to starting or while in operation. The lubricating system shall consist of following major components.
- Oil pan
- Oil pump
- Oil filter
- Oil pipe/hose
- Oil cooler
- Piston cooling nozzle
- Oil temperature & gauge
- Oil pressure gauge
- By-pass filters.

Lubricating oil filter shall be provided for operation of 500 hour without any necessity of replacement or cleaning.

The engine shall be water cooled with Heat Exchanger. All standard accessories like inlet, outlet connection, fuel connection, drain plug etc. shall be provided.

Engines shall be suitable for running at 1500 RPM the speed of the engine shall be controlled by means of a governor which may sense the actual speed and make adjustment to the fuel system when required. The speed governing system shall be Class A hydraulic type as per BS 649. The maximum change in speed of engine shall be not more than 10% or 4% when the full load is either taken off or thrown ON temporary or
permanently as the case may be. The engine/alternator set shall be able to attain the steady speed within a time period of 3 seconds from the time load change takes place.

**Engine Starting**

The engine shall be self starting type. The starter motor shall conform to BS-2613-1970. Time required for starting of engine from cold conditions shall be 10-20 secs maximum.

**Fuel Tanks**

Fuel tank(s) shall be fabricated from 3 mm thick MS sheet and of 990 liters capacity. Fuel lines shall be of MS "C" class welded pipe & standard hose pipes. The fuel tank shall have all standard fittings like outlet, fuel return, drain & vent connection. The fuel tank shall also have level indicator so as to indicate the quantity of fuel present in liters with calibration chart. It shall be provided with high & low level switches having potential free contacts for annunciation and also for auto control of fuel oil pump.

**Exhaust System**

Industrial type Air intake filter shall be provided in the turbo charger assembly of the engine unit. The exhaust system shall consist of turbo charger with cladded pipe inter connecting it with the cylinder head inlet. The exhaust manifold shall be suitably lagged and covered as well. The exhaust pipe shall discharge the exhaustible smoke at the top of the building.

The exhaust system, which carries away the products of combustion from the engine to the atmosphere, shall be such as to restrict the backpressure within prescribed limit (below 75 mm of Hg) to ensure proper engine operation. The exhaust system shall consist exhaust pipe, flexible pipe of minimum 30 cm length, and exhaust noise suppressor silencer, and catalytic converter.

*The silencer shall be of hospital type*, which can provide suppression in noise as per specifications. A test certificate to this effect shall be furnished. The exhaust piping system shall have a provision of condensate trap with drain plug valves. Exhaust piping shall be insulated with a layer of 75 mm dia glass wool with aluminium cladding rope to minimize the heat radiated to the room.

**DETAILS OF D.G.SET**

**Engine Instrumentation on Engine**

- Speedometer with time totalizer.
- Lub oil pressure gauge.
- Lub oil temperature gauge.
- Cooling water temperature gauge.
- Battery Charger (Separate).
- Starting switch with key.
- Over speed relays.
- Run/Idle toggle switch

**Alarms/Trip (Audio and Visual)**

- Over speed.
- High Cooling water temperature.
- Low lub oil pressure.
Alternator

Screen protected, drip proof, 3 phase 415 Volts, 4 wire, 50 Hz, 0.8 p.f., 1500 RPM, self regulated, class H insulation, brushless alternator; continuous rating as per relevant Indian Standards, A removable gland plate shall be provided for the cables. Also an automatic voltage regulator at 415 Volts ± 2.5% shall be provided. Enclosure shall be as per IP-23. Rated voltage shall be 415 V suitable for 50° ambient temperature and overload capacity shall be 10% for one hour during 12 hours continuous running must have droop characteristics and others for synchronizing system and fine adjustment of voltages.

Exciter

Self excited, self regulated, providing alternator output regulation at plus or minus 2.5%, from no load to full load along P.F. between unity to 0.8 lagging, with 4% speed variable, of the engine. Solid state excitation system is preferred.

BATTERY CHARGING EQUIPMENT

Battery charging equipment should be incorporated in the generator control panel and shall comprise of:

AC and DC "ON" and "OFF" switches with HRC fuses.

Indicating lamps for indicating mains "ON" and battery charging.

Ballast to give charging.

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

Rotary switch to give step control.

Single phase full wave bridge connected silicon rectifier stack.

Moving coil ammeter to indicate charging current.

Moving coil Voltmeter with a selector switch to measure the battery/charger voltage.

Silicon blocking diodes connected to a suitable tap to maintain continuity of DC supply. Trickle and boost arrangement must be there.

AC and DC contactors of suitable rating as required

SPECIFICATION OF MATERIALS

Exhaust Silencer Piping

The exhaust silencer piping system shall be of heavy duty MS pipes confirming to Class C. 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.

Exhaust pipe inside the building shall be lagged with 75 mm dia glass wool with aluminium cladding and suitably bonded with asbestos cloth.

Water Piping and Oil Piping
Water Piping shall be of C class MS pipe. Oil piping shall be of MS or braided flexible type only. Cooling water and oil piping shall be tested in accordance with ASA-B 31.1 pressure piping code.

**Wiring**

All the wiring outside the panel shall be drawn to 16 gauge MS conduits. The minimum size of wires outside the panel shall be 2.5 sq.mm stranded copper conductor.

The minimum size of control cables inside the panel shall be 1.5 sq.mm stranded copper conductor.

All the wires and cables suitable for 650/1100 Volts. As per IS-694-1990 latest amendment.

**INSTALLATION OF GENERATING SET**

The engine and alternator shall be mounted on specially designed common MS base plate and frame of extremely rigid welded construction, so as to provide no deflection. The engine/ alternator set shall be installed over the Dunlop -make, S-type anti-vibration cushy base in order to isolate the transmission of vibrations to the floor or building structures.

The exhaust system shall be designed and installed in such a manner that it avoids excessive stresses on the exhaust manifold of turbocharger, washing spray or any other source.

The exhaust pipe shall pass through an oversized collar, filled with glass wool when crossing floor/wall.

All exposed metal parts shall be suitably painted to prohibit corrosion under the climatic conditions at site.

The installation of fuel piping, power distribution and control panels shall be carried out in accordance with the specification of respective items.

**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 ENGINEER-IN-CHARGE and the results shall be recorded in the test sheet at 30 minutes intervals. Alternator efficiencies as determined in works test shall be used as the basis of calculation for fuel consumption rate. A tolerance of 15% shall be allowed on the fuel oil consumption to cover possible errors of measurement.

Tests providing the satisfactory performance of all safety and operating controls shall be carried out. Governor trials shall be carried out as laid down in BS : 639. Alternator insulation resistance and commutation check shall be as per BS 2613/BS 5000. Starting time of sets shall be tested at least five times the sufficient time integral to allow for cold start. On completion of tests, inspection doors shall be removed and running gears inspected and alignment has to be checked. An further reasonable trial as suggested by the Client shall be carried out with no extra charges. All instruments, materials and labour required for carrying out the trials shall be provided by the Contractor. Test sheets of trials shall be forwarded in quadruplicate to ENGINEER-IN-CHARGE. The successful bidder has to submit a list of recommended spares to client for purchasing the same. A set of tools and tackles has to be supplied alongwith each set. List of recommended spares shall be indicated to client.

**DAY SERVICE TANK**

Day service tank shall be of 3mm thick MS sheet fuel oil storage tank of capacity 990 liters for each set with all accessories such as oil level indicator, inlet pipe connection.
Outlet pipe connection, with gun metal valve through to collect split oil, air vent pipe, manhole with cover, low level and full level float valve arrangements and interconnections between tanks and painting. The tank shall be provided with Suitable calibration scale. The tank shall be fabricated from 3mm thick MS sheet.

**FOUNDATION**

Foundation shall be casted as per the recommendations of the manufacturer in consultation with the Supplier and as per the requirements of the site. The successful bidder shall submit detailed foundation drawings within 7 days of award of work.

**PAINTING**

The Contractor shall paint all exposed metal parts and equipment supplied by him. All sheet metal work shall undergo a process of phosphating, passivating and then sprayed with high corrosion treatment of two coats of synthetic enamel paint of approved colour. All piping shall be colour coded.

**24 VOLTS DC BATTERIES & BATTERY CHARGER**

Lead acid type batteries, 2 x 12V - 25 plate : 180AH as required conforming to IS shall be provided for each set for starting purposes as per requirements. These batteries shall be fitted with electrolyte (specific gravity 1.280) and initially charged, discharged and recharged and placed in suitable enclosure, in ready to use shape.

**SHOCK TREATMENT CHART**

Shock treatment chart explaining the method of shock treatment in English, Hindi and local language shall be provided dully framed in glass in the diesel generating station.

**WIRING**

Providing conduits and drawing wires for the following : -
Control wiring between diesel generating set and the automatic mains failure panel.
All wiring associated with the fuel oil transfer pump and including level controllers and circulating water pumps

All wiring associated with DC supply.
All earthing conductors associated with this installation.
All wiring and cables shall be PVC insulated stranded copper conductor wires and cables suitable for 660/1100 volts minimum size of wires for control wiring shall be 2.5 sq.mm and minimum size of wire for pumps shall be 4 sq.mm. The wires would be as per IS.

**CABLES**

MV cables shall be XLPE aluminum conductor armoured cables, laid in trenches between diesel generating set and DG panel. All power & control cables will be rated for 1.1 KV grade.
Storing, laying, jointing procedures as same as that for the LT cables stated elsewhere.
TEST PERFORMANCE

Scope
This section lay down the procedure for conducting test on the installation. In general the procedure laid down here shall be followed. However, if manufacturer of the equipment has prescribed different procedure which is at variance, the same may be adopted. All required artificial load, testing equipment other required material required for testing purpose shall be supplied by agency.

Physical Test
Particulars such as name plate details of all major component equipment shall be recorded and compared with what has been offered by the contractor as per agreement.

- Level of foundation.
- Firmness of mounting.
- Verticality of installed set.
- Tightness of nuts & bolts.
- Proper installation of exhaust pipe.
- Insulation of exhaust pipe with 75 mm dia glass wool with aluminium cladding.
- Provision of guard on engine/alternator set coupling joints.
- Termination of various cables.
- Rating of various fuses.
- Termination of earth leads on neutral & body.

Earth Resistance
The resistance shall be measured by isolating the connecting earth lead in respect of all earth stations.

Run Test
The engine shall be given a test run continuously for at least six hours with alternator supplying full rated load. During this run following observation shall be recorded.

<table>
<thead>
<tr>
<th>S.No</th>
<th>ITEMS</th>
<th>TIME AFTER START OF RUN/TEST</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Lubricating oil pressure</td>
<td>1 Hr 2 Hr 3 Hr 4 Hr 5 Hr 6 Hr 7Hr</td>
</tr>
<tr>
<td>2</td>
<td>Exhaust gas colour</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Speed engine</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Output voltage</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Load current</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Load (KW)</td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Noise Level (DB)</td>
<td></td>
</tr>
</tbody>
</table>

Stator Temperature Rise Test
The alternator shall be loaded of full rated load and stator (alternator) body temperature be recorded as under at intervals of 30 minutes till such time that there consecutive readings are
<table>
<thead>
<tr>
<th>S.No</th>
<th>TIME (Hr)</th>
<th>AMBIENT TEMP (°C)</th>
<th>STATOR TEMP (°C)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>the same.</td>
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<td></td>
</tr>
</tbody>
</table>


a. The temperature rise shall be maintained with in 60°C above the ambient.

**Fuel Consumption Test**
Fuel consumption for half an hour shall be measured after the full load operation condition have stabilized.
During this measurement the load shall be maintained unchanged.
The fuel consumption shall be compared with values given in the technical particulars.

**Over Load**
Over load test to the extent of 10% over the rated load shall be conducted immediately after the full load run test.
The various parameters as in the case of run test shall regularly be monitored and recorded.
After the over load test, the load shall be normalized to rated value and all parameters recorded.

**Insulation Test**
Insulation test shall be conducted after testing the engine/alternator set at overload.
The insulation resistance between the starter coil and from shall be measure with 5000 volts meggar.
The insulation resistance of alternator winding shall be not below:
Rated output voltage + 1 Mega Ohms
\[
\frac{1000}{\text{Rated}} + \text{out in KVA}
\]

Isulation resistance of control wiring with 500 volts meggar shall be measure. Which shall not be less than one mega ohms.

**Regulation Test**
The voltage regulation from no laid to full rated load at 0.8 p.f. and from no load to half the rated load at 0.8 p.f. shall be measured between phase & neutral under automatic and manual regulation mode, which shall not exceed 0.5% of the nominal rated output voltage.
In automatic regulation mode, the recovery line shall be noted which shall not exceed 3 seconds.
The frequency of output supply of various load conditions shall be noted and recorded.
The variation shall be compared with the accuracy standards specified.
Change in speed of engine with change in load shall be observed and compared with standard reading for the speed governor.

**Data Sheet:**
Vendor’s shall fill in the performance data in the block columns of the attached Data sheets.
21. ACCOUSTIC ENCLOSURE

Construction Details

The Structure is fabricated using CRCA sheets of 14/16 SWG Thickness and steel members. The enclosure is fabricated on a MS Channel Frame work further strengthened by suitable cross members to make it robust and sturdy. Rock wool / Mineral wool of suitable thickness and density conforming to IS 8183 is used for acoustic insulation to reduce the sound level to 68 – 70 dB from the original sound level of 105 – 110 dB, when measured at 1mtr.distance from the D.G. Set. The acoustic enclosure consists of following:

a) Acoustic Insulation:

High density Fireproof Acoustic Enclosure Material i.e. resin bonded rock wool / fiber glass wool (75 – 100mm thick of 64Kg/m³ density) conforming to IS:8183 is provided on all doors and roof to absorb noise. The insulation material used is fire retardant. The insulation is covered with fiber glass cloth and is supported by perforated sheet. Sound attenuators / down stream silencers are provided at all openings for air inlet/outlet to facilitate free air flow but to absorb sound resulting in extremely low noise level. Detachable partitions are provided inside the enclosure to attain further noise attenuation of the engine.

b) Noise Suppressor:

A suitably designed absorption type Hospital noise suppressor is provided which minimize the exhaust noise of the engine.

c) Exhaust System:

The exhaust gas is taken out through a specially designed flexible pipe, which prevents any back pressure on the engine.

d) Thermal Insulation:

The exhaust system and noise suppressor is provided thermal insulation by using glass wool & covering it with Aluminum sheet. This prevents it from radiating excess heat on the engine, makes it safe for the operator and enhances aesthetics.

e) Surface Treatment:

The enclosure is surface treated and painted with high quality polyurethane epoxy paint with prior zinc oxide primer base, which make it weather proof and suitable for outdoor application. The paint is highly resistant to acids, alkaline, salt sprays, halogens, solvents, lubricants etc and has very good dielectric properties and is resistant to abrasion and cracking.

f) Air Circulation & Ventilation System:

A suitable forced air circulation and ventilation system is designed to maintain safe operating temperatures inside the enclosure. Requisite air circulation for engine
aspiration combustion and cooling is provided by means of Exhaust fans or tube axial fan driven by a 3 phase squirrel cage induction motor according to need of engine.

g) **Vibration Isolation:**

The engine and alternator is mounted on Anti-Vibration Mounting pads to eliminate engine vibration.

h) **Hardware:**

Inlet and Outlet for cable, draining of lube oil and diesel etc. are provided. The doors are gasketed with high quality EPDN gaskets to avoid leakage of sound. All doors are lockable.

i) **Testing / R&D:**

The Gen set shall be thoroughly tested on load before it is dispatched from factory.

<table>
<thead>
<tr>
<th>Technical Data Sheet</th>
<th>Project:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diesel Generator (Alternator) 250 KVA</td>
<td>Date:</td>
</tr>
<tr>
<td>S.No.</td>
<td>Item</td>
</tr>
<tr>
<td>1</td>
<td>Serial</td>
</tr>
<tr>
<td>2</td>
<td>Type</td>
</tr>
<tr>
<td>3</td>
<td>Make</td>
</tr>
<tr>
<td>4</td>
<td>Voltage, Phase, Frequency</td>
</tr>
<tr>
<td>5</td>
<td>Normal Continuous Rating</td>
</tr>
<tr>
<td>6</td>
<td>Starting KVA</td>
</tr>
<tr>
<td>7</td>
<td>Manufacturer</td>
</tr>
<tr>
<td>8</td>
<td>MAXIMUM VALUE OF MOTORLOAD WHICH DOESNOTAFFECT STARTING</td>
</tr>
<tr>
<td>9</td>
<td>Power Factor</td>
</tr>
<tr>
<td>10</td>
<td>Class of insulation</td>
</tr>
<tr>
<td>11</td>
<td>Efficiency &amp; losses at 0.8 p.f. and Actual</td>
</tr>
</tbody>
</table>

a) **1/4th Full load**
<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>b)</td>
<td>½ th Full load</td>
<td></td>
</tr>
<tr>
<td>c)</td>
<td>¾ Full load</td>
<td></td>
</tr>
<tr>
<td>d)</td>
<td>full load</td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>OVERLOAD CAPACITY</td>
<td>10%</td>
</tr>
<tr>
<td>13</td>
<td>Build up time for voltage from no load to full load</td>
<td>20sec Maximum</td>
</tr>
<tr>
<td>14</td>
<td>NO. of hours alternator can be run with no increase in temp under 10% over load</td>
<td>1hr Minimum</td>
</tr>
</tbody>
</table>

Prepared by: Name: Date:  
Format no:  
Page 1 of 5
Cranes Specification

02. 3Ton Single Girder Under Slung crane

Technical Specification :

- Crane Type
- Main Hoist Safe Working Load
- Span
- Height of Lift
- Bay Length
- Class of Duty
- Operation
- Location
- Main Hoisting Speed
- Cross Travel Speed
- Long Travel Speed
- Main Hoist Motor Rating
- Cross Travel Motor Rating
- Long Travel Motor Rating
- All Motors Type
- Main Hoist, Cross Travel & Long Travel Brake Type
- Main Hoist Wire Rope Diameter
- Main Hoist Number of Falls
- Wire Rope Construction
- All Wheels
- Soft Starter for Long Travel
- Hook
- Limit Switches (Hoisting / Cross Traverse / Long Traverse)
- Polyethylene Buffer on Long Traverse
- Power / Control Voltage
- Power Supply for L.T.
- Painting / Surface treatment.

- Wire Rope
- LT motion
- Platform
- Gear & Pinion Material
- MPCB
SINGLE GIRDER UNDERSLUNG
CRANE. 3 Ton
12 m
6 mtrs.
30 m
II as per IS 807/3177
Floor Operated from Pendant Push Button control Station.
Indoor
3 m/min.
12 m/min
12 m/min
3 HP
0.5 HP
0.5HP x 2 Nos.
Sq. cage, Crane Duty Motors, 40% CDF, 150 Siemens. for L.T. only
Electromagnetic D.C Brake
13 mm.
2 fall 6x36, FMC.
Single Flange for CT & LT.
EMCO - KIMO
Single shank, forged as per IS: 3815, Swiveling type
Included.

Included
415V, 3 Phase, 50 Hz / 110V, 1 Ph, 50 Hz
GI – 4 Way Shrouded bus bar
1. Scrubbed with wire brush
2. Surface cleaned with cleaner Solutions.
3. Two coats of reinforced polymer based paint.
Usha Martin.
Twin Drive
N.A.
EN-9 and EN-31
L&T / Siemens.(not included).
L&T / Siemens.
L&T / Yasakawa mak
Section II  Sanitary Fixtures

1  Scope of work

1.1 Work under this section shall consist of furnishing all materials & labour necessary and required to completely install all sanitary fixtures, chromium plated fittings and accessories as required by the drawings specified hereinafter and given in the Schedule of Quantities.

1.2 Without restricting to the generality of the foregoing the sanitary fixtures shall include the following:-

   a) Sanitary fixtures
   b) Chromium plated fittings
   d) Accessories e.g., toilet paper holders, soap dish, coat hooks etc.
   e) Connections to all kitchens, equipment, pump headers and other equipment requiring water and drainage connections.

1.3 Whether specifically mentioned or not all fixtures and appliances shall be provided with all fixing devices, nuts, bolts, screws, hangers as required.

1.4 All exposed pipes within toilets and near fixtures shall be chromium plated brass or copper unless otherwise specified.

2  General requirements

2.1 Sanitary fixtures and C.P. fittings in manufacturer’s packing as specified in the schedule of quantities shall be supplied by the Contractors.

2.2 All fixtures and fittings shall be provided with all such accessories as are required to complete the item in working condition whether specifically mentioned or not in the Schedule of Quantities, specifications, drawings. Accessories shall include proper fixing arrangement, brackets, nuts, bolts, screws and required connection pieces, WC flexible connectors etc.

2.3 Fixing screws shall be half round head chromium plated brass screws with C.P. washers where necessary.

2.4 Contractor shall furnish without cost all such accessories and fixing devices that are necessary and required but not supplied along with the Plumbing Fixtures & CP Fittings by the manufacturers as a part of the original and standard supply.

2.5 All fittings and fixtures shall be fixed in a neat workmanlike manner true to level and heights shown on the drawings and in accordance with the manufacturer’s recommendations. Care shall be taken to fix all inlet and outlet pipes at correct positions. Faulty locations shall be made good and any damage to the finished floor, tiling or terrace shall be made good at Contractor's cost.

2.6 Contractor shall seal all fixtures fixed near wall, marble and edges with an approved type of poly-sulphide sealant appropriate for its application.

3  European W.C
3.1 European W.C. shall be wash down or syphonic type floor or wall mounted set flushed by means of porcelain/plastic flushing cistern, which will be an integral part of the WC system. Framework, walling and finishing will not form a part of the contractor's work. Where applicable flush pipe/bend shall be connected to the W.C. by means of a suitable rubber adapter. Wall hung W.C. shall be supported by C.I. floor mounted chair.

3.2 Each W.C. set shall be provided with a plastic seat shall be with rubber buffers and chromium plated hinges.

3.3 Plastic seat shall be so fixed that it remains absolutely stationary in vertical position without falling down on the W.C. Each W.C. shall be suitable for flushing in low volume of water 3-6 litres.

3.4 Flushing cistern when provided shall be provided with all internal flushing mechanism, 15 mm dia ball cock with unbreakable polythene float and overflow pipe. Any framework required for fixing cistern has to be provided by the contractor.

4 Urinals

4.1 Urinals shall be white glazed vitreous china of size, shape and type specified in the Schedule of Quantities.

4.2 Bowl urinals shall be provided with 15 mm dia C.P. spreader, 32 mm dia stainless steel domical waste and C.P. cast brass bottle trap with pipe and wall flange, and shall be fixed to wall by C.I. brackets and C.I. wall clips as recommended by manufacturers complete as directed by Project Manager.

4.3 Urinals shall be fixed with C.P. brass screws and shall be provided with 32 mm dia domical waste leading to urinal's trap.

4.4 Flush pipes shall be G.I. pipes concealed in wall chase but with chromium plated bends at inlet and outlet or as given in Schedule of Quantities.

4.5 Urinals shall be flushed by means of fully automatic no-touch flush valve with solenoid valves.

4.6 Waste pipes for urinals shall be G.I pipes (Medium class) to IS: 1239 or upVC class III (6 kg/sqcm) conforming to IS: 4985 as given in schedule of quantities.

Waste pipes may be exposed on wall or concealed in chase as directed by the Project Manager. Specifications for waste pipes shall be same as given in Section II.

5. Wash Basins

5.1 Wash basins shall wall mounted type or Counter top type as specified in the BOQ.

5.2 Each basin shall be supported on MS galvanised or CI brackets and clips and the basin securely fixed to wall or on the counter. The design of the brackets shall suit the basin selected and as recommended by the manufacturer.
5.3 Each basin shall be provided with 32 mm dia C.P. waste with overflow, pop-up or standard waste with rubber plug and chain, 32 mm dia C.P. brass bottle trap with CP pipe to wall and flange.

5.4 Each basin shall be provided with a Hot & cold CP mixer with pop up waste fittings, 32 mm dia. CP cast brass bottle trap with outlet pipe and wall flange.

5.5 Some of the selected wash basins as identified in the BOQ shall be similar to the one described above but the supply tap shall be a Magic Eye Infrared operated automatic hot and cold mixing fittings.

5.6 Washbasins shall be fixed at proper heights as shown on drawings. If height is not specified, the rim level shall be 79 cms or as directed by Project Managers.

6 Accessories

6.1 Contractor shall install all chromium plated and porcelain accessories as shown on the drawings or directed by the Project Manager.

6.2 All C.P. accessories shall be fixed with C.P. brass half round head screws and cup washers in wall with rawl plugs or nylon sleeves and shall include cutting and making good as required or directed by Project Manager.

6.3 Recessed porcelain accessories shall be fixed in walls and set in cement mortar 1:2 (1 cement: 2 coarse sand) and fixed in relation to the tiling work as per Interior Designer’s drawings.

7 Urinal partitions

7.1 Urinal partitions shall be white glazed vitreous china, marble, granite or any other material selected by the Project Manager.

7.2 Urinal partitions shall be fixed at proper heights with C.P. brass bolts, anchor fasteners and M.S. Clips as recommended by the manufacturer and directed by Project manager.

8 Measurement

8.1 Sanitary fixtures and accessories shall be measured by numbers in the unit given in the Schedule of Quantities.

8.2 Rates for all items shall be inclusive of cutting holes and chases and making good the same, C.P. Brass screws, nuts, bolts and any fixing arrangements required and recommended by manufacturers, testing and commissioning.
TECHNICAL SPECIFICATIONS

SECTION I - SPECIFICATIONS FOR FIRE PROTECTION SYSTEM

PART-1 GENERAL SPECIFICATION

1. SCOPE OF WORK

1.1 The form of Contract shall be according to the "Conditions of Contract". The following clauses shall be considered as an extension and not in limitation of the obligation of the Contractor.

1.2 Work under this Contract shall consist of furnishing all labour, materials, equipment and appliances necessary and required. The Contractor is required to completely furnish all the Fire fighting system and other specialized services as described hereinafter and as specified in the schedule of quantities and/or shown on the Fire fighting system drawings.

1.3 Without restricting to the generality of the foregoing, the Fire Fighting system installations shall include the following:-
   i) Fire Pumps.
   ii) Hydrant system installation
   iii) Sprinkler system installation
   iv) Fire Fighting Piping installation
   v) Getting Approval of Fire system installation from local fire authority for Fire hydrant, Sprinkler and Fire Alarm system.
   vi) Co-ordination with other agencies during process of NOC for fire approval from Local fire authority.

1.4 Services rendered under this section shall be done without any extra charge.

2. SPECIFICATIONS

2.1 Work under this Contract shall be carried out strictly in accordance with specifications attached with the tender.

2.2 Items not covered under these specifications due to any ambiguity or misprints or additional works, the work shall be carried out as per latest specifications of the Central Public Works Department with upto date amendments as applicable in the Contract.

2.3 Works not covered under para 2.1 and 2.2 shall be carried out as per relevant Indian Standards specifications and Code of Practice as applicable (TAC, NFPA and NBC).

3. EXECUTION OF WORK
3.1 The Contractor should visit and examine the site of work and satisfy himself as to the nature of the existing roads and other means of communication and other details pertaining to the work and local conditions and facilities for obtaining his own information on all matters affecting the execution of work. No extra charge made in consequence of any misunderstanding or incorrect information on any of these points or on grounds of insufficient description will be allowed.

3.2 The work shall be carried out in conformity with the Fire fighting drawings and within the requirements of architectural, HVAC, electrical, structural and other specialized services drawings.

3.3 The Contractor shall cooperate with all trades and agencies working on the site.

3.4 On award of the work, Contractor shall submit a schedule of construction in the form of a pert chart or bar chart for approval of the Engineer-in-Charge. All dates and time schedule agreed upon shall be strictly adhered to, within the stipulated time of completion/commissioning along with the specified phasing, if any.

4. **DRAWINGS**

4.1 Fire fighting drawings are diagrammatic but shall be followed as closely as actual construction permits. Any deviations made shall be in conformity with the architectural and other services drawings.

4.2 Architectural drawings shall take precedence over fire fighting system or other services drawings as to all dimensions.

4.3 Contractor shall verify all dimensions at site and bring to the notice of the Engineer-in-Charge all discrepancies or deviations noticed. Decision of the Engineer-in-Charge shall be final.

4.4 Large size details and manufacturers dimensions for materials to be incorporated shall take precedence over small scale drawings.

4.5 Any drawings issued by the Architects/Consultant for the work are the property of the Architects/Consultant and shall not be lent, reproduced or used on any works other than intended without the written permission of the Architects/Consultant.

5. **INSPECTION AND TESTING OF MATERIALS**

5.1 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.

5.2 For examination and testing of materials and works at the site Contractor shall provide all testing and gauging equipment necessary and required at site for such tests.
5.3 All such equipment shall be tested for calibration at any approved laboratory, if required by the Engineer-in-Charge.

5.3.1 Samples of all materials shall be got approved before placing order and the approved samples shall be deposited with the Engineer-in-Charge. Any materials declared defective by Engineer-in-Charge shall be removed from the site within 48 hours.

6. **METRIC CONVERSION**

6.1 All dimensions and sizes of materials and equipment given in the tender document are commercial metric sizes.

6.2 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.

7. **REFERENCE POINTS**

7.1 Contractor shall provide permanent bench marks, flag tops and other reference points for the proper execution of work and these shall be preserved till the end of the work.

7.2 All such reference points shall be in relation to the levels and locations, given in the architectural and Fire fighting drawings.

8. **REFERENCE DRAWINGS**

8.1 The Contractor shall maintain one set of all drawings issued to him as reference drawings. These shall not be used on site. All important drawings shall be mounted on boards indexed and placed in racks no drawings shall be rolled.

8.2 All corrections, deviations and changes made on the site shall be shown on these reference drawings for final incorporations in the completion drawings. All changes to be made shall be initialed by the Engineer-in-Charge.

9. **SHOP DRAWINGS**

9.1 The Contractor shall submit to the Engineer-in-Charge four copies of the shop drawings.

9.2 Shop drawings shall be submitted under following conditions:-

a) Showing any changes in layout in the fire fighting system drawings.

b) Equipment layout, piping and wiring diagram.

c) Manufacturer's or Contractor's fabrication drawings for any materials or equipment supplied by him.

9.3 The Contractor shall submit four copies of catalogues, manufacturer's drawings, equipment characteristics data or performance charts as required by the Engineer-in-Charge.
10. COMPLETION DRAWINGS

10.1 On completion of work, Contractor shall submit one complete set of original tracings and two prints of "As Built" drawings to the Engineer-in-Charge. These drawings shall have the following information.

a) Run of all piping, diameters on all floors, vertical stacks and location of external services.

b) Ground and invert levels of all fire pipes together with location of all manholes and connections up to outfall.

c) Run of all fire pipe lines with diameters, locations of control valves, access panels.

d) Location of all mechanical equipment with layout and piping connections.

NOTE: No completion certificate shall be issued unless the above drawings are submitted.

10.2 Contractor shall provide four sets of catalogues, service manuals, manufacturer's drawings, performance data and list of spare parts together with the name and address of the manufacturer for all electrical and mechanical equipment provided by him.

10.3 All "Warranty Cards" given by the manufacturers shall be handed over to the Engineer-in-Charge.

11. CONTRACTOR'S RATES

Refer to relevant clause of General Conditions of contracts.

12. TESTING

12.1 Piping and drainage works shall be tested as specified under the relevant clauses of the specifications.

12.2 Tests shall be performed in presence of the Engineer-in-Charge.

12.3 All materials and equipment found defective shall be replaced and whole work tested to meet the requirements of the specifications.

12.4 Contractor shall perform all such tests as may be necessary and required by the local authorities to meet municipal or other bye-laws in force.

12.5 Contractor shall provide all labour, equipment and materials for the performance of the tests.

13. SITE CLEARANCE AND CLEANUP
13.1 The Contractor shall, from time to time, clear away all debris and excess materials accumulated at the site.

13.2 After the fixtures, equipment and appliances have been installed and commissioned, Contractor shall clean-up the same and remove all plaster, paints, stains, stickers and other foreign matter or discoloration leaving the same in a ready to use condition.

13.3 On completion of all works, Contractor shall demolish all stores, remove all surplus materials and leave the site in a broom clean condition, failing which the same shall be done at Contractor's risk and cost.

14. LICENSE, PERMITS AND AUTHORITIES

14.1 Contractor must hold a valid any other license as required by the municipal authority or other competent authority under whose jurisdiction the work falls.

14.2 Contractor must keep constant liaison with the municipal /statutory authority and obtain approval of all fire fighting system and other works carried out by him.

14.3 Contractor shall obtain, from the municipal and other authorities on completion of his work No Objection Certificate with respect to his work, as required for occupation of the building. Engineer-in-Charge shall reimburse the fees paid to the authorities towards the statutory fee charges on production of receipts for money paid.

15. RECOVERY OF COST FOR MATERIALS ISSUED TO CONTRACTORS FREE OF COST

15.1 If any materials issued to the Contractor, free of cost, are damaged or pilfered, the cost of the same shall be recovered from the Contractor on the basis of actual cost to owner which shall include all freight and transportation, excise duty, sales tax, octroi, import duty etc, plus 100%. The decision on the actual cost given by the Engineer-in-Charge shall be final and binding on the Contractor.

16. CUTTING OF WATER PROOFING MEMBRANE

16.1 No walls or terraces shall be cut for making any opening after water proofing has been done without written approval of Engineer-in-charge. When permitted cutting of water proofing membrane shall be done very carefully so that other portion of water proofing is not damaged. On completion of work at such place the water proofing membrane shall be made good and ensured that the opening/cutting is made fully water proof as per contract specifications and details of water proofing.

17. CUTTING OF STRUCTURAL MEMBERS

17.1 No structural member shall be chased or cut without the written permission of the Engineer-in-Charge.
18. MATERIALS SUPPLIED BY EMPLOYER

18.1 The Contractor shall verify that all materials supplied by the Employer conform to the specifications of the relevant item in the tender and approved technical datasheet. Any discrepancy found shall be brought to the notice of the Engineer-in-Charge.

19. MATERIALS

19.1 The contractor shall submit technical datasheets of all materials before procurement at site for approval by Consultant/Engineer-in-Charge. No material will be inspected/acceptable without duly approved technical datasheet by the consultants.

19.2 Unless otherwise specified and expressly approved in writing by the Engineer-in-Charge, only materials of makes and specification as mentioned in the list of approved makes attached with the specifications shall be used.

19.3 If required, the Contractor shall submit samples of materials proposed to be used in the works. Approved samples shall be kept in the office of the Engineer-in-Charge and returned to the Contractor at the appropriate time.

PART-2 SPECIFICATIONS FOR PUMPS AND ANCILLARY EQUIPMENT

1. SCOPE OF WORK

1.1 Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install electrically operated pumps for fire hydrant installations as required by the drawings and specified hereinafter or given in the schedule of quantities.

1.2 Without restricting to the generality of the foregoing the pumps and the ancillary equipment and shall include the following:

   a) Electrically operated pumps with motors, base plate and accessories.
   b) Pump suction and delivery headers, valves, air vessel and connections.
   c) Pressure gauges/Pressure switch
   d) Electrical switch board, wiring, cabling, cable tray, control panel and properly connecting to earthing system of the Factory.

2. GENERAL REQUIREMENTS

2.1 Pumps shall be installed true to level on suitable concrete foundations. Base plate shall be firmly fixed by foundation bolts properly grouted in the concrete foundations.

2.2 Pumps and motors shall be truly aligned with suitable instruments.
2.3 All pump connections shall be standard flanged type with appropriate number of bolts.

2.4 Manufacturers instructions regarding installation connections and commissioning shall be followed with respect to all pumps, switch gear and accessories.

3. **FIRE AND JOCKEY PUMPS**

3.1 Pump Sets

a) Centrifugal, split casing, horizontal pump should be selected as per IS. Pump should have following specification.

**Materials of Construction**

<table>
<thead>
<tr>
<th>PARTS</th>
<th>DESCRIPTION</th>
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<tbody>
<tr>
<td>CASING CAST IRON</td>
<td></td>
</tr>
<tr>
<td>IMPELLER BRONZ IS:318, GR.LTBJ/LTB 2</td>
<td></td>
</tr>
<tr>
<td>CASING WEARING CAST IRON</td>
<td></td>
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<tr>
<td>SHAFT STAINLESS STEEL</td>
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<tr>
<td>SHAFT SLEEVE SS-410</td>
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<tr>
<td>SHAFT SEAL MECHANICAL (FACTORY FITTED)</td>
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<tr>
<td>THRUST BEARING ANTI-FRICTION OF TITLING PAD TYPE</td>
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</tbody>
</table>

b) Shut up head should not exceed 120% of rated head. Pump shall not develop less than 65% of rated head at 150% of rated capacity.

c) Pumps shall be provided with pressure gauge with isolation cock on the delivery side.

d) The pump and its prime mover (Electric motor or Diesel Engine) shall comply with all the requirements of the Rules of Tariff Advisory Committee.

4. **FIRE PUMPS**

4.1 Wet riser hydrant shall be pressurized through a set of pumps driven by electric motors. Desired pressure shall be created and maintained in the systems by means of main and Jockey pump sets. The working of the pump sets shall be as under:

4.2 Main pump for Hydrant

a) Automatic start on reduction in the pressure in the system at pre-determined level through pressure switches. Also manual start arrangement shall be made in case of failure of automatic start system.

b) Pump set shall stop by manual operation only.
4.3 Stand-by main pump (Diesel Engine Driven)

a) In the event of failure in the operation of main pump sets for hydrants, the stand-by main pump shall come into operation when the pressure in the system is reduced to a pre-determined level. Also manual start arrangement shall be made in case of failure of automatic start arrangement.

b) Pump set shall stop by manual operation only.

5. Jockey Pump

5.1 Starting and stopping of Jockey pump set shall be automatic at pre-determined levels through pressure switch. However, arrangements for manual start and stop of the pump shall also be made. Jockey pump shall take care of small leakage’s in the piping system and pumps cushion tanks.

6. Electric Driven Motor

6.1 Electrically driven pumps shall be provided with totally enclosed fan cooled induction motors suitable for fire pumps with IP55 enclosure.

6.2 The motors should be rated not to draw more than 4.5 times the starting current.

6.3 Motors shall be at least equivalent to the horse power required to drive the pump at 150% of its rates discharge.

6.4 The motors shall be wound for class E-insulation and windings shall be vacuum impregnated with heat and moisture resisting varnish, glass fiber insulated.

7. Diesel Engine

7.1 Diesel Engine shall be of 4/6 cylinders with individual heat assemblies. The engine shall be water cooled and shall include heat exchanger and connecting piping strainer, isolating and pressure reducing valves, bye-pass line, exhaust pipe, silencer, day tank for fuel all interconnected piping etc. complete in all respects.

7.2 Engine shall be direct injection type with low noise and exhaust emission levels.

7.3 The speed of engine shall match the pump speed for direct drive.

7.4 The engine shall be capable of being started without the use of the wicks, cartridge heater plugs or either at engine room temperature of 4 deg. C and shall take full load within 15 seconds from the receipt of the signal to start.

7.5 The engine shall effectively operate at 46 Deg.C ambient temperature at 150 meter above mean sea level.
7.6 Noise level of the engine shall not exceed 105 db. (free sound pressure) at 3 meters distance.

7.7 The engine shall be self starting type upto 4 deg.C shall be provided with one 24 volts heavy duty D.C. battery, starter, cutout, battery leads complete in all respects. The battery shall have a capacity of 200 ampere hours and 640 amperes cold cranking amperage.

Pump Control Panel should have visual and audio alarm and indication for battery failure.

The battery should have output amperage capacity for at least 3 consecutive cranking/starting of the Engine.

7.8 Provide a battery charger of 20 amperage capacity of fully charge the batteries in 20 hours with tickle and booster charging facility and regulators.

7.9 Arrangement for starting shall be automatic on receiving the signal. But shut-off shall be manual.

7.10 The engine shall be provided with an oil bath or dry type air cleaner as per manufacturer’s design.

7.11 Engine shall be suitable for running on high speed diesel oil.

7.12 The system shall be provided with a control panel with push button starting arrangement also wired to operate the engine on differential pressure gauge.

7.13 The entire system shall be mounted on a common structural base plate with anti vibration mounting, Dunlop make, and flexible connections on the suction and delivery piping.

7.14 Contractor provide one fully mounted and supported day oil tank fabricated from 6mm thick MS sheet electrically welded of 8 hours working load but not less than 200 ltrs. Provide level indicators - low level and full level in the day oil tank on the control panel through float switches and an air breather. Day oil tank shall also be provided with filling connection (threaded) with cap, gauge glass indication & cocks, drain cock, inspection/cleaning cover with gasket and nuts/bolts. M.S. dyke to hold 150% of the Day Tank capacity to be built around the Day Tank.

7.15 Contractor to provide one exhaust pipe with suitable muffler (residential type) to discharge the engine gasses to outside in open air as per site conditions (contractor to check the site).

7.16 Contractor to provide all accessories, fittings, and fixtures necessary and required for a complete operating engine set. The exhaust pipe shall be taken outside the building with minimum number of bends (approx. length 30 mts.) and shall be duly heat insulated with 50 mm thick glass wool covered with 24 gauge aluminium cladding.
7.17 Contractor shall indicate special requirements, if any, for the ventilation of the pump room.

8. **BASE PLATE**

8.1 Pumps and motors shall be mounted on a common structural base plate and installed as per manufacturer's instructions.

9. **VIBRATION ELIMINATORS**

9.1 The Contractor shall provide on all suction and delivery lines double flanged reinforced neoprene flexible pipe connectors. Connectors should be suitable for a working pressure of each pump and tested to the test pressure given in the relevant head. Length of the test connector shall be as per manufacturer details.

10. **CUBICLE TYPE SWITCH BOARDS/L.T. PANEL**

10.1 Cubicle type switch boards and components shall conform to the requirements of the latest revision including amendments of the following codes and standards.

- **IS:8623**: Specification for factory built assemblies of switch-gear and control gear for voltage up to and including 1000-V AC/1200 V-DC.
- **IS:4237**: General requirements for switch-gear and control-gear for voltage not exceeding 1000-V.
- **IS:2147**: Degree of protection provided by enclosures for low voltage switch-gear and control-gear.
- **IS:1018**: Switchgear and control-gear selection/installation and maintenance.
- **IS:6005**: Code of practice for phosphating of iron and steel.
- **IS:1248**: Direct acting indicating analogue electrical measuring instruments and testing accessories.

The board shall be metal enclosed single front, indoor, floor mounted free standing type or wall mounting type as mentioned in BOQ. The panel shall be designed for a degree of protection of IP-52. The panel height shall not exceed 2350 mm including horizontal main bus bar at top. Keeping in view the operating height of the top switch 1750mm from finish floor. 400 mm clear space shall be left throughout the panel at bottom. The cold rolled sheet steel will be of 2mm thick.

All cut-outs and covers shall be provided with synthetic rubber gaskets. (Preferably neoprene).
The panel shall be divided into distinct vertical sections each comprising of:

i) Complete enclosed bus bar compartment for running horizontal and vertical bus bars.

ii) Complete enclosed switch gear compartment one for each circuit for housing air circuit breaker, MCCB etc.

iii) Compartmentally for power and control cables of at least 300mm width covering entire height provided.

iv) All cable alley must be provided with threaded nipples for CO flooding system and shall be connected to all compartment with centralised CO system

v) The panel shall have 20% spare space duly wired for future use.

The front of each compartment shall be provided with hinged single lead door with locking facilities. Panel shall be provided with suitable lifting facilities. Isolators & MCCB/ACBs shall be of fixed/drawout type as described later.

Each feeder shall have compartmentalised construction cable entry shall be from top/bottom (3mm thick gland plate shall be provided) as required.

The panel shall be provided with three phase buses and neutral bus bars of aluminium sections throughout the length of the panel and shall be adequately supported and braced to withstand the stresses due to the short circuit current of 50 KA rms. for 1 sec. Maximum temperature rise of bus bars and bus bar connection while carrying rated current shall not exceed 40 C over an ambient temperature of 50 C.

The minimum clearance in air between phases and between phases and earth for the entire run of the bus bar connections shall be 25mm minimum bus bars support insulators shall be made of non-hydroscopic non-combustible track resistant and high strength type porcelain or polyester fibre glass moulded material.

All bus bars shall be colour coded as per IS: 375.

G.I. earth bus of 50x6mm size shall be provided at the bottom of the panel throughout the length. Similarly 40x6mm G.I. strip in each vertical section for earthing the individual equipment/accessories shall be provided and connected to main horizontal bus.

All fuses shall be of HRC cartridge plug in type and shall be of class 2 type (80 KA rms) breaking capacity. Fuses shall have visible operation indications. Neutral link shall be mounted on fuse carriers which shall be mounted on fuse bases.

Contactors shall be electro-magnetic type with interrupted duty as per IS:2959. The main contacts shall be of Silver or silver alloy, provided with minimum 2 NO and 2 NC auxiliary contacts. The push button should be of shrouded type and each should be provided with 1 NO and 1 NC contact. Colour coding shall be as per IS:6875 (Part II).

10.2 ACB
The circuit breaker shall be of air break type in order to eliminate fire and explosion risk and shall comply with the IS:13947-1993 with a rupturing capacity of not less than 50 MVA at 415 volts or as specified elsewhere (The service short circuit breaking capacity shall be as specified and equal to the short circuit with stand value). The breaker shall be provided with microprocessor based releases for overload and short circuit protection.

The breaker shall consist of a horizontal drawout pattern triple pole, fully interlocked, independent manual spring operated mechanism. The mechanism should be such that the circuit breaker is at all times free to open immediately. The trip coil is energised. Current carrying parts should be silver plated and suitable arcing contacts shall be provided to protect the main contact arc-chutes for each pole shall be provided and shall be lifted out for the inspection of main and arcing contact.

Self aligning cluster type isolating contacts shall be provided on breaker for interlocking protection metering and for any other purposes.

Breaker shall be provided with automatic safety shutters to screen the main live contact when the breaker is withdrawn. The frame of the circuit breaker should be positively earthed when the breaker is racked into the cubicle.

The following safety arrangements shall be provided for the safety of the personnel to prevent mal-operation.

i) Interlock to prevent the truck from being withdrawn or replaced except in the fully isolated position.
ii) Interlock to prevent earth connection from being made by the earthing device except breaker is open.
iii) Interlock to prevent the breaker from being made alive without its rack in position.

10.3 Moulded Case Circuit Breaker (MCCB)

MCCB shall conform to the latest IS:13947-1993/IEC 947-1989. The Service Short Circuit Breaking Capacity (ICS at 415 VAC) should be 50 KA.
MCCB shall be Current Limiting and comprise of Quick Make - Break switching mechanism preferably Double Break Contact system are extinguishing device and the tripping unit contained in a compact, high strength, heat resistant, flame retardant, insulating moulded case with high withstand capability against thermal and mechanical stresses. All MCCBs shall be capable of defined variable overload adjustment. All MCCBs rated 200 Amps and above shall have adjustable Magnetic short circuit pick up.

The trip command shall over ride all other commands. MCCB shall employ maintenance free double break contact system to minimise the let thru’ energies and capable of achieving discrimination upto the full short circuit capacity of downstream MCCB. The manufacturer shall provide both the discrimination tables and let thru’ energy curves. The MCCB shall not be restricted to Line/Load connections.
The handle position shall give positive indication of ‘ON’, ‘OFF’ or ‘Tripped’ thus qualifying to disconnection as per the IS/TEC indicating the true position of all the contacts. In case of 4 pole MCCB the neutral shall be defined and capable of offering protection.

The general purpose control switch shall be provided for ON/OFF Auto/Manual. The switch shall be provided with engraving plates on the front with the complete inscription.

The switch shall be normally a fixed control box type heavy duty unit.

Indicating lamps shall be of the panel mounting, LED type and shall have execution plates marked with its function wherever necessary. The colour of the lamp cover shall be red for ‘ON’ and green for ‘OFF.’

10.4 Name Plates & Lables

i) Panel and all modules shall be provided with prominent engraved identification plates. The module identification designation. For single front switch boards, similar panel and board identification labels shall be provided at the rear also.

ii) All name plates shall be of non-rusting metal or 3 ply lamicold, with white engraved lettering on black background. Inscription and lettering sizes shall be subject to Owner’s approval.

iii) Suitable stenicilled paint marks shall be provided inside the panel/module identification of all equipments in addition to the plastic sticker lables, if provided. These lables shall be partitioned so as to be clearly visible and shall have the device number, as mentioned in the module wiring design.

10.5 Painting

All steel work shall be pretreated in tanks in accordance with clause painting.

10.6 Wiring

Control and protective wiring shall be done with copper conductor PVC insulated 1100 volts grade multi-stranded flexible wire of 2.5sq.mm 2 cross section. The colour coding shall be as per latest edition of IS:375.

Each wire shall be identified by plastic ferrule. All wire termination shall be made with type connection. Wire shall not be taped or spliced between terminal points.

Terminal blocks shall preferably by grouped according to circuit function and each terminal block group shall have at least 20% spare capacity.

Not more than 1 (one) wire shall be connected to any terminal block.
11. **CABLES**

11.1 Contractor shall provide all power and control cables from the motor control center to various motors and control devices, of ratings as per IS:3961.

11.2 All power and wiring cables shall be FRLS with aluminium conductor PVC insulated armoured and PVC sheathed of 1.1 KV grade. Control cables and power cables of 2.5 sq.mm or less shall be of copper, FRLS, armoured. Cables and wires shall comply with requirements of IS:5831, 694, 8130, 7098(I) & 1554 as the case may be.

11.3 All cables shall have stranded conductors. The cables shall be supplied in drums as far as possible and bear the manufacturer’s identification mark.

11.4 All cable joints shall be made in an approved manner as per accepted practice.

12. **CABLE TRAYS**

12.1 Cable trays shall be 2 mm thick CRCA hot dip galvanised sheet steel, ladder type/perforated cable tray including fixing along wall/ceiling complete with M.S. rod/flat hangers directly grouted in walls/ceiling etc as required.

12.2 The sizes shall be as follows and as directed by Engineer-in-Charge.

A. PERFORATED CABLE TRAY
   a) 150 mm wide 75 mm deep
   b) 300 mm wide 75 mm deep

B. LADDER TYPE CABLE TRAY
   a) 150 mm wide
   b) 300 mm wide

13. **EARTHING**

13.1 The earthing pit would be provided by the Owner. Fire Fighting Contractors shall required to extend earthing from the earthing pit by earthing strips (G.I. 25x3mm) or earthing wires (G.I. 8 SWG) as may be required for proper earthing of the equipments supplied by him. Thickness of galvanisation to be 75 microns (minimum). Each electrical equipment is to be earthed at 2 points.

14. **COMMISSIONING**

14.1 Commissioning of the systems shall commence only after:
a. All pipes, accessories, pumping set, fire alarms etc. have been completely installed and tested.

b. The electrical connection has been made and direction of motors rotation checked.

c. Related works by other agencies has been completed in all respects.

d. Water supply is available in adequate quantity in the underground tank.

e. Basement drainage pumps are fully commissioned.

f. On completion of all related work given in para above, start pumping sets and develop desired pressure in both the systems.

g. Open one hydrant and test if pumps starts at desired drop in pressure and the alarm operates. If required make adjustments and reset.

15. **MAINTENANCE MANUAL**

15.1 On completion of the entire work and successful commissioning, contractor shall hand over four copies of maintenance manuals of all equipment installed by him.

15.2 Maintenance manuals shall include information relating to make, model Number, year of manufacture for all electrical and mechanical equipment with names of local suppliers or manufacturers’ agents.

16. **MEASUREMENTS**

16.1 Pumping sets, air vessel, switchboard cubicle, pressure switch, fire alarm shall be measured by number and shall include all items necessary and required and given in the specifications.

16.2 Earthing shall be measured as a lump sum item.

16.3 Earthing tape will be linear measurement.

16.4 Cabling shall be measured per linear meter from switchboard to each motor and shall include all items necessary and required and given in the specifications.
PART–3 SPECIFICATION FOR HYDRANT SYSTEM

1. SCOPE OF WORK

1.1 Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install wet riser fire hydrant system as required by the drawings and specified hereinafter or given in this schedule of quantities.

1.2 Without restricting to the generality of the foregoing, the fire hydrant system shall include the following:

   a. Mild steel mains including valves, hydrants and all other accessories.
   b. Mild steel pipe fire risers within the building.
   c. Landing valves, canvas hose pipes, hose reels, hose cabinets, fire brigade connections, connection to pumps, appliances and pressure reducing devices.
   d. Excavation, anchor blocks and valve chambers.

2. GENERAL REQUIREMENTS

2.1 All materials shall be of the best quality conforming to the specifications and subject to the approval of the employer.

2.2 Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.

2.3 Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages, etc.

2.4 Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified. Only approved type of anchor fasteners shall be used for RCC ceilings and walls.

2.5 Valves and other appurtenances shall be so located that they are easily accessible for operations, repairs and maintenance.

3. PIPES AND FITTINGS

For Internal Work

a. All pipes within the building in exposed locations and shafts including connections buried under floor shall be ERW mild steel tubes conforming to IS:1239 (Heavy class) with screwed or welded joints as specified by the Engineer-in-Charge.

b. Fittings of 50mm or below shall be FORGED FITTINGS of approved makes. For 65mm and above shall be W.I./M.S. with butt weld ends.

4. JOINTING
Gasket, for use in between flanged joints, to be of CAF as per BS-2712, thickness as specified in S.O.Q.

5. **EXCAVATION**

5.1 Excavations for pipe line shall be in open trenches to levels and grades shown on the drawings or as required at site. Pipe lines shall be buried to a minimum depth of 1 to 1.5 meter or as shown on the drawings.

5.2 Wherever required contractor shall support all trenches or adjoining structures with adequate supports to prevent land slides.

5.3 On completion of testing and painting, trenches shall be refilled with excavated earth in 15 cm layers and compacted.

5.4 Contractor shall dispose off all surplus earth within the site.

6. **ANCHOR BLOCKS**

6.1 Contractor shall provide suitable cement concrete anchor blocks as may be necessary for overcoming pressure trusts in under ground/external pipes. Anchor blocks shall be of cement concrete 1:2:4 mix.

7. **VALVES**

7.1 Butterfly valve 80mm dia and above shall be cast iron wafer type shall confirm to and marked IS:13095 Class PN-1.0.

7.2 Valves on M.S. pipe 50mm and below shall be heavy pattern gun-metal valves (with cast iron wheel) tested to 20 Kg/sq.cm pressure. Valves shall conform to and marked IS:778.

7.3 Check valves shall be DUAL PLATE TYPE with cast iron steel body and stainless steel internal trims.

8. **EXTERNAL FIRE HYDRANTS**

8.1 Contractor shall provide external hydrants. The hydrants shall have instantaneous type 63 mm dia outlets. The hydrants shall be of gunmetal and flange inlet and single outlet conforming to I.S. 908 with M.S. duck foot bend and flanged riser of required height to bring the hydrant to correct level above ground.

8.2 Contractor shall provide for each external fire hydrant two nos. of 63mm dia 15 meter long hose pipe with gunmetal male and female instantaneous type couplings machine wound with copper wire hose to I.S. 636 type A and couplings to IS 903 with IS certification, gunmetal branch pipe with 16 mm nozzle to I.S. 903.

9. **INTERNAL HYDRANTS**
9.1 Contractor shall provide on each FHC at landing and other locations as shown on the drawings of required nos. single headed gunmetal landing valve with 63mm dia outlets and 80 mm inlet (I.S. 5290-1969) with individual shut off valves and cast iron wheels. Landing valves shall have flanged inlet and instantaneous type outlet as shown on the drawings.

9.2 Instantaneous outlets for fire hydrants shall be of standard pattern approved and suitable for fire brigade hoses. Contractor shall provide for each internal fire hydrant station TWO numbers of 63 mm dia 15 meter long C.P./reinforced rubber lined hose pipes with gunmetal male and female instantaneous type coupling machine wound with copper wire (Hose to I.S. 636 type A and couplings to I.S. 903 with I.S. certification), fire hose reel, gunmetal branch pipe with nozzle I.S. 903 fireman’s axe.

9.3 Each hose box shall be, after thorough cleaning of surface, painted with one coat of red oxide primer and 2 coats of enamel paint of fire red shade as per IS:5. The words FIRE HOSE to be painted on the inner face of the glass.

10. **FIRST AID HOSE REELS**

10.1 Contractor shall provide standard fire hose reels with 20 mm dia high pressure rubber hose of 36 meters length with gunmetal nozzle with 5mm bore, and control valve, shut of nozzle connected wall mounted on circular hose reel of heavy duty mild steel construction and cast iron brackets. Hose reel shall conform to IS 884-1969. The hose reel shall be connected directly to the M.S pipe riser through an independent connection.

11. **PRESSURE GAUGES**

i) All pressure gauges shall be of dial type with bourdon tube element of SS 316. The gauge shall be of reputed make. The dial size shall be 150 mm dia and scale division shall be in metric units marked clearly in black on a white dial. The range of pressure gauge shall be 0 to 10 kg/sq.cm.

ii) All pressure gauges shall be complete with isolation cock, nipples, tail pipes etc.

12. **PRESSURE SWITCHES**

i) The pressure switch shall be industrial type single pole double throw electric pressure switch designed for starting or stopping of equipment when the pressure in the system drops or exceeds the pre-set limits. It shall comprise of a single pole change-over switch, below element assembly and differential sprinkle.

ii) All the pressure switches shall have 1/4” B.S.P(f) inlet connection and screwed cable entry for fixing cable gland.

iii) The electric rating of the switch shall be as under:

<table>
<thead>
<tr>
<th>Type of supply</th>
<th>Voltage</th>
<th>Non-Inductive</th>
<th>Inductive</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.C.</td>
<td>110-380</td>
<td>10 Amp</td>
<td>6 Amp</td>
</tr>
<tr>
<td>D.C.</td>
<td>24-250</td>
<td>12 Watts</td>
<td>12 Watts</td>
</tr>
</tbody>
</table>
13. **FIRE BRIGADE CONNECTION**

13.1 The contractor shall provide as shown on drawing gunmetal four way collecting head with 63mm dia instantaneous type inlets with built in check valve and 100/150 mm dia. Outlet connection to the fire main grid and for tank filling, collecting head shall conform to IS 904-1965.

14. **AIR VALVES**

14.1 The contractor shall provide 25mm dia screwed inlet case iron single acting air valve on all high points in the system or as shown on drawings.

15. **DRAIN VALVE**

15.1 The contractor shall provide 25mm dia G.I. pipe to IS:1239 (Heavy class) with brass ball valve for draining any water in the system in low pockets as shown in drawings or as directed by the Owner.

16. **VALVE CHAMBERS**

16.1 Contractor shall provide suitable brick masonry chambers in cement mortar 1:5 (1 cement: 5 coarse sand) on cement concrete foundations 150 mm thick 1:5:10 mix (1 cement: 5 fine sand 10 graded stone aggregate 40 mm nominal size) 15 mm thick cement plaster inside and outside finished with a floating coat of neat cement inside with cast iron surface box approved by fire brigade including excavation, back filling, complete.

16.2 Valve chamber shall be of the following size:

For depths 100 cm and beyond 120x120 cms, Weight of C.I. frame and cover shall be 38 kg.

17. **PIPE PROTECTION**

**PAINTING**

17.1 All above ground pipes, pipe fittings, valves, structural steel work pipe supports etc. shall be painted as per specifications given below.

17.2 Painting shall be done only after the completion of fabrication work and testing.

17.3 The instructions of paint manufacturer shall be followed as far as possible otherwise the work is to be done as directed by the Owner.

17.4 All cleaning materials, brushes, tools and tackles, painting, material etc. shall be arranged by the Contractor at site in sufficient quantity.

17.5 All rust, dust shall scales, welding slag or any other foreign materials shall be removed fully so that a clean and dry surface is obtained prior to painting. Any
other oily containment shall be removed by use of a solvent prior to surface cleaning.

17.6 First coat of primer paint must be applied by brush on dry clean surface immediately or in any case within 3 hours of such cleaning.

17.7 Primer paint - two coat (minimum thickness 100 microns) of zinc chromate.

17.8 Finishing coats

a) For External areas - 2 coats (thickness minimum 50 microns each) of epoxy paint, fire red shade as per IS:5.

b) For Internal areas - 2 coats of synthetic enamel paint, fire red shade as per IS:5.

COATING WRAPPING FOR UNDERGROUND PIPES

17.9 All underground piping shall be protected by coating and wrapping as per the following procedure.

17.10 The materials and workmanship shall in general confirm to IS:10221 or as directed by the Owner.

17.11 Cleaning - The pipes shall be thoroughly cleaned by dust, rust will scales, oil, grease etc. by stiff wire brush and scrappers. The surface shall be coated with the primer immediately after cleaning.

17.12 Priming - The primer shall be PYPKOTE/RUSTFIRE/CORPORATE undercoat. The manufacturers recommended procedure would be followed for applying the primer.

17.13 Paste Application - PYPKOTE-AW Paste/RUSTFIRE Paste/CORPORATE Paste shall be applied to fill up uneven surfaces in order to ensure smoothness for subsequent wrapping with multi-layer tape.

17.14 Tape Wrapping - The tape is to wrapped while the second coat of primer is still tacky. Winding is to be done with 50% overlap so that the total thickness of 2.0mm tape would become 4.0mm. It should be ensured while wrapping that air bubbles are trapped. The ends of tape shall be secured with nylon binding to ensure that the tape doesn’t get loosened while handling.

17.15 The total thickness including 2 coats of primer, 50% overlap of tape etc. should not be less than 4.5mm or as per manufacturers recommendations.

17.16 The ‘Holiday Test’ is to be conducted for detecting any entrapped air or any other defect. The Contractor is to arrange for the Holiday Test and to rectify the defects if found any.

18. PIPE SUPPORTS
18.1 All pipes shall be adequately supported from ceiling or walls by means of anchor fasteners by drilling holes with electrical drill in an approved manner as recommended by manufacturer of the fasteners.

18.2 All supports/clamps fabricated from M.S. structural e.g. roads, channels, angles and flats shall be painted as described in specifications for “Painting” ABOVE. The Shade shall be BLACK.

18.3 Where inserts are not provided the contractor shall provide anchor fasteners. Anchor fasteners shall be fixed to walls and ceilings by drilling holes with electrical drill in an approved manner as recommended by the manufacturer of the fasteners

19. **TESTING**

19.1 All piping in the system shall be tested to a hydrostatic pressure of 14.0 kg/sq.cm without drop in pressure for at least 2 hours.

19.2 Rectify all leakage’s, make adjustments and reset as required and directed.

20. **HOSE CABINETS**

20.1 Provide doors/hose cabinets for internal/external hydrants respectively fabricated from 14 gauge CRCA sheet with double glass front door and locking arrangement, with breakable glass key access arrangement, duly painted red with stove enameled paint fixed to wall floor as per site conditions. The cabinet shall have a separate chamber to store a key with breakable glass as per approved design. Hose cabinets shall be hinged double door partially glazed with locking arrangement, stove enameled fire red paint with ‘FIRE HOSE’ written on it prominently. Detailed drawings of hose cabinet for indoor and outdoor works shall be got approved from Owner before fabrication and installation at site.

20.2 For external hydrants the hose cabinets shall be fabricated from 14 gauge thick CRCA sheet with double shutter glass front door and locking arrangement with breakable glass key access arrangement. The cabinet shall have ‘FIRE HOSE’ written on it prominently. Detail drawings of hose cabinet shall be got approved from the Owner before fabrication and installation at the site. (Also see Clause 9.3 of this Volume).

21. **MEASUREMENT**

21.1 Mild steel pipes shall be measured per linear meter of the finished length and shall include all fittings (including flanges), welding, jointing, clamps for fixing to walls or hangers, anchor fasteners and testing.

21.2 Sluice valves, orifice plates, check valves and full way valves shall be measured by numbers and shall include all items necessary and required for fixing and as given in the specifications/schedule of quantities.
21.3 Landing valves with orifice flange, hose cabinets, reinforced rubber lined fire hose pipes, First-aid fire hose reels (with gunmetal full way valves) and gunmetal branch pipes shall be measured by numbers and shall include all items necessary and required for fixing as given in the specifications/schedule of quantities.

21.4 Suction and delivery headers shall be measured per linear meter or finished length and shall include all items as given in the schedule of quantities.

21.5 Painting/wrapping/coating of headers, pipes shall be included in the rate for pipes and no separate payment shall be made.

21.6 Brick masonry chambers shall be measured by number and shall include all items as given in the schedule of quantities/specifications.

21.7 No additional payment shall be admissible for cutting holes or chases in walls or floors, making connections to pumps, equipment and appliances.

PART-4 MISCELLANEOUS FIRE SERVICES EQUIPMENT

1. GENERAL

1.1 This Section specifies the manufacture and installation of miscellaneous fire services equipment which shall be provided according to the Drawings for the completion of the FS installation.

1.2 The whole installation shall be installed and commissioned in accordance with DFS requirements.

2. STANDARDS

2.1 Relevant Codes and Standards

2.2 BS 1042: Measurement of Fluid Flow in Closed Conduits

2.3 Codes and regulations of the jurisdictional authorities

3. TECHNICAL AND INSTALLATION REQUIREMENTS

3.1 Portable Equipment

3.1.1 Carbon Dioxide (CO2) Type Fire Extinguisher

a) CO2 fire extinguishers shall be DFS approved, and shall also be FOC approved or UL listed.

b) Fire extinguishers shall be constructed of heavy duty mild steel case, stainless steel discharge lever and fixed carrying handle with a heavy duty, brass chrome-plated valve body.

c) Unit shall be operable to 40 °C.

d) Sturdy wall hanger shall be provided for fixing of each fire extinguisher.
3.1.2 Foam Type Portable Fire Extinguisher

a) The fire extinguishers shall be DFS approved, and shall also be FOC approved or UL listed.
b) The fire extinguishers shall be constructed of steel container and completed with nylon foam making branch pipe, operating lever, safety pin, gas cartridge piercer, gas cartridge, wall hook and screw.
c) Fire extinguishers shall be operable to 40 °C.

PART-5 TECHNICAL SPECIFICATION FOR ROOF TOP SOLAR PLANT

The proposed projects shall be commissioned as per the technical specifications given below. Any shortcomings will lead to cancelation of subsidy in full or part as decided by SECI. Competent Authority’s decision will be final and binding on the bidder.

DEFINITION
A Grid Tied Solar Rooftop Photo Voltaic (SPV) power plant consists of SPV array, Module Mounting Structure, Power Conditioning Unit (PCU) consisting of Maximum Power Point Tracker (MPPT), Inverter, and Controls & Protections, interconnect cables, Junction boxes, Distribution boxes and switches. PV Array is mounted on a suitable structure. Grid tied SPV system is without battery and should be designed with necessary features to supplement the grid power during day time. Components and parts used in the SPV power plants including the PV modules, metallic structures, cables, junction box, switches, PCUs etc., should conform to the BIS or IEC or international specifications, wherever such specifications are available and applicable.

Solar PV system shall consist of following equipments/components.
- Solar PV modules consisting of required number of Crystalline PV cells.
- Grid interactive Power Conditioning Unit with Remote Monitoring System
- Mounting structures
- Junction Boxes.
- Earthing and lightning protections.
- IR/UV protected PVC Cables, pipes and accessories

SOLAR PHOTOVOLTAIC MODULES:
1. The PV modules used should be made in India.

2. The PV modules used must qualify to the latest edition of IEC PV module qualification test or equivalent BIS standards Crystalline Silicon Solar Cell Modules IEC 61215/IS14286. In addition, the modules must conform to IEC 61730 Part-1 - requirements for construction & Part 2 – requirements for testing, for safety qualification or equivalent IS.

a) For the PV modules to be used in a highly corrosive atmosphere throughout their lifetime, they must qualify to IEC 61701.
b) The total solar PV array capacity should not be less than allocated capacity (kWp) and should comprise of solar crystalline modules of minimum 500 Wp and above wattage. Module capacity less than minimum 500 watts shall not be accepted.

c) Protective devices against surges at the PV module shall be provided. Low voltage drop bypass diodes shall be provided.

d) PV modules must be tested and approved by one of the IEC authorized test centres.

e) The module frame shall be made of corrosion resistant materials, preferably having anodized aluminium.

f) The bidder shall carefully design & accommodate requisite numbers of the modules to achieve the rated power in his bid. SECI/owners shall allow only minor changes at the time of execution.

g) Other general requirement for the PV modules and subsystems shall be the Following:
I. The rated output power of any supplied module shall have tolerance within +/- 3%.
II. The peak-power point voltage and the peak-power point current of any supplied module and/or any module string (series connected modules) shall not vary by more than 2 (two) per cent from the respective arithmetic means for all modules and/or for all module strings, as the case may be.
III. The module shall be provided with a junction box with either provision of external screw terminal connection or sealed type and with arrangement for provision of by-pass diode. The box shall have hinged, weather proof lid with captive screws and cable gland entry points or may be of sealed type and IP-65 rated.
IV. I-V curves at STC should be provided by bidder.

Solar PV modules
Plants installed in high dust geographies like Rajasthan and Gujrat must have the solar modules tested with relevant dust standards (Applicable standard would be IEC 60068-2-68).

Modules deployed must use a RF identification tag. The following information must be mentioned in the RFID used on each modules. This should be inside the laminate only.

a) Name of the manufacturer of the PV module
b) Name of the manufacturer of Solar Cells.
c) Month & year of the manufacture (separate for solar cells and modules)
d) Country of origin (separately for solar cells and module)
e) I-V curve for the module Wattage, Im, Vm and FF for the module
f) Unique Serial No and Model No of the module
g) Date and year of obtaining IEC PV module qualification certificate.
h) Name of the test lab issuing IEC certificate.
i) Other relevant information on traceability of solar cells and module as per ISO 9001 and ISO 14001

Warranties:
a) Material Warranty:
   i. Material Warranty is defined as: The manufacturer should warrant the Solar Module(s) to be free from the defects and/or failures specified below for a
period not less than five (05) years from the date of sale to the original customer ("Customer")
ii. Defects and/or failures due to manufacturing
iii. Defects and/or failures due to quality of materials
iv. Non conformity to specifications due to faulty manufacturing and/or inspection processes. If the solar Module(s) fails to conform to this warranty, the manufacturer will repair or replace the solar module(s), at the Owners sole option

b) Performance Warranty:
i. The predicted electrical degradation of power generated not exceeding 20% of the minimum rated power over the 25 year period and not more than 10% after ten years period of the full rated original output.

ARRAY STRUCTURE
a) Hot dip galvanized MS mounting structures may be used for mounting the modules/panels/arrays. Each structure should have angle of inclination as per the site conditions to take maximum insolation. However to accommodate more capacity the angle inclination may be reduced until the plant meets the specified performance ratio requirements.

b) The Mounting structure shall be so designed to withstand the speed for the wind zone of the location where a PV system is proposed to be installed (like Delhi-wind speed of 150 kM/ hour). It may be ensured that the design has been certified by a recognized Lab/Institution in this regard and submit wind loading calculation sheet to SECI. Suitable fastening arrangement such as grouting and calming should be provided to secure the installation against the specific wind speed.

c) The mounting structure steel shall be as per latest IS 2062: 1992 and galvanization of the mounting structure shall be in compliance of latest IS 4759.

d) Structural material shall be corrosion resistant and electrolytically compatible with the materials used in the module frame, its fasteners, nuts and bolts. Aluminium structures also can be used which can withstand the wind speed of respective wind zone. Necessary protection towards rusting need to be provided either by coating or anodization.

e) Aluminium frames should be avoided for installations in coastal areas.

f) The fasteners used should be made up of stainless steel. The structures shall be designed to allow easy replacement of any module. The array structure shall be so designed that it will occupy minimum space without sacrificing the output from the SPV panels.

g) Regarding civil structures the bidder need to take care of the load bearing capacity of the roof and need arrange suitable structures based on the quality of roof.

h) The total load of the structure (when installed with PV modules) on the terrace should be less than 60 kg/m2.

i) The minimum clearance of the structure from the roof level should be 300 mm.

JUNCTION BOXES (JBs)
a) The junction boxes are to be provided in the PV array for termination of connecting cables. The J. Boxes (J Bs) shall be made of GRP/FRP/Powder Coated Aluminium /cast aluminium alloy with full dust, water & vermin proof arrangement. All wires/cables must be terminated through cable lugs. The JBs shall be such that input & output termination can be made through suitable cable glands.

b) Copper bus bars/terminal blocks housed in the junction box with suitable termination threads Conforming to IP65 standard and IEC 62208 Hinged door with EPDM rubber gasket to prevent water entry. Single / double compression cable glands. Provision of earthing. It should be placed at 5 feet height or above for ease of accessibility.

c) Each Junction Box shall have High quality Suitable capacity Metal Oxide Varistors (MOVs) / SPDs, suitable Reverse Blocking Diodes. The Junction Boxes shall have suitable arrangement monitoring and disconnection for each of the groups.

d) Suitable markings shall be provided on the bus bar for easy identification and the cable ferrules must be fitted at the cable termination points for identification.

e) All fuses shall have DIN rail mountable fuse holders and shall be housed in thermoplastic IP 65 enclosures with transparent covers.

DC DISTRIBUTION BOARD:

a) DC Distribution panel to receive the DC output from the array field.

b) DC DPBs shall have sheet from enclosure of dust & vermin proof conform to IP 65 protection. The bus bars are made of copper of desired size. Suitable capacity MCBs/MCCB shall be provided for controlling the DC power output to the PCU along with necessary surge arrestors.

AC DISTRIBUTION PANEL BOARD:

a) AC Distribution Panel Board (DPB) shall control the AC power from PCU/ inverter, and should have necessary surge arrestors. Interconnection from ACDB to mains at LT Bus bar while in grid tied mode.

b) All switches and the circuit breakers, connectors should conform to IEC 60947, part I, II and III/ IS60947 part I, II and III.

c) The changeover switches, cabling work should be undertaken by the bidder as part of the project.

d) All the Panel’s shall be metal clad, totally enclosed, rigid, floor mounted, air - insulated, cubical type suitable for operation on three phase / single phase, 415 or 230 volts, 50 Hz

e) The panels shall be designed for minimum expected ambient temperature of 45 degree Celsius, 80 percent humidity and dusty weather.

f) All indoor panels will have protection of IP54 or better. All outdoor panels will have protection of IP65 or better.

g) Should conform to Indian Electricity Act and rules (till last amendment).

h) All the 415 AC or 230 volts devices / equipment like bus support insulators, circuit breakers, SPDs, VTs etc., mounted inside the switchgear shall be suitable for continuous operation and satisfactory performance under the following supply conditions

Variation in supply voltage
+/- 10 %
Variation in supply frequency
+/- 3 Hz

**PCU/ARRAY SIZE RATIO:**
a) The combined wattage of all inverters should not be less than rated capacity of power plant under STC.
b) Maximum power point tracker shall be integrated in the PCU/inverter to maximize energy drawn from the array.

**PCU/ Inverter:**
As SPV array produce direct current electricity, it is necessary to convert this direct current into alternating current and adjust the voltage levels to match the grid voltage. Conversion shall be achieved using an electronic Inverter and the associated control and protection devices. All these components of the system are termed the “Power Conditioning Unit (PCU)”. In addition, the PCU shall also house MPPT (Maximum Power Point Tracker), an interface between Solar PV array & the Inverter, to the power conditioning unit/inverter should also be DG set interactive. If necessary, Inverter output should be compatible with the grid frequency. Typical technical features of the inverter shall be as follows:
Switching devices
IGBT/MOSFET
Control
Microprocessor /DSP
Nominal AC output voltage and frequency
415V, 3 Phase, 50 Hz (In case single phase inverters are offered, suitable arrangement for balancing the phases must be made.)
Output frequency
50 Hz
Grid Frequency Synchronization range
+ 3 Hz or more
72
Ambient temperature considered
-20o C to 50o C
Humidity
95 % Non-condensing
Protection of Enclosure
IP-20(Minimum) for indoor.
IP-65(Minimum) for outdoor.
Grid Frequency Tolerance range
+ 3 or more
Grid Voltage tolerance
-0.20.15
No-load losses
Less than 1% of rated power
Inverter efficiency(minimum)
>93% (In case of 10 kW or above with in-built galvanic isolation)
>97% (In case of 10 KW or above without in-built galvanic isolation)
Inverter efficiency (minimum)
> 90% (In case of less than 10 kW)
THD
< 3%
PF
> 0.9
a) Three phase PCU/ inverter shall be used with each power plant system (10kW and/or above) but in case of less than 10kW single phase inverter can be used.
b) PCU/inverter shall be capable of complete automatic operation including wake-up, synchronization & shutdown.
c) The output of power factor of PCU inverter is suitable for all voltage ranges or sink of reactive power, inverter should have internal protection arrangement against any sustainable fault in feeder line and against the lightning on feeder.
d) Built-in meter and data logger to monitor plant performance through external computer shall be provided.
e) Anti-islanding (Protection against Islanding of grid): The PCU shall have anti islanding protection in conformity to IEEE 1547/UL 1741/ IEC 62116 or equivalent BIS standard.
f) Successful Bidders shall be responsible for galvanic isolation of solar roof top power plant (>100kW) with electrical grid or LT panel.
g) In PCU/Inverter, there shall be a direct current isolation provided at the output by means of a suitable isolating transformer. If Isolation Transformer is not incorporated with PCU/Inverter, there shall be a separate Isolation Transformer of suitable rating provided at the output side of PCU/PCU units for capacity more than 100 kW.
h) The PCU/ inverter generated harmonics, flicker, DC injection limits, Voltage Range, Frequency Range and Anti-Islanding measures at the point of connection to the utility services should follow the latest CEA (Technical Standards for Connectivity Distribution Generation Resources) Guidelines.
i) The power conditioning units / inverters should comply with applicable IEC/ equivalent BIS standard for efficiency measurements and environmental tests as per standard codes IEC 61683/IS 61683 and IEC 60068-2 (1,2,14,30)/ Equivalent BIS Std.
j) The MPPT units environmental testing should qualify IEC 60068-2 (1, 2, 14, 30)/ Equivalent BIS Std. The junction boxes/ enclosures should be IP 65 (for outdoor)/ IP 54 (indoor) and as per IEC 529 specifications.
k) The PCU/ inverters should be tested from the MNRE approved test centres/ NABL/ BIS/ IEC accredited testing- calibration laboratories. In case of imported power conditioning units, these should be approved by international test houses.

INTEGRATION OF PV POWER WITH GRID:
The output power from SPV would be fed to the inverters which converts DC produced by SPV array to AC and feeds it into the main electricity grid after synchronization. In case of grid failure, or low or high voltage, solar PV system shall be out of synchronization and shall be disconnected from the grid. Once the DG set comes into service, PV system shall again be synchronized with DG supply and load requirement would be met to the extent of availability of power. 4 pole isolation of inverter output with respect to the grid/ DG power connection need to be provided.

DATA ACQUISITION SYSTEM / PLANT MONITORING
i. Data Acquisition System shall be provided for each of the solar PV plant above 10 kWp capacity.
ii. Data Logging Provision for plant control and monitoring, time and date stamped system data logs for analysis with the high quality, suitable PC. Metering and Instrumentation for display of systems parameters and status indication to be provided.

iii. Solar Irradiance: An integrating Pyranometer / Solar cell based irradiation sensor (along with calibration certificate) provided, with the sensor mounted in the plane of the array. Readout integrated with data logging system.

iv. Temperature: Temperature probes for recording the Solar panel temperature and/or ambient temperature to be provided complete with readouts integrated with the data logging system.

v. The following parameters are accessible via the operating interface display in real time separately for solar power plant:
   a. AC Voltage.
   b. AC Output current.
   c. Output Power
   d. Power factor.
   e. DC Input Voltage.
   f. DC Input Current.
   g. Time Active.
   h. Time disabled.
   i. Time Idle.
   j. Power produced
   k. Protective function limits (Viz-AC Over voltage, AC Under voltage, Over frequency, Under frequency ground fault, PV starting voltage, PV stopping voltage.

vi. All major parameters available on the digital bus and logging facility for energy auditing through the internal microprocessor and read on the digital front panel at any time) and logging facility (the current values, previous values for up to a month and the average values) should be made available for energy auditing through the internal microprocessor and should be read on the digital front panel.

vii. PV array energy production: Digital Energy Meters to log the actual value of AC/ DC voltage, Current & Energy generated by the PV system provided. Energy meter along with CT/PT should be of 0.5 accuracy class.

viii. Computerized DC String/Array monitoring and AC output monitoring shall be provided as part of the inverter and/or string/array combiner box or separately.

ix. String and array DC Voltage, Current and Power, Inverter AC output voltage and current (All 3 phases and lines), AC power (Active, Reactive and Apparent), Power Factor and AC energy (All 3 phases and cumulative) and frequency shall be monitored.

x. Computerized AC energy monitoring shall be in addition to the digital AC energy meter.

xi. The data shall be recorded in a common work sheet chronologically date wise. The data file shall be MS Excel compatible. The data shall be represented in both tabular and graphical form.

xii. All instantaneous data shall be shown on the computer screen.

xiii. Software shall be provided for USB download and analysis of DC and AC parametric data for individual plant.

xiv. Provision for instantaneous Internet monitoring and download of historical data shall be also incorporated.

xv. Remote Server and Software for centralized Internet monitoring system shall be also provided for download and analysis of cumulative data of all the plants and the data of the solar radiation and temperature monitoring system.
xvi. Ambient / Solar PV module back surface temperature shall be also monitored on continuous basis.
xvii. Simultaneous monitoring of DC and AC electrical voltage, current, power, energy and other data of the plant for correlation with solar and environment data shall be provided.
xviii. Remote Monitoring and data acquisition through Remote Monitoring System software at the owner / SECI location with latest software/hardware configuration and service connectivity for online / real time data monitoring / control complete to be supplied and operation and maintenance / control to be ensured by the bidder.
xix. The bidders shall be obligated to push real-time plant monitoring data on a specified intervals (say 15 minute) through open protocol at reciever location (cloud server) in XML/JSON format, preferably. Suitable provision in this regard will be intimated to the bidders.

TRANSFORMER “IF REQUIRED” & METERING:
a) Dry/oil type relevant kVA, 11kV/415V, 50 Hz Step up along with all protections, switchgears, Vacuum circuit breakers, cables etc. along with required civil work.
b) The bidirectional electronic energy meter (0.5 S class) shall be installed for the measurement of import/Export of energy.
c) The bidder must take approval/NOC from the Concerned DISCOM for the connectivity, technical feasibility, and synchronization of SPV plant with distribution network and submit the same to SECI before commissioning of SPV plant.
d) Reverse power relay shall be provided by bidder (if necessary), as per the local DISCOM requirement.

POWER CONSUMPTION:
a) Regarding the generated power consumption, priority need to give for internal consumption first and thereafter any excess power can be exported to grid. Finalization of tariff is not under the purview of SECI or MNRE. Decisions of appropriate authority like DISCOM, state regulator may be followed.

PROTECTIONS
The system should be provided with all necessary protections like earthing, Lightning, and grid islanding as follows:

1.LIGHTNING PROTECTION
a) The SPV power plants shall be provided with lightning &overvoltage protection. The main aim in this protection shall be to reduce the over voltage to a tolerable value before it reaches the PV or other sub system components. The source of over voltage can be lightning, atmosphere disturbances etc The entire space occupying the SPV array shall be suitably protected against Lightning by deploying required number of Lightning Arrestors. Lightning protection should be provided as per IEC 62305 standard. The protection against induced high-voltages shall be provided by the use of metal oxide varistors (MOVs) and suitable earthing such that induced transients find an alternate route to earth.

2.SURGE PROTECTION
a) Internal surge protection shall consist of three MOV type surge-arrestors connected from +ve and –ve terminals to earth (via Y arrangement).

3. **EARTHING PROTECTION**
   a) Each array structure of the PV yard should be grounded/earthed properly as per IS:3043-1987. In addition the lighting arrester/masts should also be earthed inside the array field. Earth Resistance shall be tested in presence of the representative of Department/SECI as and when required after earthing by calibrated earth tester. PCU, ACDB and DCDB should also be earthed properly.
   b) Earth resistance shall not be more than 5 ohms. It shall be ensured that all the earthing points are bonded together to make them at the same potential.

4. **GRID ISLANDING:**
   a) In the event of a power failure on the electric grid, it is required that any independent power-producing inverters attached to the grid turn off in a short period of time. This prevents the DC-to-AC inverters from continuing to feed power into small sections of the grid, known as “Islands.” Powered Islands present a risk to workers who may expect the area to be unpowered, and they may also damage grid-tied equipment. The Rooftop PV system shall be equipped with islanding protection. In addition to disconnection from the grid (due to islanding protection) disconnection due to under and over voltage conditions shall also be provided.
   b) A manual disconnect 4-pole isolation switch beside automatic disconnection to grid would have to be provided at utility end to isolate the grid connection by the utility personnel to carry out any maintenance. This switch shall be locked by the utility personnel.

**CABLES**
Cables of appropriate size to be used in the system shall have the following characteristics:

i. Shall meet IEC 60227/IS 694, IEC 60502/IS1554 standards
ii. Temp. Range: –10oC to +80oC.
iii. Voltage rating 660/1000V
iv. Excellent resistance to heat, cold, water, oil, abrasion, UV radiation
v. Flexible
vi. Sizes of cables between array interconnections, array to junction boxes, junction boxes to Inverter etc. shall be so selected to keep the voltage drop (power loss) of the entire solar system to the minimum (2%)

vii. For the DC cabling, XLPE or, XLPO insulated and sheathed, UV-stabilized single core multi-stranded flexible copper cables shall be used; Multi-core cables shall not be used.

viii. For the AC cabling, PVC or, XLPE insulated and PVC sheathed single or, multi-core multi-stranded flexible copper cables shall be used; Outdoor AC cables shall have a UV-stabilized outer sheath.

ix. The cables (as per IS) should be insulated with a special grade PVC compound formulated for outdoor use. Outer sheath of cables shall be electron beam cross-linked XLPO type and black in colour.

x. The DC cables from the SPV module array shall run through a UV-stabilized PVC conduit pipe of adequate diameter with a minimum wall thickness of 1.5mm.

xi. Cables and wires used for the interconnection of solar PV modules shall be provided with solar PV connectors (MC4) and couplers.
xii. All cables and conduit pipes shall be clamped to the rooftop, walls and ceilings with thermo-plastic clamps at intervals not exceeding 50 cm; the minimum DC cable size shall be 4.0 mm² copper; the minimum AC cable size shall be 4.0 mm² copper. In three phase systems, the size of the neutral wire size shall be equal to the size of the phase wires.

xiii. Cable Routing/ Marking: All cable/wires are to be routed in a GI cable tray and suitably tagged and marked with proper manner by good quality ferule or by other means so that the cable easily identified. In addition, cable drum no. / Batch no. to be embossed/ printed at every one meter.

xiv. Cable Jacket should also be electron beam cross-linked XLPO, flame retardant, UV resistant and black in colour.

xv. All cables and connectors for use for installation of solar field must be of solar grade which can withstand harsh environment conditions including High temperatures, UV radiation, rain, humidity, dirt, salt, burial and attack by moss and microbes for 25 years and voltages as per latest IEC standards. DC cables used from solar modules to array junction box shall be solar grade copper (Cu) with XLPO insulation and rated for 1.1kV as per relevant standards only.

xvi. The ratings given are approximate. Bidder to indicate size and length as per system design requirement. All the cables required for the plant shall be provided by the bidder. Any change in cabling sizes if desired by the bidder shall be approved after citing appropriate reasons. All cable schedules/ layout drawings shall be approved prior to installation.

xvii. Multi Strand, Annealed high conductivity copper conductor PVC type ‘A’ pressure extruded insulation or XLPE insulation. Overall PVC/XLPE insulation for UV protection Armoured cable for underground laying. All cable trays including covers to be provided. All cables conform to latest edition of IEC/ equivalent BIS Standards as specified below:

BoS item / component Standard Description Standard Number
Cables General Test and Measuring Methods, PVC/XLPE insulated cables for working Voltage up to and including 1100 V, UV resistant for outdoor installation IS /IEC 69947.

xviii. The total voltage drop on the cable segments from the solar PV modules to the solar grid inverter shall not exceed 2.0%.

xix. The total voltage drop on the cable segments from the solar grid inverter to the building distribution board shall not exceed 2.0%.

**CONNECTIVITY**

The maximum capacity for interconnection with the grid at a specific voltage level shall be as specified in the Distribution Code/Supply Code of the State and amended from time to time. Following criteria have been suggested for selection of voltage level in the distribution system for ready reference of the solar suppliers.

**Plant Capacity**

**Connecting voltage**

- Up to 10 kW
  - 240V-single phase or 415V-three phase at the option of the consumer
  - Above 10kW and up to 100 kW
  - 415V – three phase
Above 100kW
At HT/EHT level (11kV/33kV/66kV) as per DISCOM rules
a) The maximum permissible capacity for rooftop shall be 1 MW for a single net metering point.
b) Utilities may have voltage levels other than above, DISCOMS may be consulted before finalization of the voltage level and specification be made accordingly.
c) For large PV system (Above 100 kW) for commercial installation having large load, the solar power can be generated at low voltage levels and stepped up to 11 kV level through the step up transformer. The transformers and associated switchgear would require to be provided by the SPV bidders.

TOOLS & TACKLES AND SPARES:
a) After completion of installation & commissioning of the power plant, necessary tools & tackles are to be provided free of cost by the bidder for maintenance purpose. List of tools and tackles to be supplied by the bidder for approval of specifications and make from SECI/owner.
b) A list of requisite spares in case of PCU/inverter comprising of a set of control logic cards, IGBT driver cards etc. Junction Boxes. Fuses, MOVs / arrestors, MCCBs etc along with spare set of PV modules be indicated, which shall be supplied along with the equipment. A minimum set of spares shall be maintained in the plant itself for the entire period of warranty and Operation & Maintenance which upon its use shall be replenished.

DANGER BOARDS AND SIGNAGES:
a) Danger boards should be provided as and where necessary as per IE Act. /IE rules as amended up to date. Three signage shall be provided one each at battery –cum- control room, solar array area and main entry from administrative block. Text of the signage may be finalized in consultation with SECI/owner.

FIRE EXTINGUISHERS:
The firefighting system for the proposed power plant for fire protection shall be consisting of:
a) Portable fire extinguishers in the control room for fire caused by electrical short circuits
b) Sand buckets in the control room
c) The installation of Fire Extinguishers should confirm to TAC regulations and BIS standards. The fire extinguishers shall be provided in the control room housing PCUs as well as on the Roof or site where the PV arrays have been installed.

DRAWINGS & MANUALS:
a) Two sets of Engineering, electrical drawings and Installation and O&M manuals are to be supplied. Bidders shall provide complete technical data sheets for each equipment giving details of the specifications along with make/makes in their bid along with basic design of the power plant and power evacuation, synchronization along with protection equipment.
b) Approved ISI and reputed makes for equipment be used.
c) For complete electro-mechanical works, bidders shall supply complete design, details and drawings for approval to SECI/owners before progressing with the installation work

PLANNING AND DESIGNING:
a) The bidder should carry out Shadow Analysis at the site and accordingly design strings & arrays layout considering optimal usage of space, material and labour. The bidder should
submit the array layout drawings along with Shadow Analysis Report to SECI/Owner for approval.
b) SECI reserves the right to modify the landscaping design, Layout and specification of sub-systems and components at any stage as per local site conditions/requirements.
c) The bidder shall submit preliminary drawing for approval & based on any modification or recommendation, if any. The bidder submit three sets and soft copy in CD of final drawing for formal approval to proceed with construction work.

**DRAWINGS TO BE FURNISHED BY BIDDER AFTER AWARD OF CONTRACT**
a) The Contractor shall furnish the following drawings Award/Intent and obtain approval
b) General arrangement and dimensioned layout
c) Schematic drawing showing the requirement of SV panel, Power conditioning Unit(s)/inverter, Junction Boxes, AC and DC Distribution Boards, meters etc.
d) Structural drawing along with foundation details for the structure.
e) Itemized bill of material for complete SV plant covering all the components and associated accessories.
f) Layout of solar Power Array
g) Shadow analysis of the roof

**SOLAR PV SYSTEM ON THE ROOFTOP FOR MEETING THE ANNUAL ENERGY REQUIREMENT**
The Solar PV system on the rooftop of the selected buildings will be installed for meeting upto 90% of the annual energy requirements depending upon the area of rooftop available and the remaining energy requirement of the office buildings will be met by drawing power from grid at commercial tariff of DISCOMs.

**SAFETY MEASURES:**
The bidder shall take entire responsibility for electrical safety of the installation(s) including connectivity with the grid and follow all the safety rules & regulations applicable as per Electricity Act, 2003 and CEA guidelines etc.

**DISPLAY BOARD**
The bidder has to display a board at the project site (above 25 kWp) mentioning the following:
a. Plant Name, Capacity, Location, Type of Renewable Energy plant (Like solar wind etc.), Date of commissioning, details of tie-up with transmission and distribution companies, Power generation and Export FY wise.
b. Financial Assistance details from SECI/MNRE/Any other financial institution apart from loan. This information shall not be limited to project site but also be displayed at site offices/head quarter offices of the successful bidder
c. The size and type of board and display shall be approved by Engineer-in-charge before site inspection.
OTHERS:

1. Agency to be deployed for commissioning for solar panel system shall be registered with MNRE.
2. All the equipments like PV panels, inverter grid tile shall be of MNRE approved make.
3. The agency shall be responsible to obtain NOC from Govt for arranging/processing subsidies from the considered department.
4. The agency shall be responsible for designing of system with maximum efficiency, reliability and equipped with advanced monitoring system, control alarm, safety fixture and remote monitoring display.
5. The agency shall provide O & M of the system at least for 1 year for free of cost.
6. The agency shall provide guarantee/warrantee certificate of the system at least for 25 years.
7. The agency shall provide necessary junction boxes to be mounted to undertake parallel strings of modules to collect maximum power from the modules and transfer to the inverters.

PART-6 TECHNICAL SPECIFICATION FOR SEWAGE TREATMENT PLANT

Process Description

The Sewage during plant operation will be passed through the ss-304 screen chamber to remove the floating material like Plythen, leaves etc. The effluent generated during plant operation will be passed through oil & grease tank & go to by gravity in equalization. The equalization tank will be provided to take care of the batch discharges & sludge loadings. The equalization tank will be equipped with a diffused aeration system comprising of perforated pipe grid & air blower assembly. Air will be purged to uniformly mix the contents & avoid settling of solids in this tank and also to mention aerobic conditions in the tank. The Sewage water goes to FAB tank by Pump.

Biological Treatment

We are offering the system, which is a latest technology based on FAB (Fluidized Aerobic Bio Reactor) for the treatment of wastewater.

The FAB reactor incorporates the advantage of fixed film technologies & combined with them the fine bubble diffused aeration techniques to get a high efficiency biological treatment Unit.
The treatment is consisting of a signal stage biological treatment system. The biological treatment units the biodegradable organic matter represented by biochemical Oxygen demand (BOD) is converted to simpler products by microorganisms (mainly bacteria) in presence of oxygen.

The waste water from the primary clarifier come to by gravity in to an aeration tank where it will be mix with living organisms also called MLSS (Mixed Liquor Suspended Solids) in presence of air & air shall be introduced through submerged air diffusers (MLSS in aeration tank shall be maintained 3000-4000 mg/l). The aeration system shall be designed in a way so as to achieve complete mixing of organisms with waste water. From the aeration tank this mixed liquor passes into the secondary clarifier through the use of baffles the liquid in the clarifier tank is maintained in quiescent condition which allows the solids to settle the bottom for collection. The accumulating solids known as “sludge” shall be constantly pumped back in to the aeration tank by sludge recirculation pump. This return sludge undergoes further digestion in the aeration tank & also provides the active organism needed to digest the incoming raw effluent.

The clarifier shall be provided with adjustable overflow weir to collect the treated effluent & a scum baffle shall keep any floating matter from passing out in the final treated water. The treated water from secondary clarifier shall over flow into a baffled chlorine contact tank where hypochlorite solution shall be added to disinfect the treated water. Excess sludge from the bottom of the clarifier shall be wasted in sludge Bed/ Filter press/ centrifuge

**Filtration**

The effluents will then be passed though a dual media filter & activated carbon filter to remove the color, suspended solids.

**SECONDARY CLARIFICATION**

Treated effluent from the Aeration tank to secondary clarifier by pump into required dia Pipes go into Clarifiers. Because of mixing Provided in aeration tank, the aerobic bacterial flocks are uniformly dispersed in the tank liquid. However, in the clarifier, quiescent settling conditions are provided and bacterial flocs bio flocculate and settle down as a sludge blanket at the bottom of the clarifier. The Clear water collects the supernatant sump. From the clarifiers, settled sludge is carried by gravity to a recycle the sludge to aeration tank to maintain the desire concentration of MLSS in the aeration tank and the excess sludge in the sludge holding tank then feed to filter press by screw pump.

**Air Blower**
These can be high speed roots blower is causes transfer of oxygen from the atmosphere into the water.

**Diffuser**
In this system the air is diffused into the aeration tank through diffusers located over the full floor area of the reactor. The air is supplied through air blower. This diffusion of air also causes full mixing of the tank contents.

**Diffuser Performance:** The efficiency of oxygen transfer depends upon the type and porosity of the diffuser, the size of the bubbles produced, the depth of submergence, and other factors, such as oxygen concentration in the tank. While coarse bubble diffusion systems and aerator systems have oxygen transfer rates that are comparable, the fine bubble diffusion systems offer oxygen transfer rates which are nearly twice that of the coarse bubble and surface aerator rates. This higher efficiency is achieved at the cost of a higher initial investment.

### CLIENT SCOPE

1. **SCREEN CHEMBER**
   - **Sizes**
     - Length: 800MM
     - Width: 600 MM
     - Depth: 800 MM
     - Nos. of Tank: 1 Nos.
     - MOC: RCC/ Brick Masonry
     - MAKE BY: CLIENT

2. **OIL & GREASE TRAP**
   - **Sizes**
     - Length: 1000MM
     - Width: 800 MM
     - Depth: 1000 MM
     - Nos. of Tank: 1 Nos.
     - MOC: RCC/ Brick Masonry
     - MAKE BY: CLIENT

3. **EQUALIZATIONS TANK**
   - **Capacity:** 10 KL/day
   - **Length:** 1.5 mtr.
   - **Width:** 1.5 mtr.
   - **Depth:** 2.5 mtr.
   - **Nos. of Tank:** 1 No.
4. TREATED WATER STORAGE TANK

Capacity - 10 KL/day
Length - 1.5 mtr.
Width - 2 mtr.
Depth - 2.5 mtr.
Nos. of Tank - 1 No.
MOC - RCC / Brick Masonry
MAKE BY- CLIENT

5. Foundation for Mechanical Equipment

As Req.

SCOPE OF SUPPLY ELECTRO-MACHNICAL EQUIPMENT

1. FAB REACTOR TANK

Capacity - 10 KL/day
Length - 0.8 mtr.
Width - 1 mtr.
Depth - 2.5 mtr.
Nos. of Tank - 2 Nos.
MOC - MSEP
MAKE BY- SWSPL

6. TUBE SETTELR TANK

Capacity - 10 KL/day
Length - 0.8 mtr.
Width - 1 mtr.
Depth - 2.5 mtr.
Nos. of Tank - 1 Nos.
MOC - MSEP
MAKE BY- SWSPL

7. CHLORINE CONTACT TANK

Capacity - 10 KL/day
Length - 1 mtr.
Width - 1 mtr.
8. **SLUDGE HOLDING TANK**

- **Capacity:** 10 KL/day
- **Length:** 1 mtr.
- **Width:** 1 mtr.
- **Depth:** 2.5 mtr.
- **Nos. of Tank:** 1 No.
- **MOC:** MSEP
- **MAKE BY:** SWSPL

1. **Bar Screen**

   - **Size:** 300 x 500 mm
   - **MOC:** SS-304
   - **Opening:** 10 mm
   - **No. of units:** 1 No.
   - **SCOPE:** SWSPL

2. **EFFLUENT TRANSFER PUMP**

   - **Capacity discharges:** 0.5 m³/Hrs.
   - **Head:** 10-12 mtr.
   - **Solid Handling:** 32 mm
   - **No. of units:** 2 Nos. (1w+1S)
3. **AIR BLOWER**

- **Capacity discharges**: 15 m³/Hrs.
- **Head**: 0.50 kg/cm²
- **HP**: 2
- **No. of units**: 2 Nos. (1w+1S)
- **Make**: Blowvacc/βeta/EQV,

**SCOPE**
- **SWSPL**

4. **FAB MEDIA**

- **Qty**: One Lot
- **MOC**: PVC
- **Make**: Cooldeck/PP aquateck/Equivalent

5. **TUBE MEDIA**

- **Qty**: One Lot
- **MOC**: PVC
- **Make**: Cooldeck/PP aquateck/Equivalent

6. **SLUDGE TRANSFER PUMP**

- **Duty**: To transfer the waste water
- **Capacity discharges**: 0.5 m³/hrs.
- **Head**: 10 – 12 mtr.
7. **FILTER FEED PUMP**

   **Duty**
   To transfer the waste water

   **Capacity discharges**
   1 m$^3$/hrs.

   **Head**
   28 mtr.

   **No. of units**
   2 Nos.

   **Make**
   Kirloskar /KSB / EQV.

   **SCOPE**
   SWSPL

8. **TREATED WATER PUMP**

   **Duty**
   To transfer the waste water

   **Capacity discharges**
   2 m$^3$/hrs.

   **Head**
   15 mtr.

   **No. of units**
   2 Nos.

   **Make**
   Kirloskar /KSB / EQV.

   **SCOPE**
   SWSPL

9. **CHLORIN DOSING PUMP**

   **Discharge**
   0-6 LPH

   **Make**
   E-DOSE/Aventura/Eqv
MOC: \text{STANDRED}

No of units: One

\textbf{SCOPE}: SWSPL

10. \textbf{CHEMICAL DOSING TANK}

Capacity: 100 Liters

Make: SINTEX/EQV.

No. of Tank: ONE

\textbf{SCOPE}: SWSPL

11. \textbf{SAND FILTER}

\textbf{Size}

Dia: - 1354

Flow: - 1 m$^3$/hrs.

MOC: - FRP

Nos. of filter: - 1 No.

\textbf{MAKE}: SWSPL

12. \textbf{ACTIVATED CARBON FILTER}

\textbf{Size}

Dia: - 1354

Flow: - 1 m$^3$/hrs.

MOC: - FRP

Nos. of filter: - 1 No.

\textbf{MAKE}: SWSPL

13. \textbf{SCREW PUMP}

\textbf{Size}

- 0.5 m$^3$/hrs.
14. FILTER PRESS

Size - 12” x 12” x 12 plat
MOC - MS+PP
Make - farmatech/Eqv.

15. INSTRUMENTATION

Level Switches
Make - Track/Radar/eqv.

Pressure gauge
Range - 0-7 bar
Dail size - 4 inches
Type - bourdon
Make - H-Guru/Pricol

16. INTERCONNECTING PIPE

Qty - 1 Lot
MOC - uPVC/ MS/G.I.
Make - Jindal/Princ/Astral/EQV.

17. BUTTERFLY/BALL VALVES

Qty - 1 Lot
MOC - C.I.
Make - CRI/Audco/Zoloto/Koro

18. ELECTRICAL PANEL

MCC PANEL- Panel consist of incoming MCCB with ammeter with selector switch , ct , voltmeter with selector switch, indicating lamps & outgoing starter shall be with fuse switch units , DOL starter, including bi metal relay control, OFF push button, indicating lamps etc,

*Local control push buttons consisting of on/off with power & control cable included cable termination.

*Soft water Testing & commissioning.

Scope- SWSPL
SWSPLENGG. SCOPE OF SUPPLY (STP Plant - 1No. 10 KLD One Unit)
1. MSEP Fabricated STP Tank with FAB, Tube Settler, Chlorine contact tank and Sludge Holding Tank.

2. Bar Screen- SS-304 = 1 No.

3. Inlet pump submersible type = 2 Nos.


5. FAB Media = One Lot

6. TUBE deck Media = One Lot

7. Sludge pump = 2 No.

8. Filter Feed pump = 2 Nos.

9. Treated Water pump = 2 Nos.

10. Chlorine Dosing Pump = 1 No

11. Chlorine Dosing Tank (HDPE) = 1 No

12. Sand Filter (FRP) = 1No.

13. Activated Carbon filter (FRP) = 1 No

14. Screw pump = 1 Nos.

15. Filter Press (PP/MS) = 1 No.

16. Instrumentation = 1 Lot.

17. Pipeline & accessories = 1 Lot

18. Butterfly valav/Membrane type Diffuser = 1 Lot

19. Electrical Panel with Cabling = 1 Job

20. Erection of Mechanical equipment at site = 1 Job

21. Training to your personnel operator for 2-3 day’s period of In pertaining the plant.
TERMS & CONDITIONS:

1) SCOPE OF WORK:

a. Design of the Sewage Treatment Plant.
b. Supply of Equipments as outlined above.
c. Erection & Commissioning of the entire plant.
d. Electrical work as related to STP works.

2) EXCLUSION:

1. All civil works of laboratory, MCC room, chemical house, storeroom, green belts, etc.
2. Construction roads inside the plant and approach roads.
3. Construction of fencing to the plant.
4. Supply of all types of laboratory equipments.
5. Plants and area illumination.
6. Air conditioning/ventilation system/exhaust fans from plant buildings.
7. Emergency power supply and illumination system.
8. All piping beyond the termination points shown in our P&I diagram.
10. Lightening protection.
11. Commissioning consumables, chemicals, etc.
12. Water sampling and testing charges shall be charged extra.
13. Charges for approval from local Pollution Control Board shall be extra.
14. Crane charges Extra, If Required

3) Site facilities:

a. Electricity/Water/Lighting supply to the Plant Room.
b. Unskilled manpower as & when required

PART-7 TECHNICAL SPECIFICATION FOR EFFLUENT TREATMENT PLANT (ETP)

INTRODUCTION:

This specification covers the minimum requirements for the design, engineering, material procurement, civil construction, fabrication, painting, assembly, Inspection, supply, shipment, erection and commissioning of Effluent Treatment Package (ETP)

The Vendor shall be responsible for the design, engineering, construction, fabrication, assembly, inspection, co-ordination, testing, delivery and proper performance of the ETP.

The Vendor shall ensure that the design complies with the requirements of this requisition and its referenced specifications and standards. The data sheets, which form part of this specification, shall be completed by the Vendor. The Vendor shall highlight any noncompliance at the offer stage in the Table of Compliance, Appendix D. The Table of Compliance and filled in data sheets shall form a part of the offer. Not providing completed compliance table and data sheets can cause rejection of the offer. Failure to clearly identify specific deviations shall be assumed by the Purchaser to be total compliance with the requisition.

Only those deviations that are specifically agreed to, by the Purchaser prior to award of the order will be incorporated into the purchase order. Deviations to the specification will not be allowed after award of order. Unless referred to in the Table of Compliance (Appendix D), it will be assumed that all specifications are adhered to and that they do not have implications with respect to cost, delivery and integrity of the equipment.

The Vendor shall procure third party material from vendors listed in the approved Vendor List only, unless the particular type of material is not covered by the list, and a special dispensation to deviate from the list has been granted in writing by the Purchaser. Company will reject any materials found at any stage to be out of the approved VENDOR or sub Vendor list.

Note that “lead times” will not be considered by the COMPANY as a justifiable reason for using alternate VENDOR.

This requisition shall in no way relieve the Vendor from final guarantee as to materials, apparatus, workmanship and performance of the equipment and services supplied.

All correspondence and documentation shall be in English. All measurements and units shall be in SI units. Where necessary for a specific application, alternative units may be indicated in brackets behind the SI units.

The VENDOR shall guarantee the equipment and all component parts against defective workmanship and improper materials for the agreed period following the date of delivery of the equipment or from commencement of operation as agreed. The VENDOR shall replace or repair (the carrying out of all work including uncovering, removal, procurement and reinstallation and construction as may be necessary) the components that are defective at their own cost during the guarantee period at a suitable time to the COMPANY. Guarantee period shall be as per the Contract and to be covered in commercial documentation.
SCOPE OF SUPPLY

Process Description The waste water effluent shall be subjected to physio-chemical treatment so that the treated effluent shall meet the stipulations laid down by the Central Pollution Control Board.

The following steps shall form the process of treatment:

a) The untreated effluent from various locations like Cylinder washing, Water test bath, Hydrotesting, soap water trays, etc of the LPG terminal shall reach the ETP through surface drains by HDPE pipes, after passing through vapour seals. The effluent generated by these streams shall be approx. 6 m³/day.

b) The caustic soda stream from the paint booth in the cylinder testing shed is neutralized with 10% Sulphuric acid in the Neutralization tank. The Transfer pumps shall also be used for mixing acid in the caustic by recirculation. Once the pH in the range of 7.5 to 8.5 is sensed by the pH meter, the recirculation will be stopped and effluent is pumped to main ETP through Pressure Sand Filter (PSF). The quantity of effluent generated by this stream is 2000 litres/day. Provision for backwash with service water shall be provided to the pressure sand filter.

c) The water requirement for the cylinder degassing is 50m³/day (1000 cylinders degassed per day). At a time not more than 6 cylinders are degassed at a time i.e. the water requirement per batch is approximately 300 liters. This water is pumped from the underground tank (5 m³ capacity) to the empty cylinder degassing via filter. After degassing the water is recycled back to the underground tank and reused. The underground water is replenished by a continuous supply of service water at the rate of 250 litres/hour. The overflow from the underground tank is taken to main ETP by surface drain, which is approximately 2 m³/day.

d) The main ETP shall be designed to treat 10 m³ of effluent generated in 8 hours shift from all sources listed from (a) to (c) above.

(i) After passing through the bar screen, all free floating matters in the effluent stream including the oil and grease shall be collected in the oil and grease trap. This collected oil and grease is removed manually by hand-rack from time to time.

(ii) The effluent, after passing through the Oil and grease trap, is collected in the underground equalization tank after passing through the coarse and fine screens to arrest the larger and smaller particles respectively.

(iii) The effluent is made homogeneous in the equalization tank. Homogeneous effluent from the equalization tank is pumped to the reaction tank.

(iv) In the reaction tank, agitator shall be provided for mixing the dosing chemicals with the effluent. The chemical dosing results in the precipitation, which entraps the colloidal things thus results in the removal of dissolved matter. The conversion of micro flocs into macro flocs is facilitated by the addition of poly-electrolyte dosing in the reaction tank.

(v) From reaction tank, the effluent overflows to the settling tank. Here the macro flocs settle down as the chemical sludge. The Backwash water of the Pressure Sand Filter (Cylinder wash Area) and Dual Media Filter is also collected in the settling tank for further treatment.

(vi) The effluent from the settling tank overflows to the buffer tank.
(vii) From the buffer tank, the effluent is pumped and discharged through a dual media filter. The treated water shall be sent for horticulture purpose to the nearby green belt.

(viii) The sludge collected at the bottom of the settling tank is taken to the sludge drying beds for drying. After drying, the dried sludge cake is removed manually from the sludge drying beds. These filled bags are to be stored in the covered hazardous waste pit.

(ix) Vendor can propose an alternate scheme to minimize total hardware required, if possible, as an option to the basic scheme. The Vendor shall make every effort to optimize the scheme.

e) Vendor shall carry out the Hazardous Area Classification for the proposed ETP and shall ensure the instruments and electrical components suitable for the Area Classification, as per IS: 5572 (1994).

f) Vendor to note that the control panel shall be located in a safe area near the ETP. All the signals required to monitor the operation of the plant shall be repeated and made available to be connected by others, though a serial link (soft signals) to the central control panel. Necessary interface to connect the above cables shall be provided by the control panel vendor.

EQUIPMENT AND MATERIALS

Scope of supply of Effluent Treatment Plant shall include but not necessarily be limited to following. Any additional equipment required to achieve treated water quality shall be included by the Vendor in their scope of supply and shall mention the details of the same in the bid document.

A. Equipments and Materials for ETP section of Cylinder washing area.

• Dilution tank suitable for diluting H2SO4 to 10% from 98%. Preferable Material of construction is CS tank with lead lining or PTFE lining. Diaphragm dosing Pumps (1W+1S) with FLP motors, pulsation dampner, Piping and Valves for dosing 10% H2SO4 in the neutralizing tank. The tank and Dosing Pumps shall be skid mounted with to facilitate quick erection & interconnection at site.

• Neutralizing tank of 3 m3 capacity for collection of effluent with caustic soda.

• Pressure Sand filter complete with frontal Piping, Valves, Media, Interconnecting Piping and Internals. Filter design shall be as per ASME Section VIII Div. I, latest edition.

• Filter feed/ Transfer Pumps with FLP Motors (1W+1S) mounted on common base plate complete with flexible spacer type couplings, non-sparking coupling guards, suction and discharge piping and valves. The head of this pump shall be sufficient to transfer neutralised and filtered water to Main ETP.

• All Civil work (excluding Piling), Interconnecting Piping & Pipe supports, Ladders, Crossovers, Power cabling, Control Cabling, Instrumentation, Earthing, etc. within this ETP area and interconnection with main ETP.

B. EQUIPMENTS AND MATERIALS FOR ETP SECTION OF DEGASSING SHED.

• Underground storage sump for water storage of 5 m3 capacity. With suitable overflow arrangement for transfer of water to main ETP.
• Water transfer pumps of capacity 10 m³/hr with FLP Motors (1W+1S) mounted on common base plate complete with flexible spacer type couplings, non-sparking coupling guards, suction and discharge piping and valves. The head of this pump shall be sufficient to transfer water from pit up to empty cylinder filling via filter.

• Filter (Basket type or Cartridge) to remove suspended particles from the water being filled in empty cylinders for degassing.

• All Civil work (excluding Piling), Interconnecting Piping & Pipe supports, Ladders, Crossovers, Power cabling, Control Cabling, Instrumentation, Earthing, etc. within this ETP area and interconnection with main ETP.

• A Rotameter that will ensure continuous flow of 0.25 m³/hr to the underground storage sump.

C. EQUIPMENTS AND MATERIALS FOR MAIN ETP.

• Bar Screen at the inlet Oil and Grease trap.

• Design and Construction of Oil & Grease Trap, Equalisation tank, Reaction tank, Dosing Tanks, Settling tank, Buffer tank, Treated water tank, Sludge drying beds and Hazardous waste pit.

• Effluent transfer pumps with FLP motors (1W+1S) mounted on common base plate complete with flexible spacer type couplings, non-sparking coupling guards, suction and discharge piping with valves. These pumps are for transfer of equalised effluent from equalisation tank to reaction tank. The Effluent flows by gravity from reaction tank to Settling tank to Buffer tank.

• Filter Feed Pumps with FLP Motors (1W+1S) mounted on common base plate complete with flexible spacer type couplings, non-sparking coupling guards, suction and discharge piping and valves. Suction of these pumps shall be taken from Buffer tank.

• Dual Media filter complete with frontal Piping, Valves, Media, Interconnecting Piping and Internals.

Filter Backwash Pumps with FLP Motors (1W+1S) mounted on common base plate complete with flexible spacer type couplings, non-sparking coupling guards, suction and discharge piping and valves. Suction of backwash pump shall be taken from Treated water tank.

• Treated Water Pumps for Gardening with FLP Motors (1W+1S) mounted on common base plate complete with flexible spacer type couplings, non-sparking coupling guards, suction and discharge piping and valves. The discharge pressure of the pump shall be 5 kg/cm².

• Complete Civil design and Construction of Sumps, Pits, Equipment foundations and Control room. Piling for Pits & foundations, as required, by others.

• All necessary interconnecting piping/tubing and valves within the battery limit of the package.

• Purchaser will provide one point Instrument air supply within battery limit. Vendor to provide the estimated Instrument Air Supply requirement.

• Instrumentation as required complete with control panel for control and monitoring the quality of treated water.
• Motor Control Centre (MCC), Local Control Panel, Supply of cables within the battery limit and termination in the control panel/ MCC located in safe area near the ETP Purchaser shall provide one point power supply in the MCC Incomer.

• Interfacing with the ETP of cylinder washing area & ETP of degassing shed including required piping, cables, civil works etc.

D. EQUIPMENTS AND MATERIALS COMMON FOR ALL ETP AREAS AND MAIN ETP.

• Lifting & Earthing lugs for packaged unit, Vessels and Pump sets.

• Anchor bolts, fixing bolts, jack screw bolts, shims, etc.

• First fill of lubricants to be supplied separately along with the pump sets.

• Commissioning & Start-up Spares.

• Spares for two years trouble free operation. Vendor to furnish the list for the same.

• Inspection and testing as specified.

• Submission of documents as specified in this document.

• Painting, preservation, preparation for shipment and delivery at site.

• Special tools if required (Bidder to provide list in the bid).

• Construction, Installation & Commissioning.

ENGINEERING SERVICES
The Vendor shall provide engineering services, which shall include, but not necessarily be limited to, the following:

• Providing/Coordinating detailed design of all equipment and components within the scope of supply.

• Preparing Civil foundation design and drawings for construction at site.

• Resolving engineering queries related to the equipment and components within the scope of supply.

• Performing and coordinating all aspects of design.

• Providing progress reports etc.

• Providing expediting services for all sub-vendors.

• Providing quality assurance including all sub-vendors with respect to ISO 9000 or equivalent.

• Erection & Commissioning to be quoted separately.

• Attendance of kick-off meetings, coordination meetings, Design reviews meetings in the Consultant’s/Purchaser’s office.
• Resolve/incorporate all action points from Design reviews, HAZOP, etc.

• Any technical document if required by Purchaser for statutory approval shall be furnished by vendor.

EXCLUSIONS
The following are excluded from the Vendor's scope and will be provided by others:

• Piping/ trenches up to collection tank and beyond the outlet nozzle of last equipment in the treatment scheme.

• Service water will be provided for Backwash of Pressure Sand Filters in the Cylinder Washing Area at one point.

• Interconnecting power cabling and cable trays to vendor supplied MCC of ETP and Purchaser’s PMCC.

• Instrument air connection piping up to battery limit.

• Cable between Vendor’s Control panel and Purchaser’s Control room. • Piling required for Pits & Equipment foundations.

PART-8 TECHNICAL SPECIFICATION FOR WATER TREATMENT PLANT (WTP)

SCOPE OF WORK
This specification covers the design, fabrication and installation of a combination reverse osmosis/electrode ionization system at ALIMCO KANPUR. Every effort will also be made to minimize waste and recover all wastes economically recoverable.

GENERAL REQUIREMENTS
The water treatment system shall be capable of treating station raw water to produce 86,400 gallons per day net output of demineralized water in accordance with the conditions of service, required performance, materials and construction stated in this specification.

The water treatment system shall consist of a pre-treatment section, reverse osmosis (RO) section and a post-treatment section. The pre-treatment section will condition the water before it goes into the RO section. The pre-treatment section shall include filtration and de-chlorination, softening and ultraviolet
sterilization. Softening equipment shall include a saturation tank and regeneration facilities. Booster pumps in the pre-treatment section will supply the necessary pressure to drive water through the RO elements and the post-treatment equipment.

The RO section shall be divided into two 100% capacity trains. Each train shall have a minimum of two-stages in which Concentrate water from the first stage feeds the second stage.

The post-treatment system will remove the remaining dissolved solids. It will consist of one membrane based degasifies and two electrode mineralizers which will treat the water to boiler make-up water specifications.

WORK FURNISHED BY SUPPLIER
The major items of equipment furnished by the Supplier shall include, but not be limited to the following:

A. Two 100% activated carbon/multimedia filters (capable of flowing 100% when the second unit is in backwash), two 100% sodium cycle softeners, two 100% 5µ cartridge filters, one 100% ultraviolet sterilizer, two booster pumps, two 100% reverse osmosis trains, piping to and from one 100% membrane degasifies and to and from two 100% electrode mineralizers and along with connections and piping into demineralized water storage tanks (Condensate tanks).

Pumps for backwashing softeners and filters using Reclaim water tank shall also be provided.

B. Regeneration equipment for softeners.

C. Local and CRT based controls and instrumentation as required for the automatic and/or manual operation of the water treatment system in accordance of this specification.

D. Integral and interconnecting piping, valves and fittings within the limits as specified

E. Technical Services Representative, Construction Manager and Startup Engineer.

F. Labor for unloading, handing and erection of all apparatus at the jobsite.

G. Concrete foundations, trenches, sumps and anchor bolts as required.

H. Piping and controls to reclaim storage tank for water reuse.

I. Interface electrical wiring, conduit, grounding and connections between the skids and from skids to the control board.

J. Motor starters for all motors with local MCC for system isolation.
K. Piping, valves and fittings within Supplier’s terminal limits specified

L. All pneumatic lines with Supplier-furnished control panel.

M. A concrete building or buildings to house control panel, pretreatment and post-treatment equipment and suitable to withstand wind from typhoons.

N. 120 V AC single phases and 480 V AC three-phase power source for control and motors, respectively.

O. Brine saturator tank and brine pumps.

P. CS+FRP Lining Reclaim water tank for reclaiming RO reject and rinse water.

Q. The space for a small Chemical Lab. Inside building which as used to perform manual analysis for quality control.

CONDITIONS OF SERVICE – PROCESS DESIGN

Capacity

A. There are two trains reverse osmosis/EDI water treatment system, each Train shall have the capacity to deliver a net output per day, the two Trains Alternate operation of the water quality.

B. The net output of the water treatment system is defined as the amount of demineralized water actually available for make-up use and excludes water discharged to waste during the normal operation of equipment or used for backwashing filters or softeners.

C. Each softener bed shall have sufficient ion exchange material to operate at least for 24 hours continuously before requiring regeneration.

PRETREATMENT EFFLUENT REQUIREMENTS

D. The effluent from the pretreatment section of the water treatment system shall be designed to produce a silt density index (SDI) of 3 or less, using an elapsed time of 15 minutes.

E. The effluent from the pretreatment section of the Apparatus shall have the following properties.

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Cl₂</td>
<td>Less than 0.02 ppm</td>
</tr>
<tr>
<td>Total Hardness</td>
<td>Less than 0.5 ppm as CaCO₃</td>
</tr>
</tbody>
</table>

REVERSE OSMOSIS MODULES

The reverse osmosis system shall reduce the feedwater conductivity by at least 98% and reduce the feedwater silica by 99% operation.
MEMBRANE CLEANING AND CHEMICAL DOSING

F. Membrane Clean-In-Pace (CIP) system
Contractor shall provide an individual and removable Clean-In-Place (CIP) skid for Reverse Osmosis membrane cleaning/disinfection purposes. Portable skid design shall consist of control/monitor panel (switches and indicating lamps for main power, motor starter and tank immersion heater etc. are panel mounted) with extension lead power supply cable, pre-piped and pre-wired free-standing and open-top 250 gallons FRP cleaning solution preparation/storage tank, 316 stainless steel single-stage centrifugal transfer pump, immersion heater, flowmeter, pH meter, thermometer, CIP inlet/outlet quick connections, isolation valves, CIP outlet cartridge filter (25-micron), and provide quick connected transfer hoses for the system demands.

The RO machine shall be provided with equipped (pre-piped) to perform a periodic cleaning of the RO membrane elements in order to restore lost product flow and/or product quality. The cleaning process shall be performed manually with the membranes remaining in the housings and the RO machine shutdown. The cleaning solution shall be re-circulated through the RO membranes via CIP. And the RO machine shall be equipped with CIP inlet/outlet isolation valves and quick connect cleaning connections.

The EDI machine shall be equipped with CIP inlet/outlet isolation valves and quick connect cleaning connections, to perform cleaning in order to restore lost product flow and/or product quality.

G. CHEMICAL DOSING SYSTEMS
Contractor shall provide each RO train with two chemical injection systems, one for membrane fouling prevention and pH adjustment the other one for membrane scaling prevention.

For membrane fouling prevention and pH adjustment, injection of chemical liquid shall be provided. The injection system shall consist of an electronic positive displacement metering pump with PVC wetted parts, 35-gallon polyethylene day solution tank, electric solution mixer, liquid level switch, and foot valve. The pump is to be field-wired to the RO control panel to prevent the dosage of chemical during a machine shutdown or placed in stand-by. A status alarm shall be added to the control system during low chemical tank level.

For membrane scaling prevention, injection of anti-scalant shall be provided. The injection system shall consist of an electronic positive displacement metering pump with PVC wetted parts, polyethylene day solution tank, electric solution mixer, liquid level switch, and foot valve. The pump is to be field-wired to the RO control panel to prevent the dosage of chemical during a machine shutdown or placed in stand-by. A status alarm shall be added to the control system during low chemical tank level.
POST-TREATMENT

H. The post-treatment section shall consist of membrane base degasifies for carbon dioxide removal and electrode ionization equipment’s.

I. The outlet pressure after the electrode ionizers (EDI) shall be at least 60 psig.

J. The electrode mineralizers shall polish the water to the specifications. Electrode mineralizers shall be operated at over 90% recovery. Supplier shall provide sufficient controls to allow each EDI train to be operated over the flows specified with minimal operator adjustments.

EFFLUENT QUALITY FROM ELECTRODE IONIZATION

K. The Electro ionization Units, when operating at the warranted rates of flow, shall reduce constituents in the effluent to the following acceptable values:

- Conductivity: 0.08 μS/cm @ 25°C
- Silica (as SiO2): <10 ppb

L. Test methods used to determine the performance of the unit shall be as follows:

- Test: ASTM Method
- Silica: D 859 Referee Method B
- Conductivity: D 1125

OPERATING CONDITIONS

Apparatus shall be installed indoors in a supplier furnished building, except for the brine and reclaim systems.

Equipment installed outdoors may be exposed to rain, high winds (including typhoons), blowing sand, salt mist or spray and ambient temperatures of 50 to 105°F.

DESIGN AND FABRICATION

R. The Supplier shall provide detail design control wire diagram, Layout, flow diagram including specify manufacturing and Model of all instruments, controller, Pumps, RO section needs to show detail flow from one vessel to another vessel in each stage, etc. for GPA/TEMES Review within two months from award of the contract.

S. The Supplier shall furnish the pretreatment equipment, reverse osmosis
modules and pumps, and softener regenerate equipment assembled and mounted on skids for ease of installation.

T. The Supplier shall complete the electrical wiring on the skids and complete the necessary interconnections among the controls, instrumentation and to the terminal boxes. Instrument wiring shall not run through conduit with power wiring. Terminal boxes and conduit shall be dust-tight, weather-tight, and corrosion resistant.

ACTIVATED CARBON/MULTIMEDIA FILTERS

A. The activated carbon/multimedia filters shall be designed for the dual function of chlorine removal and suspended solids reduction.

B. Each activated carbon/multimedia filter shall have sufficient freeboard height to permit bed expansion of 50 percent. Freeboard provided shall be based on total volume of media; activated carbon, quartz and garnet.

C. Each activated carbon/multimedia filter shall be provided with vent valving at the highest point and a drain connection at the lowest point.

D. Each activated carbon/multimedia filter shall have an 3 inch by 12 inch observation window centered at the top of the settled media bed.

E. The internal systems and components for each tank shall be constructed of 316L stainless steel.

F. Each activated carbon/multimedia filter tank shall have a neoprene rubber lining throughout.

G. Two activated carbon/multimedia filters shall be provided. The filters shall have a minimum activated carbon bed depth of 3.0 feet. Support beds will have the following minimum bed depths:

- #20 Quartz - 9 inches
- 30 by 40 Garnet - 5 inches
- #8 Garnet - 4 inches

Quartz subfill as necessary for distribution of backwash water.

The maximum in-service 100% flow rate for each filter shall be below 10 gpm/ft². Each filter shall be designed to handle 100% of the normal feedwater flow and the complete flow when the other filter is in backwash.

H. All piping downstream of the multimedia filters shall be schedule 80 CPVC.

I. Vendor shall provide all media needed and shall be responsible for loading the media.

J. Activated Carbon supplied shall be the following criteria:

- Carbon shall be hydrochloric acid-washed Calgon F200 12 X 40 Bituminous Grade Virgin (not reprocessed) carbon suitable for potable water use.
SODIUM CYCLOSOFTENERS
K. Each softener shall have sufficient freeboard height to permit bed expansion of 50 percent without loss of resin unless using packed-bed technology.

L. Each softener shall be provided with vent valving at the highest point and a drain connection at the lowest point.

M. Each softener shall have an observation window centered at the top of the settle media bed and at the normal backwashing level (unless using packed-bed technology). The observation windows shall be vertical with minimum dimensions of 3 inches by 12 inches.

N. The internal systems and components for each tank shall be constructed of 316L stainless steel. Laterals shall be screened with 50 mesh Wedgewire.

O. Each softener tank shall have 3/16-inch thick sheet Neoprene rubber lining throughout.

P. The softeners shall have a minimum bed depth of 3.0 feet. The maximum in-service 100% flow rate shall be 3 gpm/ft$^3$.

Q. All piping downstream of the softeners shall be schedule 80 CPVC.

R. Softener shall be designed for downflow service and upflow regeneration (countercurrent regeneration).

ION EXCHANGE RESINS FOR SOFTENERS
Ion exchange materials for the softeners shall be provided consisting of properly graded and chemically stable uniform particle size bead strong-acid cation resins. (the Resin is Amberlite or Dowex)

RESIN TRAP STRAINER
A strainer shall be provided in the common effluent line of the sodium cycle softeners to prevent passage of resin. The strainer shall be designed to withstand the maximum system pressure. The strainer shall retain all particles larger than 50 mesh (U.S. Sieve Series) and shall utilize Johnson Wedgewire.

BRINESYSTEM
S. Brine Pumps
1. Two Brine pumps shall be provided. One of the pumps shall be a spare.
2. Each pump shall be sized to deliver 150 percent of the maximum regenerate flow rate required.
3. Materials of construction for wetted parts in contact with the regenerate shall be Type 316 stainless steel for brineservice.
T. Brine Mixing Tees

1. A brine mixing tee shall be provided for the regeneratesystem, capable of thoroughly mixing the incoming regenerate and dilution water to provide a continuous dilute solution of 10% w/w sodium chloride. The dilution water come from Reclaim water Tank.

2. Materials of construction shall be 316L stainless steel for brine service. The end connections shall be flanged.

U. Salt Tank

1. A FRP brine saturator with a minimum capacity of 5 tons shall be provided along with lines and compartments to allow dry salt to be delivered and saturated salt solutions to be made up for regeneration the softeners. A manhole will be provided to minimize external contamination. Supplier will provide salt and fill up the tank for the initial operation of the system.

2. Filling of the brine saturation compartment shall be provided locally, Filtering of suspended material from the saturated brine shall be provided using sand or other suitable media drawing from a lateral system.

3. A ladder shall also be provided to allow access to the top of the saturator.

4. Level indication shall be provided for both dry salt and saturated liquid.

5. A drain line and flush connections shall also be provided for tank cleanout.

Cartridge Filters

V. Two 5μ cartridge filters shall be provided with each be sized for 100% flow.

W. Cartridge filters shall have the following features:

1. Filters shall be constructed in single 40 inch length, will be 2.5 inches in diameter and have a single open end with a Buna-N “o”-ring.

2. Filters shall be made entirely of polypropylene.

3. Cartridges shall have rating of 5 micron absolute.

X. Filter element change out shall be accomplished with no loose parts. No tie rods shall be used to secure elements. Housing design shall allow filter change out in less than one hour. Cover shall be hinged.
and fastened with swing bolts. Tube sheet adapters shall be raised to prevent dirty fluid downstream during change out. Sufficient cartridges shall be provided to maintain a differential pressure of less than 4 psid across the housing at a flow rate of 95 gpm with new filters.

Y. Each cartridge filter housing shall be constructed of 316L stainless steel and shall have both a vent and drain valve.

Ultraviolet Sterilizer

Z. An ultraviolet sterilizer shall be provided to minimize bacteria in the feed to the RO system. Sterilizer shall allow easy change out of ultraviolet lamps.

AA. Sterilizer shall be constructed of stainless steel and designed for a flow rate of 95 gpm.

Booster Pumps

A. Two booster pumps, complete with motor driver, coupling and baseplate, shall be provided. The pumps shall increase pressure to drive the water through the RO elements, the EDI, and to the top of the demineralized water storage tanks. Vents shall be provided on the discharge of the pumps.

B. The pumps shall be of the multistage centrifugal, each sized for 100% of the required system flow. Each pump shall be capable of delivering approximately 95 gpm at a discharge pressure from 150 to 300 psig. Pump and motor shall be encapsulated in a fiberglass pressure vessel for noise reduction. Pump shall be torpedo style pump from Pumps Unlimited.

C. Materials of construction for the wetted parts shall be 316 stainless steel.

RO Elements and Pressure Vessels

D. The reverse osmosis elements shall be 8” polyamide TFC membranes in a spiral wound configuration. Each of the two trains will have a minimum of 2 stages. The average flux for the RO membranes will not exceed 12 GFD. Supplier will provide computer projections for RO performance.

E. The pipe, valves and fittings (including tubing) used to interconnect the reverse osmosis permeate shall be 316L stainless steel. Use of Victaulic couplings is permitted only for pipe bends.

F. The reverse osmosis elements shall be arranged into 2 different trains on a common pressurerack.

G. RO flow will be maintained 67 GPM per train will be controlled by the VFDs. RO reject shall be routed back to the Reclaim Tank for reuse using CPVC piping furnished by Supplier. Reject flow rate will be maintained at
a constant flow rate independently of the permeate flow. The timer and level switch in RO water tank shall be control the duty and stand by for each RO Unit and can change it with PLC.

ROFlushing
Flush of RO modules shall occur automatically upon shutdown or placed in stand-by and will be done using softened water from the pretreatment system. An automatic dump valve shall be provided to protect the RO membranes upon shutdown or placed in stand-by as a means of reduces membrane scaling and fouling.

Degasifier system

H. Permeate from the one RO trains shall be routed to three 6-inch Celgard membrane contactors to reduce carbon dioxide prior to the electrode mineralizers.

I. Membrane contactors shall include a blower and vacuum pump for carbon dioxide removal. Air removal equipment shall produce sufficient flow to reduce the carbon dioxide level below 4 ppm under all flow conditions. Blower shall produce oil-free air and will include a filter to meet the membrane manufacturer’swarranty.

Electro-Demineralizers

J. An electrode lionizer system consisting of two 67 gpm trains shall be provided. Each will operate at over 90% recovery. Electrode ionizers shall be selected from one of the following EDI models: E-Cell MK-3 or CDI-LX. These are the only acceptableelectrode ionizers.

K. Waste streams from the electrode mineralizers shall be routed back to GPA’s Raw Water Tank or Recycle for reprocessing using CPVC piping furnished by Supplier.

L. Each electrode mineralizer train shall be capable of meeting the limits defined in section 5.8 over a flow 60gpm.

M. Flow rate through the EDI units will be controlled by varying the RO flow rate using the VFDs. Any adjustments on the concentrate flow or pressure will take place automatically.

N. EDI voltage and or amperage can be done manually by the system operator.

Building and Construction

O. All equipment with the exception of the service water pumps, backwash pumps, the Reclaim water tank and the brine tank shall be enclosed within a concrete building supplied by the supplier. Building(s) shall include all necessary lighting to furnish lighting to 80 foot candles. Floor drains shall also be provided under the RO and EDI trains, each filter and
softener.

Contractor is responsible for demolition and removal or relocated of old equipment, as well as installation of new equipment.

P. A CS+FRP Lining Reclaim tank shall be supplied to recover RO rinse and reject water. Tank shall be 20 feet in diameter with a height of 15 feet. Tank shall be used as a Reclaim water source for all softener Regenerate operations and for activated carbon/multimedia filter backwashes. In addition, the controls shall allow the water to also be used for other purposes within the power plant as long as there is sufficient volume remaining to perform complete softener regeneration. Reclaim tank overflow line will terminate two inches above supplier-furnished funnel which will be connected to supplier’s pipe which will empty in storm drain.

Q. Construction of the entire water treatment system shall be the responsibility of the supplier. Construction shall include but is not limited pouring to all concrete pads (including those for the recovery water and the brine tanks), erection of the building and placement of all equipment within the building. In addition, electrical wiring from GPA’s electrical panel shall be included in the scope of the project. All electrical, controls and air connections will be the responsibility of supplier. Project is to “turn-key”. Wiring from EDI skid-mounted control panel and instruments to PLC is also Supplier’s responsibility.

R. Minimum Electrical Test requirements: Contractor “Turn Key” Project

1. GPA will provide a 480V AC feeder supply and assure the correct operation and settings of all feeder protection.

2. Contractor shall be responsible for “ringing out” all new wiring prior to the initial energization and for modifying the construction drawings to an “as built” condition.

3. Contractor shall megger all new wiring prior to initial energization.

4. Contractor shall be responsible for dynamic testing (where possible) of all new circuit protection devices prior to initial energization.

S. Contractor supplier shall provide specifications for the equipment enclosure/building. It shall meet be designed to meet all Federal and Local Codes and Seismic Zone 4 criteria. The design and specifications shall be reviewed and certified (signed) by a Registered Professional Engineer licensed to Practice and do business in the Territory of Guam. Design shall include but not limited to providing calculations, specifications and drawings for construction.
A. General

1. Instruments and controls shall be of the solid-state electronic type and shall be suitable for use with pneumatic operated valves and shall be protected from the environment.

2. The automatic control systems, using PLC control (two sets and could transfer automatically while operating set failed) shall be capable of the following functions:
   a. Place the water treatment system in service or stand-by condition with on-line operator interfacing using CRT touch screen or on-line mouse.
   b. Provide for a gradual start up when the water treatment system is placed in service. The filter effluent shall be directed to reclaim tank until proper turbidity and the removal of total chlorine has been confirmed. The softener effluent shall be directed to reclaim tank until hardness and conductivity are verified. The RO product stream shall be directed to reclaim tank until the proper conductivity is verified. The electro demineralizer product stream shall be directed to reclaim tank until the proper conductivity is verified.
   c. Place each activated carbon/multimedia filter in backwash when initiated with on-line operator interfacing using PLC control. Following initiation, the backwash cycle shall be completely automatic. After backwash and rinse, the filter shall be held in stand-by condition until returned to service with on-line operator interfacing using computer control.
   d. Alarm on high differential pressure to indicate when the activated carbon/multimedia filters require backwashing.
   e. Regenerate each softener when initiated with on-line operator interfacing using PLC control. Only one softener shall be regenerated at a time so that the operation of the water treatment system is not interrupted. Following initiation, regeneration shall be completely automatic. After regeneration, the softener shall be held in stand-by condition until returned to service with on-line operator interfacing using computer control when the other softener exhausts.
   f. Alarm on high differential pressure to indicate when the cartridge filters require replacement.
   g. Rinse the RO elements for a minimum of ten minutes when the water treatment system is continued operation. The booster pumps
and raw water pumps will continue to operate. At the lower RO feed pressure and/or with the appropriate valve actuation, no product shall be produced. All of the RO feed shall exit through the second stage concentrate waterlines.

h. Control pressure of influent water to provide constant pressure conditions for maintaining constant flow rates during filter backwashes.

i. Accomplish other functions as required for the proper operation of the water treatment system. Failure of any automatic operation to reach completion within the predetermined time interval, based on the quality end point criteria, shall be annunciated. Any such failure shall stop progress for the automatic process until correct conditions have been established.

j. Filling of brine saturator salt tank shall be manually initiated and controlled by the operator. Automatic high level shut-off switches shall be supplied to prevent overfilling.

3. The Supplier shall provide the means for manually accomplishing every operation from the water treatment system control panel which is performed by the automatic control systems.

Instrumentation Requirements

4. The two activated carbon/multimedia filters shall be provided with a differential pressure indicator and a high differential pressure alarm. Each filter shall be provided with flowmeter.

5. A turbidity analyzer shall be provided downstream of the activated carbon/multimedia filters. The turbidity analyzer shall be equipped with a high turbidity alarm and a high high turbidity shut down which shall shut down the water treatment system without rinsing the RO elements.

6. Each of the softeners shall be provided with a flow indicating totalizer. One common total hardness analyzer shall be provided for monitoring the effluent of the softener in-service. After a preset gallonage limit has elapsed, an alarm will annunciate to notify the operator that one of the softeners requires regeneration and the “exhausted” softener will continue to operate. In the event of high total hardness, the operated RO train shall be shut down for rinsing the RO elements.

7. The two 5μ filters shall be provided with a differential pressure indicator for the combination, a differential pressure transmitter, and high differential pressure alarm.

8. Each booster pump shall be provided with a low suction pressure shut down, a high discharge pressure shut down, suction and discharge pressure gauges and a pressure relief valve. In addition, a discharge pressure transmitter shall be provided. The high and low pressure shut
downs shall shut down the system.

9. The combined permeate from both RO trains shall be equipped with a conductivity indicator and a high conductivity alarm. High conductivity shall shut down the operated RO train and put another RO train in service automatically/ormanually.

10. The effluent of each electrode mineralizer train shall have a conductivity monitor. An alarm shall annunciate in the event of high conductivity. Each train shall be provided with an inlet and outlet pressureindicators.

11. The softener resin trap shall be provided with a differential pressure indicator and a differential pressurealarm.

SpecificRequirements

In addition to the items listed below, the equipment provided by Supplier shall have the following features.

12. The programmable controller shall control all functions associated with softener regeneration, filter backwashing, RO module rinsing and electro demineralizeroperation.

13. All indicators and transmitters shall read out in engineering units. All flow indicators and transmitters shall read out directly in gallons per minute (gpm). All pressure indicators and transmitters shall read out directly in pounds per square inch (psi). All transmitters shall have linearoutput.

14. Flow indicators, locally mounted, shall measure the water flow rate each of the activated carbon/multimedia filters, the RO feed water flow to each RO train, and concentrate water from each ROtrain.

15. A flow indicator, locally mounted, shall measure the flow of dilution water to the brine mixing tee. Also a brine concentration meter to measure the concentration of the diluted brine used to regenerate the softeners shall be provided. Meter can be local and shall read out in percent sodiumchloride.

16. A flow indicating, locally mounted “in-line” type, shall measure the flow rate of saturated brine. This indicator shall be sized for at least 150 percent of the expected flowrate.

17. A flow indicating totalizer, locally mounted, shall measure the flow through eachsoftener,fromtheROpermeateofeachtrainandthedemineralized water flow to the storage tank. They shall indicate flow rate and shall have contacts to actuate the “volume exhausted” alarm point for thesofteners.

18. A turbidity analyzer shall be provided for monitoring the activated carbon/multimedia effluent. Turbidity analyzer shall be Hach Model 1720D or equivalent.

19. A hardness analyzer shall be provided to monitor the effluent of the in-
service softener. Hardness analyzer shall be a Hach Model 510 or equivalent.

20. A silica and TOC analyzer shall be provided for the combined EDI effluent. Silica analyzer shall be Hach Series 5000 or equivalent.

21. One annunciator, board mounted, with separate buzzer, to contain points as required for monitoring operation. The annunciator shall have a relay contact to transmit any of the aforementioned alarm to a single alarm window in the main control room. Wiring from the annunciator to GPA’s main control room shall be provided and installed by Supplier. Wiring shall be terminated at a single point in a terminal box. A test switch shall be provided to test operation of the annunciator lamps.
**ANNEXURE – I**

Detail description of Equipment offered in the proposed EFFLUENT TREATMENT PLANT 10 KLD

<table>
<thead>
<tr>
<th>S.No.</th>
<th>Item Description</th>
<th>Qty.</th>
</tr>
</thead>
<tbody>
<tr>
<td>01.</td>
<td>Effluent water transfer pump capable to transfer 1 HP. CRI / Kirlosker</td>
<td>2 Nos.</td>
</tr>
<tr>
<td>02.</td>
<td><strong>Air Blower 2HP. Everest / Beta</strong></td>
<td>2Nos.</td>
</tr>
<tr>
<td>03.</td>
<td>Dose Chemical storage tanks of HDPE of 100 Lts.</td>
<td>03 Nos.</td>
</tr>
<tr>
<td>04.</td>
<td>Chemical Mixer cum Flocculator constructed in 4mm M.S 4mm</td>
<td>01 Nos.</td>
</tr>
<tr>
<td>05.</td>
<td>Tube Settler as constructed in <strong>M.S. (4mm)</strong></td>
<td>01 Nos.</td>
</tr>
<tr>
<td>06.</td>
<td>Holding Tank In PVC (500 Lit.)</td>
<td>01 Nos.</td>
</tr>
<tr>
<td>07.</td>
<td>Sand filter capable to pass 1000 L/Hr Effluent water after partial treatment constructed in <strong>MS (4mm)</strong> having multi layer media.</td>
<td>01 Nos.</td>
</tr>
<tr>
<td>08.</td>
<td>Activated Carbon filter capable to pass 1000 L/Hr Effluent water after partial treatment constructed in <strong>M S 4mm</strong></td>
<td>01 Nos.</td>
</tr>
<tr>
<td>09.</td>
<td>Treated Filter Pump 1 Hp.</td>
<td>02 No</td>
</tr>
<tr>
<td>10.</td>
<td>PVC/ Pipe line valve, fittings and other related accessories</td>
<td>01 Lot</td>
</tr>
<tr>
<td>11.</td>
<td>Multi port valve</td>
<td>02 Nos</td>
</tr>
<tr>
<td>12.</td>
<td>Epoxy pant</td>
<td>All Tank</td>
</tr>
<tr>
<td>13.</td>
<td>Electrical Panel</td>
<td>1 Nos</td>
</tr>
<tr>
<td>14.</td>
<td>PH Meter</td>
<td>01 Nos.</td>
</tr>
<tr>
<td>15.</td>
<td>Dosing Pump</td>
<td>03 Nos</td>
</tr>
</tbody>
</table>
Clint Scope
1. All Civil Work

MERC TREATMENT MAIN UNITS

1. OIL & GREASE TRAPE

   Length   -  6 feet
   Width    -  2.5 feet
   Depth    -  4 feet
   Nos. of Tank - 1 Nos.
   MOC       -  Brick Masonry

2. EQUALIZATIONS CUM COLLECTION TANK

   Capacity - 10 KL per day
   Length   -  6 feet
   Width    -  5 feet
   Depth    -  4 feet
   Nos. of Tank - 1 No.
   MOC       -  R C C

TUBE SETTLER

   Type      -  Compact
   Capacity  -  10 KLD
   MOC       -  MS Sheet with Epoxy Coated
   Nos. of Tank - 1 No.

5. SAND FILTER

   Dia       -  400 mm
   Height    -  1200 mm
   Type of filter - Up-flow with Back-wash
   MOC       -  MS Sheet with Epoxy Coated
   Nos. of filter - 1 No.

6. ACTIVATED CARBON FILTER

   Dia       -  400 mm
   Height    -  1200 mm
   Type of filter - Up-flow with Back-wash
   MOC       -  MS Sheet with Epoxy Coated
   Nos. of filter - 1 No.

7. SLUDGE DRYING BED

   Capacity -  7 Days holding
   Nos. of Tank - 3 Nos.
   Size      -  3’ x 3’ x 3’
<table>
<thead>
<tr>
<th>S. No.</th>
<th>Item</th>
<th>Manufacturer’s Name</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Civil and Interior Works</td>
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</tr>
<tr>
<td>1</td>
<td>Grey Cement OPC/PPC</td>
<td>ACC, Ultratech, JK, India Cement, JP</td>
</tr>
<tr>
<td>2</td>
<td>White Cement</td>
<td>J.K. Birla or equivalent</td>
</tr>
<tr>
<td>3</td>
<td>Reinforcement Steel (TMT bars)</td>
<td>Tata, sail, Rashtriya Spal Nigam (RINL)</td>
</tr>
<tr>
<td>4</td>
<td>Structural Steel sections</td>
<td>Sail, Vizag, Tata</td>
</tr>
<tr>
<td>5</td>
<td>Concrete Additives</td>
<td>Fosroc, Choksey, Kunal Conchem, Sikkia</td>
</tr>
<tr>
<td>6</td>
<td>Anti termite Chemical</td>
<td>Pest Control India Ltd., Pest Con India, or Equivalent</td>
</tr>
<tr>
<td>6a</td>
<td>Puff Panel</td>
<td>Industrial Foams Pvt Limited, Lloyd Insulation</td>
</tr>
<tr>
<td>6b</td>
<td>PEB Structure Fabrication</td>
<td>Interarch building products, Everest, Zamil Steel</td>
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<tr>
<td>6c</td>
<td>Concrete Mix RMC</td>
<td>Jindal or equivalent</td>
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<tr>
<td>7</td>
<td>Tile grouts, Joint Filler</td>
<td>Laticrete, “Roff Rainbow Tile Mate” of Roff, Construction Chemicals Pvt. Ltd., Mapei, Winsil 20, Silicon Sealant of GE Bayer Silicon, Matrix Group,</td>
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<tr>
<td></td>
<td>Based</td>
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<tr>
<td>8</td>
<td>Polysulphide Sealant</td>
<td>Fosroc, STP, Choksey, Kunal Conchem, Pidilite</td>
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<td>9</td>
<td>Silicone Sealant</td>
<td>GE Bayer Silicone, Dow Corning, Wacker.</td>
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<tr>
<td>10</td>
<td>Epoxy</td>
<td>Fosroc, Sika, Choksey, Kunal Conchem</td>
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<td>11</td>
<td>Water Proofing Membrane – Bitumen Based</td>
<td>Sikka, Fosroc, STP</td>
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<td>12</td>
<td>Admixture</td>
<td>Choksey, Kunal Conchem, STP</td>
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<td>13</td>
<td>Formwork Release Agent</td>
<td>Choksey, Kunal Conchem, MBT, STP</td>
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<td>14</td>
<td>Non Shrink grouts</td>
<td>Fosroc, Kunal Conchem, Choksey</td>
</tr>
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<td>15</td>
<td>Non Metallic Floor Hardeners</td>
<td>Fosroc, Choksey, Kunal Conchem, STP</td>
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<td>16</td>
<td>Bitumen</td>
<td>Shalimar tar products, Mathura oil refinery</td>
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<td>17</td>
<td>Synthetic Enamel Paints</td>
<td>Berger, Nerolac, Asian, ICI Dulux</td>
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<tr>
<td>18</td>
<td>Oil Bound Distemper</td>
<td>Berger, Nerolac, Asian, ICI Dulux</td>
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<tr>
<td>19</td>
<td>Cement Paint</td>
<td>Snowcem Plus, Berger, Kamdhenu paints, Nerolac</td>
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<tr>
<td>20</td>
<td>Plastic Emulsion Paint</td>
<td>ICI, Nerolac, Asian</td>
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<tr>
<td>21</td>
<td>Other Paints &amp; Primer</td>
<td>ICI Dulux, Asian, Berger, Nerolac</td>
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<tr>
<td>22</td>
<td>Textured Coating</td>
<td>Heritage, Unilate or Equivalent</td>
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<td>23</td>
<td>Melamine</td>
<td>ICI Dulux, Timberstone Melamine Coating, kamdhenu, Acro</td>
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<td>24</td>
<td>Polyurethane Paint</td>
<td>MRF, Nerolac, Texfin</td>
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<td>26</td>
<td>Ceramic Tiles (Glazed, Matt, Others)</td>
<td>Kajaria, HR Johnson, Somany, Orient</td>
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<td>27</td>
<td>Vitrified Tiles</td>
<td>Kajaria, Rak, Somany, Nitco, Orient</td>
</tr>
<tr>
<td>28</td>
<td>Laminated Wooden flooring</td>
<td>Krono, pergo, Berry</td>
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<tr>
<td>29</td>
<td>PVC/Vinyl Flooring</td>
<td>Polyflor, Tarkett</td>
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<tr>
<td>30</td>
<td>Terrazzo Tile</td>
<td>NITCO, Modern, Hindustan</td>
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<tr>
<td>31</td>
<td>Interlock Tiles, Glass Paver Block</td>
<td>Nimco Prefab, Unistone, Modern</td>
</tr>
<tr>
<td>32</td>
<td>Cement Concrete Tiles, Designer Tiles</td>
<td>Unistone, Ultra, Eurocon</td>
</tr>
<tr>
<td>33</td>
<td>Laminates</td>
<td>Duro, Formica, Greenlam, Merino</td>
</tr>
<tr>
<td>34</td>
<td>MDF Grade-I as per IS-12406&amp; Ecomark</td>
<td>Nuwud, URO, Greenply</td>
</tr>
<tr>
<td>35</td>
<td>Adhesive for wood work</td>
<td>Dunlop, Fevicol,</td>
</tr>
<tr>
<td>36</td>
<td>Pre Laminated Particle Board</td>
<td>Novopan, Bhutan, Kitlam, Greenlam, Century, Merino</td>
</tr>
<tr>
<td>37</td>
<td>Plywood, Block Board, Soft Board</td>
<td>Century, Duro, Alpro, Greenply, Merino</td>
</tr>
<tr>
<td>38</td>
<td>Paving Stones</td>
<td>Unistone, Nimco Prefab, Hindustan Tiles</td>
</tr>
<tr>
<td>S. No.</td>
<td>Item</td>
<td>Manufacturer’s Name</td>
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<tr>
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<td>-------------------------------------------</td>
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<tr>
<td>39</td>
<td>Wax Polish</td>
<td>Mansion, Reckitt &amp; Colman</td>
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<tr>
<td>40</td>
<td>Polyethane Sealant</td>
<td>MBT, Choksey, Kunal Conchem, Fosroc, Pidilite</td>
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<tr>
<td>41</td>
<td>Polyethylene Board, Back Up Rod</td>
<td>Supreme Industries or Equivalent</td>
</tr>
<tr>
<td>42</td>
<td>Stainless Steel Hinges</td>
<td>Hettich, Doorset, Union, haflon</td>
</tr>
<tr>
<td>43</td>
<td>Mirror &amp; Float Glass</td>
<td>Modi Float Glass, Asahi Glass, Saint Gobain</td>
</tr>
<tr>
<td>44</td>
<td>Door Hardware, Closer</td>
<td>Godrej, Dorset, Dorma, Hettich</td>
</tr>
<tr>
<td>45</td>
<td>Locks and Handles</td>
<td>Godrej, Dorset, Dorma, Hettich</td>
</tr>
<tr>
<td>46</td>
<td>Aluminum Building Expansion Joints</td>
<td>Vexcolt, Watson Bowman, Acme, Z-Tech India, JMetco</td>
</tr>
<tr>
<td>47</td>
<td>Water Stopper</td>
<td>Fixopan, Caliplast or equivalent</td>
</tr>
<tr>
<td>48</td>
<td>Aluminium Composite Panel</td>
<td>Alstone, Alstrong, Alupan</td>
</tr>
<tr>
<td>49</td>
<td>Asphalt Emulsion</td>
<td>STP, Karnak Chemical Corporation.</td>
</tr>
<tr>
<td>50</td>
<td>Expansion Joint</td>
<td>Hilti, Fischer, Canon</td>
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<tr>
<td>51</td>
<td>Stainless Steel</td>
<td>Salem, Jindal, Cavelier</td>
</tr>
<tr>
<td>52</td>
<td>Anchor Fastener, Anchor Bolts</td>
<td>Hilti, Fischer, Canon</td>
</tr>
<tr>
<td>53</td>
<td>Gypsum Partition &amp; Gypsum Ceiling</td>
<td>Saint Gobin, Boral</td>
</tr>
<tr>
<td>54</td>
<td>Impregnated Fibre Board</td>
<td>STP or equivalent</td>
</tr>
<tr>
<td>55</td>
<td>Joint Filler and Bitumen Products</td>
<td>STP or equivalent</td>
</tr>
<tr>
<td>56</td>
<td>Electrodes</td>
<td>Advani-Overlikon, ESAB, Dwekam</td>
</tr>
<tr>
<td>57</td>
<td>Mineral Fibre Ceiling System</td>
<td>Armstrong, or Equivalent</td>
</tr>
<tr>
<td>58</td>
<td>Metallic False Ceiling</td>
<td>Armstrong, or Equivalent</td>
</tr>
<tr>
<td>59</td>
<td>H.T. Bolts</td>
<td>Unbrako or equivalent</td>
</tr>
<tr>
<td>60</td>
<td>Steel Doors (General purpose)</td>
<td>Shakti Met-Dor or equivalent</td>
</tr>
<tr>
<td>61</td>
<td>Steel Doors (Fire rated)</td>
<td>Global Fire Protection Company, Radiant safe Fire Doors, Godrej, Navair, Shakti Met-Dor</td>
</tr>
<tr>
<td>62</td>
<td>Fire Door (Wooden)</td>
<td>Navair, Aadhunic, Radiant</td>
</tr>
<tr>
<td>63</td>
<td>Aluminum Sections</td>
<td>Jindal, Hindalco, or Equivalent</td>
</tr>
<tr>
<td>64</td>
<td>Rolling Shutter</td>
<td>Shivam, Milestones, Rama, Prakash</td>
</tr>
<tr>
<td>65</td>
<td>Pre-coated Roof Sheeting</td>
<td>Multicolor, BHP, Bluescope, Japan Metal Systems, Lloyds, CRIL</td>
</tr>
<tr>
<td>66</td>
<td>Glass wool and related products, Mineral wool</td>
<td>UP-Twiga, Owens Corning, Lloyds</td>
</tr>
<tr>
<td>67</td>
<td>Polycarbonate sheets</td>
<td>GE Plastics, Damplan, Sunlite, Coxwell domes</td>
</tr>
<tr>
<td>68</td>
<td>Self drilling Screws</td>
<td>Hilti, Builtex or equivalent</td>
</tr>
<tr>
<td>69</td>
<td>Logo, Signs, Name plates</td>
<td>D-Line or Equivalent</td>
</tr>
<tr>
<td>70</td>
<td>Pre-Engineered Building</td>
<td>Kirby Building, Tiger Steel or equivalent</td>
</tr>
<tr>
<td>71</td>
<td>Flush Doors</td>
<td>Duro, Greenlam, Century</td>
</tr>
<tr>
<td>72</td>
<td>MS Sliding Motorized Door</td>
<td>Shivam Associates - Beninca R1524 K System or equivalent</td>
</tr>
<tr>
<td>73</td>
<td>Water proofing compound</td>
<td>Pidilite, Cico, Fosroc, Choksey, Mapei</td>
</tr>
<tr>
<td>74</td>
<td>Fasteners</td>
<td>Gun, Atul, Hilti, Canon</td>
</tr>
<tr>
<td>75</td>
<td>Aluminum fittings</td>
<td>Urgent, Classic, Nulite</td>
</tr>
<tr>
<td>76</td>
<td>Extruded vitrified clay tile</td>
<td>Unitile, Dovetex, or Equivalent</td>
</tr>
<tr>
<td>77</td>
<td>External façade tiles</td>
<td>Faviton or Equivalent</td>
</tr>
<tr>
<td>78</td>
<td>POP</td>
<td>Siriram or equivalent</td>
</tr>
<tr>
<td>79</td>
<td>outdoor furniture (sitting bench, dustbin)</td>
<td>Arihant or equivalent</td>
</tr>
</tbody>
</table>
## List Of Preferred Makes

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Item</th>
<th>Manufacturer's Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>80</td>
<td>Modular furniture</td>
<td>Godrej, Wipro, B.P.Ergo (Blowplast)</td>
</tr>
<tr>
<td>81</td>
<td>Chairs and Sofas</td>
<td>Godrej, Geeken, Featherlite</td>
</tr>
<tr>
<td>82</td>
<td>Acoustical paneling</td>
<td>Armstrong, Anutone or equivalent</td>
</tr>
<tr>
<td>83</td>
<td>Modular Toilets</td>
<td>Merino, Green, Dorma</td>
</tr>
<tr>
<td>84</td>
<td>Mosaic tiles</td>
<td>Nitco, surya, Laxmi</td>
</tr>
<tr>
<td>85</td>
<td>Acoustical False Ceiling</td>
<td>Armstrong, Anutone or equivalent</td>
</tr>
<tr>
<td>86</td>
<td>Exterior tiles</td>
<td>Unitile, Pavit or equivalent</td>
</tr>
<tr>
<td>87</td>
<td>Patch Fitting/ Spider Fitting</td>
<td>D-Line, Hattich, Dorma</td>
</tr>
<tr>
<td>88</td>
<td>UPVC Door &amp; Window</td>
<td>Fenesta or Equivalent</td>
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<tr>
<td>89</td>
<td>Acid and alkali resistant tiles</td>
<td>Somany, Restile, Durato</td>
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<tr>
<td>90</td>
<td>Ceramic Rainscreen ventilated faced tile</td>
<td>Faveton, Moeding, NBK</td>
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<tr>
<td>91</td>
<td>Roller Blinds</td>
<td>Hunter Douglas or Equivalent</td>
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### ELECTRICAL

#### A. ELECTRICAL HIGH SIDE EQUIPMENT

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<th>S. No.</th>
<th>Item</th>
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<tbody>
<tr>
<td>1</td>
<td>SOLAR POWER PANEL</td>
<td>THEME SOLAR SYSTEM/ SOLAR HART/ KL SOLAR COMPANY/ APOLLO SOLAR/ AVANTE GLOBAL</td>
</tr>
<tr>
<td>2</td>
<td>UPS SYSTEM</td>
<td>EMERSON/ PCI/ SOCOMAC</td>
</tr>
<tr>
<td>3</td>
<td>INVERTOR</td>
<td>LUMINOUS / MICROTEK / SU-KAM</td>
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#### B. ELECTRICAL SYSTEM/ PANELS

<table>
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<tr>
<th>S. No.</th>
<th>Item</th>
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</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FUSES &amp; SWITCH FUSE UNIT</td>
<td>SIEMENS/ ABB/ SCHNEIDER/</td>
</tr>
<tr>
<td>2</td>
<td>ACB / MCCB / CONTACTOR</td>
<td>SIEMENS/ ABB/ SCHNEIDER</td>
</tr>
<tr>
<td>3</td>
<td>METAL CLAD SOCKET</td>
<td>SIEMENS/ MDS/ BHARTIA CUTLUR HAMMER</td>
</tr>
<tr>
<td>4</td>
<td>RISING MAINS / BUS DUCT</td>
<td>TRICOLITE/ ABB / SPC ELECTROTECH/ADVANCE</td>
</tr>
<tr>
<td>5</td>
<td>LED'S LIGHT</td>
<td>PHILIPS/ WIPRO/FUTURE LIGHT</td>
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<tr>
<td>6</td>
<td>ISOLATORS FOR MOTORS</td>
<td>MDS/ SIEMENS/ SCHNEIDER/ ABB</td>
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<tr>
<td>7</td>
<td>CHANGE OVER SWITCH</td>
<td>HH-ELCON/ HPL SOCOMAC / GE</td>
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<td>8</td>
<td>CONTACTOR, TIMER, SINGLE PHASE PREVENTOR &amp; OVER LOAD RELAY</td>
<td>L&amp;T/ ABB/ SIEMENS</td>
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<td>9</td>
<td>METERS - DIGITAL TYPE</td>
<td>AE/ L&amp;T/ RISHAB/ GE</td>
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<td>10</td>
<td>PROTECTIVE &amp; APFC RELAYS</td>
<td>ASLTOM/ ASHIDA/ L&amp;T</td>
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<td>11</td>
<td>CT's/ PT's- DRY TYPE-EPOXY</td>
<td>AE/ KAPPA</td>
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<td>12</td>
<td>INDICATING LAMP / PUSH BUTTON ACTUATERS - LED CLUSTER TYPE</td>
<td>L&amp;T/ SIEMENS/ BCH</td>
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<td>13</td>
<td>ROTARY SWITCHES</td>
<td>L&amp;T/ KAYCEE/ BCH</td>
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<td>14</td>
<td>TERMINAL BLOCK</td>
<td>ELEMEX/ WAGO</td>
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<td>15</td>
<td>LT PANELS</td>
<td>TRICOLITE/ ABB / SPC ELECTROTECH/ADVANCE</td>
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<td>16</td>
<td>LIGHTNING ARRESTER</td>
<td>ERIICO/ ESE/ UNIEARTH</td>
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<td>17</td>
<td>GAS FIRE SUSPERSION SYSTEM</td>
<td>FIRE LINE/ TYCO FIRE</td>
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#### C. CABLES/ TERMINATIONS/ ACCESSORIES

<table>
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<tbody>
<tr>
<td>1</td>
<td>LUGS</td>
<td>DOWELLS/ COMET</td>
</tr>
<tr>
<td>2</td>
<td>BRASS CABLE GLANDS</td>
<td>COMMET/ BELIGA</td>
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<tr>
<td>3</td>
<td>LT POWER CABLE (ALUMINIUM/ COPPER)</td>
<td>UNIVERSAL/ NICCO/ POLYCB / SKYTONE/HAVELLS</td>
</tr>
<tr>
<td>4</td>
<td>CONTROL CABLE (COPPER)</td>
<td>UNIVERSAL/ NICCO/ POLYCB / SKYTONE/HAVELLS</td>
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<td>5</td>
<td>HT XLPE CABLE</td>
<td>UNIVERSAL / RPG CABLES / NICCO/SKYTONE</td>
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<tr>
<td>6</td>
<td>H.T. CABLE END TERMINATION</td>
<td>BIRLA 3 M/ REYCHEM/ FRONTEC</td>
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<tr>
<td>S. No.</td>
<td>Item</td>
<td>Manufacturer’s Name</td>
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<td><strong>D.</strong></td>
<td>CONDUITING &amp; WIRING ACCESSORIES</td>
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<tr>
<td>1</td>
<td>MS CONDUIT / GI CONDUIT (ISI MARKED)</td>
<td>BEC/ AKG / Atul</td>
</tr>
<tr>
<td>2</td>
<td>PVC CONDUIT (ISI MARKED)</td>
<td>BEC/ POLYPACK/ AKG /Atul</td>
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<tr>
<td>3</td>
<td>PVC INSULATED COPPER CONDUCTOR FRLS WIRE</td>
<td>FINOLEX / HAVELLS/ SKYTONE</td>
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<td>4</td>
<td>PLATE TYPE - SWITCHES / SOCKETS / TV &amp; TELEPHONE SOCKETS AND ALL OTHER WIRING ACCESSORIES</td>
<td>M.K/ LEGRAND/ ANCHOR-ROMA</td>
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<td>5</td>
<td>ACCESSORIES FOR METALIC / GI CONDUIT ( ISI MARKED )</td>
<td>SHRMA STEEL CORPORATION / PRAKASH ENGINEERING WORKS / SUPER SALES CORPORATION</td>
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<td>6</td>
<td>PVC INSULATION TAPE</td>
<td>STEEL GRIP/ ANCHOR</td>
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<td>PHENOL LAMINATED SHEET</td>
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<td>RACEWAYS &amp; CABLE TRAY</td>
<td>PILCO/ SLOTCO/ VENUS/ RICCO</td>
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<td><strong>E.</strong></td>
<td>LIGHTING DBs &amp; MCBs</td>
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<td>MCB,10KA</td>
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<td>LIGHTING FIXTURES &amp; FANS</td>
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<td>BULK HEAD FITTINGS</td>
<td>CROMPTON/ PHILIPS/WIPRO/FUTURE LIGHT</td>
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<td>EXHAUST FANS / CEILING FAN / WALL MOUNTED FAN</td>
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<td>EXTERNAL LIGHTING FIXTURES</td>
<td>PHILIPS/ FUTURE LIGHT/ SCHREDER</td>
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<td>ELV- TELEPHONE/ CCTV/ DOOR ACCESS/ FIRE ALARM/ PUBLIC ADDRESS &amp; MISC. SYSTEMS</td>
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<td>SMOKE DETECTORS</td>
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<td>HEAT DETECTORS</td>
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<td>RESPONSE INDICATOR</td>
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<td>FIRE PANEL</td>
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<td>PA AMPLIFIER</td>
<td>BOSE/ PHILIPS/ AHUJA</td>
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<td>8</td>
<td>PA SPEAKERS</td>
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<td>LINE MATCHING TRANSFORMER</td>
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<td>GOOSE NECK MIKE</td>
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<td>INVERTER</td>
<td>TOPAZ INTERNATIONAL/ LUMINOUS/ HYTES</td>
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<td>CAMERA WITH ALL ACCESSORIES</td>
<td>HONEYWELL /PELCO/BOSCH</td>
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<td>13</td>
<td>ROAD BARRIER</td>
<td>NICE/ MAGNETICS/ GODREJ/ GE</td>
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<td>CARD READER</td>
<td>SENSORMATIC-USA/ MOTOROLA /HONEYWELL(XLS-3000)</td>
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<td>MONITOR</td>
<td>ALBA/ LG/ SAMSUNG</td>
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<td>ALBA/ VANTAGE</td>
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<td>PROXIMITY CARD</td>
<td>MOTOROLA/ HUGHES/ HONEYWELL/GE/SIEMENS</td>
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<td>TELEPHONE TAG BLOCK</td>
<td>KRONE/ TVS R&amp;M/SYSTIMAX/SCHNEIDER/PANDUIT</td>
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<td>21</td>
<td>TELEPHONE CABLES</td>
<td>DELTON / SKYTONE/ CLIPSAL</td>
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<td>22</td>
<td>CO-AXIAL CABLES</td>
<td>FINOLEX/ DELTON/SKYTONE</td>
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<td>23</td>
<td>EPABX</td>
<td>ALKATEL/ SIEMENS/ NORTEL</td>
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<td>CCTV SYSTEM</td>
<td>HONEYWELL/ SIEMENS /PELCO</td>
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<td>IT &amp; TELECOM SYSTEM</td>
<td>SCHNEIDER/ SYSTIMAX/ PANDUIT</td>
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<td>26</td>
<td>FIRE ALARM SYSTEM</td>
<td>NOTIFIER/ HONEYWELL(XLS-3000)/ SIEMENS/COOPER</td>
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# List Of Preferred Makes

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<thead>
<tr>
<th>S. No.</th>
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<th>Manufacturer’s Name</th>
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<tbody>
<tr>
<td>27</td>
<td>ACCESS CONTROL SYSTEM</td>
<td>HONEYWELL/ SIEMENS/GE</td>
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## H. MISCELLANEOUS SYSTEMS

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<tr>
<td>1</td>
<td>BATTERIES</td>
<td>EXIDE/ STANDARD</td>
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<td>2</td>
<td>BATTERY CHARGER</td>
<td>KELTRON/ NELCO/ EXIDE/ HBL NIFE</td>
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<td>3</td>
<td>HT PANELS</td>
<td>SIEMENS/ ABB/ AREVA</td>
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<tr>
<td>4</td>
<td>TRANSFORMER</td>
<td>VOLTAMP/ ABB/ AREVA / KIRLOSKER/SUDHIR</td>
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<th>S. No.</th>
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<td>1</td>
<td>ALTERNATOR</td>
<td>STAMFORD/ CATERPILLAR/ KIRLOSKER/CROMPTON</td>
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<td>ENGINE</td>
<td>CUMMINS/ CATERPILLAR/ KIRLOSKER</td>
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<td>3</td>
<td>HT PANELS</td>
<td>SIEMENS/ ABB/ AREVA</td>
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<tr>
<td>4</td>
<td>TRANSFORMER</td>
<td>VOLTAMP/ ABB/ AREVA / KIRLOSKER/SUDHIR</td>
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## PLUMBING SYSTEM

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<th>Item</th>
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<tbody>
<tr>
<td>1</td>
<td>VITREOUS CHINA SANITARYWARE</td>
<td>PARRYWARE,ROCA ,HINDWARE</td>
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<tr>
<td>2</td>
<td>PLASTIC W.C.SEATS &amp; COVERS</td>
<td>PARRYWARE,ROCA ,HINDWARE</td>
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<tr>
<td>3</td>
<td>C.P. FITTINGS: BIB COCK (LONG BODY/SHORT BODY), PILLAR COCK, SINGLE HOLE BASIN MIXTURE, WALL MIXER, SHOWER MIXER, ANGLE VALVE, CONCEALED STOP COCK, SHOWER WITH WALL FLANGE, C.P. WASTE 32-40 mm DIA, BOTTLE TRAP, HEALTH FAUCET WITH STEEL BEDED CONNECTING PIPE.</td>
<td>JAQUAR /ESS ESS /GROHE</td>
</tr>
<tr>
<td>4</td>
<td>AUTOMATIC WATER TAPS, AUTOMATIC URINAL FLUSHING SYSTEM</td>
<td>JAQUAR /ESS ESS /GROHE</td>
</tr>
<tr>
<td>5</td>
<td>TOWEL RING, TOWEL ROD, TOWEL RACK, COAT HOOK etc. (304 Grade S.S.)</td>
<td>PARKO / JAQUAR /ESS ESS</td>
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<tr>
<td>6</td>
<td>CHROMIUM PLATED / STAINLESS STEEL / POLY VENIEL CHLORIDE GRATING</td>
<td>Cummun, Neer, Chilly</td>
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<td>7</td>
<td>STAINLESS STEEL SINK</td>
<td>JAINA /NEELKANT/ANUPAM</td>
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<td>8</td>
<td>SAND CAST IRON SPUN PIPE, CENTIFUGALLY CASTED S &amp; S AS PER IS: 3989</td>
<td>NECO / RAJ IRON FOUNDRY / RIF/SKF</td>
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<td>9</td>
<td>CAST IRON PIPE, HORIZONTALLY / VERTICALLY CASTED S &amp; S AS PER IS:1729</td>
<td>NECO / RAJ IRON FOUNDRY / RIF/SKF</td>
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<tr>
<td>10</td>
<td>G.I. &amp; M.S. PIPES PART-I IS: 1239 UPTO 150 mm AND M.S. PIPES</td>
<td>TATA STEEL (TUBE DIVISION)/ JINDAL PIPES LIMITED</td>
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<td>11</td>
<td>G.I. AND M.S. FITTINGS</td>
<td>UNIQUE / ZOLOTO / KENT</td>
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<td>12</td>
<td>uPVC PIPES &amp; FITTINGS 4 kg./sqm, 6 kg./sqm, 10 kg./sqm PRESSURE</td>
<td>SUPREME INDUSTRIES LIMITED/ FINOLEX INDUSTRIES/ PRINCE PIPES &amp; FITTINGS PRIVATE LIMITED</td>
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<td>13</td>
<td>cPVC PIPES SDR12.5 SCHEDULE-40</td>
<td>ASTRAL POLYTECHNIC PRIVATE LIMITED/ ASHIRVAD ENTERPRISES PRIVATE LIMITED/ JAIN PLASTICS &amp; CHEMICALS LIMITED</td>
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<tr>
<td>14</td>
<td>HDPE PIPE</td>
<td>JAIN PLASTICS &amp; CHEMICALS LIMITED/ CHEMI PLAST INDUSTRIES STUROY POLYMERS LIMITED/ KISAN GROUP OF COMPANIES</td>
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### List Of Preferred Makes

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<tr>
<th>S. No.</th>
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<tr>
<td>15</td>
<td>C.I. CLASS LA PIPES</td>
<td>KESORMA SPUN PIPE &amp; FOUNDRIES, CALCUTTA/ SUPER ENTERPRISES/ INDIAN IRON &amp; CO. LTD. CALCUTTA.</td>
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<td>16</td>
<td>R.C.C. PIPES</td>
<td>PRAGATI CONCRETE UDYOG/ K.K. SPUN PIPES/ J. K. SPUN PIPES/ SOOD &amp; SOOD</td>
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<td>17</td>
<td>STONEWARE PIPES &amp; GULLY TRAP</td>
<td>DEVRAJ ANAND CERAMIC (P) LIMITED/ PERFECT POTTERI JABAL PUR (MP)/ BURN POTTERIES, JABALPUR</td>
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<tr>
<td>18</td>
<td>GUNMETAL VALVES (FULLWAY, CHECK, GLOBE AND NON RETURN VALVES)</td>
<td>LEADER VALVES LIMITED/ ARKAY SALSE CORPORATION DELHI</td>
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<td>19</td>
<td>BALL VALVE</td>
<td>TBS ENGINEERS PVT. LTD./ VIRGO ENGINEERING LTD./ GOOIJARIMAL GANPATRAI/ AUDCO INDIA LIMITED</td>
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<td>20</td>
<td>BUTTERFLY VALVE (LEVER TYPE)</td>
<td>LEADER VALVES LIMITED/ CASTLE VALVES LIMITED/ AUDCO INDIA LIMITED</td>
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<tr>
<td>21</td>
<td>BUTTERFLY VALVE (GEAR TYPE)</td>
<td>LEADER VALVES LIMITED/ CASTLE VALVES LIMITED/ AUDCO INDIA LIMITED/ GUOIJARIMAL GANPATRAI</td>
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<td>22</td>
<td>C.I. DOUBLE FLANGED SLUICE VALVE &amp; GATE VALVES</td>
<td>KIRLOSKAR BROTHERS LIMITED/ AARKO MANUFACTURING COMPANY/ ARROW ENGF.LTD</td>
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<td>23</td>
<td>FLOAT VALVE (GUNMETAL) UPTO 40M</td>
<td>SANT INDUSTRIAL CONTROLS (P) LIMITED/ BOMBAY METAL &amp; ALLOYS/ LEADER VALVES LIMITED</td>
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<td>FLOAT VALVE (C.I) 50M AND ABOVE</td>
<td>LEADER VALVES LIMITED/ INDIAN VALVE CO. LTD.</td>
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<td>FOOT VALVE / CHECK VALVES (BRASS)</td>
<td>LEADER VALVES LIMITED/ INDIAN VALVE CO. LTD. CALCUTTA/ ADVANCE VALVES (P) LIMITED/ GOOIJARIMAL GANPATRAI/ AARKO MANUFACTURING COMPANY</td>
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<td>26</td>
<td>AIR RELEASE VALVES (BRASS / CAST IRON)</td>
<td>LEADER VALVES LIMITED/ ADVANCE VALVES (P) LIMITED/ AARKO MANUFACTURING COMPANY/ GOOIJARIMAL GANPATRAI</td>
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<td>27</td>
<td>C.I. MANHOLES COVER &amp; G.I. GRATING</td>
<td>K. K. MANHOLE &amp; GRATING CO. PRIVATE LIMITED/ BANGAL IRON COMPANY WEST BANGAL/ SHINING ENGINEERING WORKS (FOUNDRY) AGRA</td>
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<td>28</td>
<td>HAND DRIER (304 Grade S.S.)</td>
<td>THE VEERA TRADING COMPANY/ KOPAL ENGG. CORPN.NEW DELHI/ ASKON ENGINEERS BOMBAY</td>
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<td>29</td>
<td>LIQUID SOAP DISPENSER (304 Grade S.S.)</td>
<td>THE VEERA TRADING COMPANY/ ASKON ENGINEERS BOMBAY</td>
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<td>STORAGE TYPE WATER HEATER</td>
<td>VENUS / RACOLD/ BAJAJ OR EQUIVALENT</td>
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<td>31</td>
<td>INSULATION</td>
<td>THERMAFLEX OR EQUIVALENT</td>
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<td>SOLAR HOT WATER EQUIPMENT</td>
<td>TATA -BP/ SOLAHART</td>
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<td>ELECTRICAL HOT WATER HEATER</td>
<td>VENUS/ KINGSTON</td>
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<td>PVC FOOT REST &amp; SFRC COVERS</td>
<td>KK MANHOLES OR EQUIVALENT</td>
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### PUMPS AND EQUIPMENTS

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<tr>
<td>1</td>
<td>WATER TRANSFER PUMPS ABB/ GROUNDFOS/ KIRLOSKAR/ SIEMENS/ CROMPTON</td>
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<td>IRRIGATION PUMP GROUNDFOS/ KIRLOSKAR</td>
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<td>SUMP PUMP SALMSON/ ZENIT/ KSB/ GROUNDFOS</td>
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<td>WATER LEVEL INDICATOR ADVANCE OR EQUIVALENT</td>
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<td>WATER LEVEL CONTROLLER ADVANCE OR EQUIVALENT</td>
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<td>ELECTRONIC SENSING PROBE ADVANCE OR EQUIVALENT</td>
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<td>CHLORINATOR ASIA LMI Pvt. Ltd/ TOSHNIWAL</td>
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<td>8</td>
<td>WATER METER CRESENT/ KAYEE/ KAPSTAN/ ANAND AASHI</td>
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<td>9</td>
<td>SOUNDER PATTERN VALVE FOR FILTER AND SOFTENER LABLINE/ AIP (AGRICULTURE AND INDUSTRIAL PUMPS.</td>
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<td>PRESSURE GAUGE FIEBIG/ H. GURU</td>
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<td>ELECTRICAL PANEL ADVANCE/ DIAMOND</td>
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<td>NON RETURN VALVE (65mm DIA &amp; ABOVE)</td>
<td>KIRLOSKAR/ LEADER</td>
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<td>BUTTERFLY VALVE (LEVER TYPE)</td>
<td>LEADER VALVE LIMITED/ CASTLE VALVE LIMITED/ AUDCO INDIA LIMITED</td>
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<td>BUTTERFLY VALVE (GEAR TYPE)</td>
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<td>FILTER AND SOFTENER</td>
<td>THERMAX/ WATCON/ BHARTIYA TECHNO CRAFT/ MIGRANI</td>
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<td>MOTORIZED VALVE</td>
<td>DANFOSS/ HONEYWELL</td>
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<td>VIBRATION PAD</td>
<td>RESISTOFLEX/ KANWAL INDUSTRIES</td>
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<td>VIBRATION ELIMINATOR</td>
<td>RESISTOFLEX/ KANWAL INDUSTRIES</td>
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#### Packaged Items

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<td>BOILER</td>
<td>FORBES MARSHEL, THERMAX</td>
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<td>SEWERAGE TREATMENT PLANT</td>
<td>THERMAX/ WACORP HYUNDAGET WATER</td>
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<td>INCINERATOR</td>
<td>THERMAX / APEX</td>
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<td>SCRUB SINK</td>
<td>VIJAY METAL INDUSTRIES / AKG</td>
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#### FIRE FIGHTING SYSTEM

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<td>ELECTRIC DRIVEN MOTOR AND PUMPS</td>
<td>GRUNDFOS / MATHER PLATT / EBARA / WILO / EMU / DP</td>
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<td>ELECTRIC DRIVEN MOTOR AND PUMPS (INDIAN STANDARD)</td>
<td>GRUNDFOS / MATHER PLATT / EBARA / WILO / EMU / DP</td>
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<td>DIESEL ENGINE</td>
<td>KIRLOSKAR / ASHOK LEYLAND / CUMMINS</td>
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<td>G.I. AND M.S. PIPES</td>
<td>TATA / JINDAL HISAR / PRAKASH</td>
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<td>5</td>
<td>FIRE HOSE PIPES / R R.L. HOSE PIPE</td>
<td>NEWAGE / CRC / PADMINI / G. TECH / INDIAN RAYON. / SUPEREME</td>
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<td>6</td>
<td>FIRST AID FIRE HOSE REEL WITH BRACKET, DRUM AND NOZZLE</td>
<td>JYOTI / TIGER / PADMINI</td>
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<td>7</td>
<td>G.I. AND M.S. FITTINGS</td>
<td>R / KS / UNIK / DRP / ZOOTO</td>
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<td>C.I. DOUBLE FLANGED SLUICE / GATE VALVE / NON-RETURN VALVES</td>
<td>H.SARKAR / KIRLOSKAR / SANT / LEADER / KALPANA / KARTAR</td>
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<td>SLIM SEAL BUTTERFLY VALVES (PN 1.6)</td>
<td>AUDCO / SANT / C&amp;R / KSB / INTERVALVE / CASTLE / ARROW</td>
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<td>C. I. BODY BUTTERFLY VALVE</td>
<td>AUDCO / SANT / INTERVALVE / CASTLE / ARROW / DANFOSS</td>
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<td>GUN METAL BODY BUTTERFLY VALVE</td>
<td>AUDCO / SANT / INTERVALVE / CASTLE / ARROW / DANFOSS</td>
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<tr>
<td>12</td>
<td>ALARM GONG</td>
<td>HD OR EQUIVALENT</td>
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<tr>
<td>13</td>
<td>QB. SPRINKLER</td>
<td>TYCO / GRINNEL / KIDDE / CENTRAL / GTECH</td>
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<tr>
<td>14</td>
<td>WRAPPING AND COATING</td>
<td>PYPECOAT / RUSTECH / COALTEK</td>
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<tr>
<td>15</td>
<td>FABRICATED FIRE HOSE CABINET</td>
<td>STEELAGE / NEWAGE / G. TECH</td>
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<tr>
<td>16</td>
<td>BRANCH PIPE / NOZZLES (GUN METAL / BRASS / COPPER &amp; BRASS / ALUMINUM)</td>
<td>MINMAX / NEWAGE / G. TECH</td>
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<tr>
<td>17</td>
<td>FIRE EXTINGUISHERS</td>
<td>MINMAX / NEWAGE / G. TECH</td>
</tr>
<tr>
<td>18</td>
<td>FIRE BRIGADE CONNECTION</td>
<td>NEWAGE / MINMAX / G. TECH / SUPEREX</td>
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<tr>
<td>19</td>
<td>SUCTION STRAINER</td>
<td>JATPEE / GRANDPRIT / DASHMESH</td>
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<tr>
<td>20</td>
<td>VIBRATION CONNECTORS ELIMINATOR</td>
<td>RESISTOFLEX / KHANWAL / D. WREN</td>
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<tr>
<td>21</td>
<td>SINGLE PHASING PREVENTOR (CURRENT OPERATED)</td>
<td>L &amp; T / SIEMENS / MINILEC</td>
</tr>
<tr>
<td>22</td>
<td>FLOW METER</td>
<td>SCIENTIFIC EQUIPMENT. (P) LTD. SHALI BANDA HYDERABAD - 500263</td>
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### List Of Preferred Makes

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Item</th>
<th>Manufacturer’s Name</th>
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</thead>
<tbody>
<tr>
<td>23</td>
<td>ELECTRICAL SWITCHGEAR &amp; STARTERS</td>
<td>SIEMENS / L &amp; T / ABB</td>
</tr>
<tr>
<td>24</td>
<td>CABLES</td>
<td>SKYTONE / GLOSTER / NICCO / ASIAN / (RPG) UNIVERSAL / POLY CAB</td>
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<tr>
<td>25</td>
<td>FLOW SWITCH</td>
<td>POTTER / SYSTEM SENSOR / JHONSON CONTROL</td>
</tr>
<tr>
<td>26</td>
<td>MAIN CONTROL PANEL (POWDER COATED)</td>
<td>TRICOLITE / ADLEC / TRINITRON / VIDYUT CONTORL / CONELEC / ENGINEERING (P) LTD. / UNILEC LTD. / RISHA / ADVANCE PANNEL / ADVANCE GEARS</td>
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<tr>
<td>27</td>
<td>PRESSURE SWITCHES</td>
<td>INDFOSS / SWITZER</td>
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<tr>
<td>28</td>
<td>PRESSURE GAUGE</td>
<td>H.GURU / FIEBIG</td>
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<tr>
<td>29</td>
<td>BATTERY</td>
<td>EXIDE / PRESTOLITE</td>
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<tr>
<td>30</td>
<td>PAINT ENAMEL OF PIPES ETC.</td>
<td>J&amp;N / ASIAN / NEROLAC / BERGER</td>
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<tr>
<td>31</td>
<td>ANNUNCIATION PANEL FOR SPRINKLER SYSTEM</td>
<td>PCD / SAFEWAY / AGNI (INDIA)</td>
</tr>
<tr>
<td>32</td>
<td>ALARM VALVE &amp; HYDRAULIC ALARM MOTOR WITH COVERING</td>
<td>MATHER &amp; PLATT / HD</td>
</tr>
<tr>
<td>33</td>
<td>CONTACTOR</td>
<td>L&amp;T / SIEMENS / SCHNEIDE / GE / ABB</td>
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<tr>
<td>34</td>
<td>THIMBLES / FERRULES (TINNED COPPER)</td>
<td>DOWEL OR EQUIVALENT</td>
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<tr>
<td>35</td>
<td>CABLE GLANDS</td>
<td>COMMEX / POWER / GRIPWELL</td>
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<tr>
<td>36</td>
<td>POWER CAPACITOR</td>
<td>L&amp;T / CROMPTON / ASIAN / DUCATTI</td>
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<tr>
<td>37</td>
<td>MEASURING METER (DIGITAL)</td>
<td>L&amp;T / SIEMENS / AE / ENERCON</td>
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<tr>
<td>38</td>
<td>DASH FASTENER</td>
<td>HILTI / FISHER</td>
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<tr>
<td>39</td>
<td>PAINT PRIMERS</td>
<td>ASIAN / JENSON NICHOLSON</td>
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<tr>
<td>40</td>
<td>WELDING ELECTRODES</td>
<td>ADVANI / ESAB / VICTOR</td>
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<tr>
<td>41</td>
<td>PIPE HANGERS</td>
<td>CHILLY / GMGR</td>
</tr>
<tr>
<td>42</td>
<td>MCB, DBs</td>
<td>MDS / LEGRAND / INDO ASIAN (GOLDLINE) HEGER</td>
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### HVAC WORK

#### A. MECHANICAL EQUIPMENT

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Item</th>
<th>Manufacturer’s Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CHILLING MACHINE</td>
<td>CARRIER/ TRANE/McQUAY/YORK</td>
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<tr>
<td>2</td>
<td>AIR HANDLING</td>
<td>CARYAIRE / ZECO / EDGETECH / ETHOS / MAPRO</td>
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<tr>
<td>3</td>
<td>THERMAL HEAT RECOVERY WHEEL</td>
<td>BRY AIR OR EQUIVALENT</td>
</tr>
<tr>
<td>4</td>
<td>AIR WASHER UNIT</td>
<td>ZECO / ROOTS / EDGETECH / WAVES / AMBASSADOR</td>
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<tr>
<td>5</td>
<td>PUMPING SET (CONSTANT SPEED)</td>
<td>BEACON / KSB / KIRLOSKAR / MATHER &amp; PLATT</td>
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<tr>
<td>6</td>
<td>PUMPING SET (VARIABLE SPEED)</td>
<td>ITT B&amp;G / GRUNDOFF / WILCO</td>
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<tr>
<td>7</td>
<td>COOLING TOWER</td>
<td>PAHARPUR / MIHIR / FLOWTECH / BELL / ADVANCE</td>
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<tr>
<td>8</td>
<td>CENTRIFUGAL FAN</td>
<td>KRUGER / FLAKT / NICOTRA</td>
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<tr>
<td>9</td>
<td>AXIAL FLOW FAN</td>
<td>KRUGER / FLAKT / NICOTRA / MAPRO</td>
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<tr>
<td>10</td>
<td>INLINE FAN</td>
<td>EDETEEH/ FLAKT / NICOTRA / NUAIRE / MAPRO</td>
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<tr>
<td>11</td>
<td>VAV BOX</td>
<td>CARRYAIRE / RAVISTAR / HONEYWELL WEBS</td>
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<tr>
<td>12</td>
<td>PRECISION / HIGH SENSIBLE AC UNIT</td>
<td>EMERSON / STULZ / UNIFLAIR</td>
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<tr>
<td>13</td>
<td>THERMAL HEAT RECOVERY WHEEL</td>
<td>NVELAIRE / FLAKTWOODS</td>
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<tr>
<td>14</td>
<td>EOT CRANE</td>
<td>MUKAND/MIJ/JESSOP/JD / HOIST &amp; CRANES / DHIRAJ ENTERPRISES / S. CRANE ENGG. WORKS / FAFCO</td>
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<tr>
<td>15</td>
<td>3T DIESEL OPERATED FORK LIFT TRUCK</td>
<td>ESCORTS/VOLTAS/TIL/ACE/GODREJ</td>
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<tr>
<td>16</td>
<td>3T UNDERLUNG SINGLE GIRDER</td>
<td>ARMSEL/SHIVPRA/S. CRANE ENGG WORKS</td>
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<tr>
<td>S. No.</td>
<td>Item</td>
<td>Manufacturer’s Name</td>
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<tr>
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</tr>
<tr>
<td>3</td>
<td>MANUAL BALANCING VALVE</td>
<td>ADVANCE / CASTLE / C &amp; R</td>
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<tr>
<td>4</td>
<td>AUTOMATIC BALANCING VALVE</td>
<td>FLOCON / T &amp; A / DANFOSS / BELL &amp; GOSSETT</td>
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<tr>
<td>5</td>
<td>BALL VALVE</td>
<td>RAPID CONTROL / ZOLOTO / GG / LEADER</td>
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<tr>
<td>6</td>
<td>GUN METAL GATE VALVE</td>
<td>LEADER / ZOLOTO</td>
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<tr>
<td>7</td>
<td>POT / Y-STRAINER</td>
<td>RAPID COOL / DS ENGG / EMERALD / LEADER</td>
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<tr>
<td>8</td>
<td>NON RETURN VALVE</td>
<td>ADVANCE / CASTLE / C &amp; R / AUDCO</td>
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<tr>
<td>9</td>
<td>BINDER’S TEST POINT</td>
<td>ANERGY OR EQUIVALENT</td>
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<tr>
<td>10</td>
<td>PRESSURE GAUGE</td>
<td>H-GURU / FEIBIG / JAPSIN</td>
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<td>11</td>
<td>V-GROOVE THERMOMETER</td>
<td>H-GURU / EMERALD / JAPSIN</td>
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<td>DIAL TYPE THERMOMETER</td>
<td>H-GURU / EMERALD / TAYLOR / STAR SCIENTIFIC</td>
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<tr>
<td>13</td>
<td>MODULATING / CONTROL VALVES</td>
<td>HONEYWELL / DANFOSS / SIEMENS / B &amp; G</td>
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<tr>
<td>14</td>
<td>AUTO AIR VENT</td>
<td>RAPID CONTROL / ANERGY</td>
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C. DUCTS, GRILLS, DIFFUSERS & DAMPERS:

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<thead>
<tr>
<th>S. No.</th>
<th>Item</th>
<th>Manufacturer’s Name</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>GSS FOR SITE FABRICATED DUCT</td>
<td>SAIL / TATA / NIPPO / BHUSHAN</td>
</tr>
<tr>
<td>2</td>
<td>FIRE / SMOKE DAMPER</td>
<td>CARYAIRE / MAPRO / RAVISTAR</td>
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<tr>
<td>3</td>
<td>GRILLE, DIFFUSER &amp; DAMPERS</td>
<td>RAVISTAR / CARYAIRE / DYNACRAFT / MAPRO</td>
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<tr>
<td>4</td>
<td>SOUND ATTENUATORS</td>
<td>RAVISTAR / CARYAIRE / KRUGER / MAPRO</td>
</tr>
<tr>
<td>5</td>
<td>ANCHOR FASTENERS</td>
<td>HILTI / FISCHER</td>
</tr>
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</table>

D. INSULATION

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Item</th>
<th>Manufacturer’s Name</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>GLASS WOOL, FIBER GLASS</td>
<td>UP TWIGA / OWENS CORNING / KIMMCO</td>
</tr>
<tr>
<td>2</td>
<td>FRP TISSUE</td>
<td>UP TWIGA OR EQUIVALENT</td>
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<td>3</td>
<td>EXPANDED POLYSTYRENE</td>
<td>BEARDSSELL / PR PACKAGING / CAPRICON</td>
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<tr>
<td>4</td>
<td>CLOSED CELL RUBBER INSULATION</td>
<td>ARMAFLEX / AEROFLEX / SUPERLON</td>
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<td>5</td>
<td>PUF PIPE SUPPORT</td>
<td>MALLANPUR TECH / BEST PLASTRONICS / LLOYD</td>
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<td>6</td>
<td>CPRX COMPOUND</td>
<td>SHALIMAR / ASIAN</td>
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<tr>
<td>7</td>
<td>PROTECTIVE COATING OVER INSULATION</td>
<td>PARAMOUNT POLYTREAT</td>
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E. ELECTRICAL ITEMS

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<th>S. No.</th>
<th>Item</th>
<th>Manufacturer’s Name</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>ELECTRICAL MOTORS</td>
<td>SIEMENS / ABB / CROMPTON</td>
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<tr>
<td>2</td>
<td>LED LIGHT</td>
<td>ARTLITE / COLOUR DESIGN / FIBRE LITE / THORN</td>
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<tr>
<td>3</td>
<td>FUSES &amp; SWITCH FUSE UNIT</td>
<td>SIEMENS / ABB / SCHNEIDER / GE / L &amp; T</td>
</tr>
<tr>
<td>4</td>
<td>ACB / MCCB / CONTACTOR</td>
<td>SIEMENS / ABB / SCHNEIDER / GE / L &amp; T</td>
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</tbody>
</table>
5. METAL CLAD SOCKET | MDS / NEPTUNE (BALS) / BCH
6. ISOLATORS FOR MOTORS | MDS / SIEMENS / L & T
7. CHANGE OVER SWITCH | HH-ELCON / HPL SOCOMAC / GE / HAVELLS
8. CONTACTOR, TIMER, SINGLE PHASE | SIEMENS / ABB / GE / L & T
9. METERS - DIGITAL TYPE | CONSERVE / AE / L & T / RISHAB
10. PROTECTIVE & APFC RELAYS | SIEMENS / GE / L & T / ASLTM
11. CT's / PT's - DRY TYPE-EPOXY | AE / KAPPA / PRAGATI
12. INDICATING LAMP / PUSH BUTTON ACTUATORS - LED CLUSTER TYPE | SIEMENS / L & T / BCH / GE

### List Of Preferred Makes

<table>
<thead>
<tr>
<th>S. No.</th>
<th>Item</th>
<th>Manufacturer's Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>ROTARY SWITCHES</td>
<td>L &amp; T / BCH / GE / KAYCEE</td>
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<tr>
<td>14</td>
<td>TERMINAL BLOCK</td>
<td>ELEMEX / WAGO</td>
</tr>
<tr>
<td>15</td>
<td>LT ELECTRICAL PANEL BOARDS</td>
<td>TRICOLITE / ADLEC / ADVANCE / VIDHYUT / EAP</td>
</tr>
<tr>
<td>16</td>
<td>CABLE TRAYS</td>
<td>PROFAB / PILOCO / SLOTCO / VENUS</td>
</tr>
<tr>
<td>17</td>
<td>PVC INSULATED COPPER CONDUCTOR</td>
<td>FINOLEX / POLYCAB / SKYTONE / HAVELLS / DELTON</td>
</tr>
<tr>
<td>18</td>
<td>PVC INSULATION TAPE</td>
<td>STEEL GRIP / ANCHOR</td>
</tr>
<tr>
<td>19</td>
<td>SINGLE PHASE EXHAUST FAN</td>
<td>CROMPTON / KHAITAN / GEC / POLAR / ALMONARD</td>
</tr>
<tr>
<td>20</td>
<td>LT POWER / CONTROL CABLES</td>
<td>FINOLEX / POLYCAB / SKYTONE / DELTON / GRANDLAY</td>
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### F. MISCELLANEOUS:

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<th>Item</th>
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<tbody>
<tr>
<td>1</td>
<td>FINE FILTER, HEPA FILTER</td>
<td>DYNA FILTERS / THERMODYNE / ANFILCO / PUROMATIC / PUROLATOR</td>
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<tr>
<td>2</td>
<td>DUCT SILENCER</td>
<td>CARYAIRE / KRUGER</td>
</tr>
<tr>
<td>3</td>
<td>THERMOSTAT / HUMIDISTAT</td>
<td>HONEYWELL / SIEMENS / JOHNSON / RANCO</td>
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<tr>
<td>4</td>
<td>WATER FLOW SWITCH, AIRSTAT</td>
<td>RAPID CONTROL / ANERGY</td>
</tr>
<tr>
<td>5</td>
<td>VIBRATION ISOLATOR</td>
<td>RESISTOFLEX / EMERALD</td>
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### LIFT

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<th>Item</th>
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<tbody>
<tr>
<td>1</td>
<td>LIFTS</td>
<td>OTIS / KONE / SCHINDLER / MITSUBISHI</td>
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### BUILDING MANAGEMENT SYSTEM

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<th>S. No.</th>
<th>Item</th>
<th>Manufacturer's Name</th>
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<tbody>
<tr>
<td>1</td>
<td>BUILDING MANAGEMENT SYSTEM</td>
<td>HONEYWELL WEBS / SIEMENS / CARRIER ALC</td>
</tr>
<tr>
<td>2</td>
<td>IMMERSION TEMPERATURE SENSOR</td>
<td>HONEYWELL WEBS / SIEMENS / GREY STONE</td>
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<tr>
<td>3</td>
<td>DUCT TEMPERATURE SENSOR</td>
<td>HONEYWELL WEBS / SIEMENS / KELE</td>
</tr>
<tr>
<td>4</td>
<td>OUTSIDE AIR TEMPERATURE SENSOR</td>
<td>HONEYWELL WEBS / SIEMENS / GREY STONE</td>
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<td>WATER FLOW METER</td>
<td>HONEYWELL WEBS / SIEMENS / CARRIER ALC</td>
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<tr>
<td>6</td>
<td>WATER FLOW SWITCH</td>
<td>HONEYWELL WEBS / SIEMENS / CARRIER ALC</td>
</tr>
<tr>
<td>7</td>
<td>THERMOSTAT / HUMIDISTAT</td>
<td>HONEYWELL WEBS / SIEMENS / JOHNSON</td>
</tr>
<tr>
<td>8</td>
<td>WATER FLOW SWITCH, AIRSTAT</td>
<td>RAPID CONTROL / ANERGY</td>
</tr>
<tr>
<td>9</td>
<td>VIBRATION ISOLATOR</td>
<td>RESISTOFLEX / EMERALD</td>
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<td>10</td>
<td>VOLTAGE / CURRENT TRANSUDER</td>
<td>ENERCON / CONZERV / ELECTREX / SETO</td>
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<td>11</td>
<td>FREQUENCY TRANSUDER</td>
<td>ENERCON / CONZERV / ELECTREX / SETO</td>
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<tr>
<td>12</td>
<td>PERSONAL COMPUTER</td>
<td>HP / COMPAQ / IBM</td>
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</tbody>
</table>
Note: Contractors are requested to take approval from Engineer-in-Charge before procurement from the list of Preferred makes. However, if the listed makes is not available in market or due to shortage of supply, contractor may propose the equivalent make for approval of the Engineer-in-Charge. The decision of Engineer-in-Charge will be final and binding on contractors in this regard.

### LIST OF PREFERRED MAKES OF MATERIALS of Electrical Works

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<tr>
<th></th>
<th>Materials</th>
<th>Preferred Makes</th>
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<tbody>
<tr>
<td>1</td>
<td>6.6 KV HT Panel with VCB / SF6 Circuit Breaker</td>
<td>Kirloskar/Siemens/Schneider/ABB/Tricolite/CGL/Advance/Areva</td>
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<tr>
<td>2</td>
<td>Dry Type Distribution Transformer 6.6KV/0.433 KV</td>
<td>Kirloskar/Crompton Greaves/Siemens/Voltamp/BHEL</td>
</tr>
<tr>
<td>3</td>
<td>Hermetically Sealed Transformer,(11KV/0.433 KV)</td>
<td>Crompton Greaves/Kotsons/Danish/Sudhir IVL</td>
</tr>
<tr>
<td>4</td>
<td>Package Substation</td>
<td>Schneider/ABB/Voltamp/Sudhir</td>
</tr>
<tr>
<td>5</td>
<td>Cubical Type PLC / L.T. Panel/Synch. Panel</td>
<td>Tricolite/Adlec/L&amp;T/Zeta/Milestone/Advance/Schneider/C&amp;S</td>
</tr>
<tr>
<td>6</td>
<td>ACB with Variable Integral Releases for Protection</td>
<td>Schneider Electric/ABB/Siemens/Mitsubishi/L&amp;T</td>
</tr>
<tr>
<td>7</td>
<td>MCCB with Variable (Static/T.M. Based Releases</td>
<td>ABB/L&amp;T/Schneider Electric/Siemens</td>
</tr>
<tr>
<td>8</td>
<td>By Pass Switch &amp; ATS</td>
<td>L&amp;T/GE/MDS/Schneider electric/Mitsubishi/ASCO</td>
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<tr>
<td>9</td>
<td>Measuring Instruments (Digital &amp; Analogue both)/ Dual type Energy Meter</td>
<td>AEI/Enercon/Secure/Trinity/L&amp;T</td>
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<tr>
<td>10</td>
<td>Panel Accessories</td>
<td>Siemens/L&amp;T/Schneider/HPL</td>
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<td>11</td>
<td>Protective Relays</td>
<td>ABB/Siemens-Epcos/L&amp;T/Areva</td>
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<td>12</td>
<td>Capacitor</td>
<td>ABB/L&amp;T/Epcos/Schneider/Ducati/Khatau/Asian</td>
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<td>13</td>
<td>APFC Relay (Digital Micro Processor Based)</td>
<td>L&amp;T / Ducati/EPCOS/ Emerson</td>
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<td>14</td>
<td>Control Fuses with Base</td>
<td>Siemens / GE / EE / C&amp;S/L&amp;T</td>
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<td>15</td>
<td>Selector Switch</td>
<td>Siemens / Salzer / HPL</td>
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<tr>
<td>16</td>
<td>CT’s (Cast Resin)</td>
<td>Kappa/ AE/ Matrix/ Conzerv</td>
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<tr>
<td>17</td>
<td>Contactors</td>
<td>L&amp;T / ABB / Siemens / Group Schneider/Mitsubishi</td>
</tr>
<tr>
<td>18</td>
<td>Terminal Strip</td>
<td>Siemens / Elmex / C&amp;S</td>
</tr>
<tr>
<td>19</td>
<td>MCB, DB’s &amp; Industrial Socket Outlets</td>
<td>Legrand (Lexic)/ ABB / Schneider Electric (Multiline) / L&amp;T (Hager)/ Mitsubishi</td>
</tr>
<tr>
<td>20</td>
<td>Programmable Timer (Self Powered Electronic Digital)</td>
<td>Siemens / L&amp;T / Legrand/Schneider Electric</td>
</tr>
<tr>
<td>21</td>
<td>Auxiliary Relays (Digital Type)</td>
<td>Siemens / Alstom / L&amp;T/ Areva/ ABB</td>
</tr>
<tr>
<td>22</td>
<td>Switch Fuse Unit</td>
<td>L&amp;T / ABB / GE /C&amp;S / HPL</td>
</tr>
<tr>
<td>23</td>
<td>Motor Starters</td>
<td>L&amp;T / ABB / Siemens / Schneider/C&amp;S</td>
</tr>
<tr>
<td>24</td>
<td>Microprocessor Based PLC Logic</td>
<td>Allen Bradley / ABB / Siemens / Rockwell</td>
</tr>
<tr>
<td>25</td>
<td>11 KV Gang Operated Switch &amp; Drop Out Fuse</td>
<td>Pactel / ELPRO / Jaipuria</td>
</tr>
<tr>
<td>26</td>
<td>11 KV Insulator</td>
<td>Jayashree / Modern / IEC</td>
</tr>
<tr>
<td>27</td>
<td>XLPE Al. Conductor Cable 11 KV grade</td>
<td>Universal /Asian Cable /CCI / Havells/Gloster/Polycab</td>
</tr>
<tr>
<td>28</td>
<td>XLPE Al. Conductor 1.1 KV Grade</td>
<td>Polycab / Skytone / Universal / Havells / Asian / Gloster/ CCI</td>
</tr>
<tr>
<td>29</td>
<td>Jointing Kit XLPE (11KV)</td>
<td>Ray Chem / Birla 3M / Mahindra / RPG / Cabsel</td>
</tr>
<tr>
<td>30</td>
<td>Brass Compression Gland (Heavy / Medium Duty)</td>
<td>Commex / Gripwell/Jainsons/Comet</td>
</tr>
<tr>
<td>31</td>
<td>Crimping Lugs / Thimbles</td>
<td>Dowel / Gripwell/Jainsons</td>
</tr>
<tr>
<td>32</td>
<td>Battery Charger</td>
<td>Volstat / Amaraja/STATCON/BCH</td>
</tr>
<tr>
<td>33</td>
<td>Sealed Maintenance Free Battery</td>
<td>Exide /Amco / SF/Amaraja</td>
</tr>
<tr>
<td>34</td>
<td>Land Acid Battery</td>
<td>Exide /Okaya /Luminaries /SF/ Amaraja</td>
</tr>
<tr>
<td>35</td>
<td>Cable Tray</td>
<td>Steelways /MEM/Slotco / Rico Steel/ Pilco/Patny</td>
</tr>
<tr>
<td>36</td>
<td>G.I. Strip &amp; Earthing Material</td>
<td>As per IS Codes &amp; as approved by Site Engg.</td>
</tr>
<tr>
<td></td>
<td></td>
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<tr>
<td>---</td>
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<td>---</td>
</tr>
<tr>
<td>37</td>
<td>PVC Conduit (ISI)</td>
<td>Polypack / BEC / Precision/Dauphin/AKG/ATUL or any ISI marked</td>
</tr>
<tr>
<td>38</td>
<td>M.S. Conduit</td>
<td>BEC/Steelkraft/AKG/ATUL or any ISI marked</td>
</tr>
<tr>
<td>39</td>
<td>Modular Plate Switch Socket with Switch Boxes.</td>
<td>Legrand / M.K. / Clipsal / Anchor/Havells/ Crabtree</td>
</tr>
<tr>
<td>40</td>
<td>Industrial Sockets Outlets</td>
<td>L&amp;T / ABB / Clipsal/ Legrand / GE</td>
</tr>
<tr>
<td>41</td>
<td>Copper Control Cable</td>
<td>Finolex / Polycab / Skytone/RR Kable / NICCO/Havells/ National/ Delton</td>
</tr>
<tr>
<td>42</td>
<td>PVC Insulated Copper Wire 1.1 KV Grade (FRLS)</td>
<td>Finolex / Polycab/ Skytone/ Bonton/ Belden/RR Kable/ National/ Delton</td>
</tr>
<tr>
<td>43</td>
<td>Telephone Cable Multipair</td>
<td>Belden / Delton / Skytone / Bonton</td>
</tr>
<tr>
<td>44</td>
<td>CAT-5E /CAT-6E Wire</td>
<td>AMP / Delton / Skytone/ Belden</td>
</tr>
<tr>
<td>45</td>
<td>Co-axial TV Cable</td>
<td>Commscope / Belden/Skytone</td>
</tr>
<tr>
<td>46</td>
<td>Telephone Tag Block with Boxes</td>
<td>Krone (German) / Pouyet</td>
</tr>
<tr>
<td>47</td>
<td>Tap-Off/ Splitter</td>
<td>Zinwell/ Novatron</td>
</tr>
<tr>
<td>48</td>
<td>a) Luminaries (Flourescent)</td>
<td>Philips / Wipro / Bajaj/Havells/ Crompton</td>
</tr>
<tr>
<td></td>
<td>b) Luminaries (Incandescent)</td>
<td>Artlite / Decon / GE/Bajaj/ Crompton</td>
</tr>
<tr>
<td>50</td>
<td>Ceiling Fan</td>
<td>Crompton Greaves / Orient/Havells/GEC/Usha</td>
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<tr>
<td>51</td>
<td>Exhaust Fans</td>
<td>Crompton Greaves / GEC/ Havells</td>
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<tr>
<td>52</td>
<td>Inverter</td>
<td>Microtek / Luminous / Su-kam</td>
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<tr>
<td>53</td>
<td>UPS</td>
<td>Emerson / A.P.C /Socomec</td>
</tr>
<tr>
<td>54</td>
<td>Poles</td>
<td>Bajaj/ Transrail/Reputed</td>
</tr>
<tr>
<td>55</td>
<td>Hand Gloves &amp; Rubber mat</td>
<td>ISI Approved</td>
</tr>
<tr>
<td>56</td>
<td>Fire Extinguisher</td>
<td>Ceasefire/Exflame/Minimax/Life guard/Safex</td>
</tr>
<tr>
<td>57</td>
<td>DG Set</td>
<td>JACKSON/SUDHIR/STERLING&amp;WILSON/SUPERNOVA</td>
</tr>
<tr>
<td>A)</td>
<td>Diesel Engine</td>
<td>Cummins/ Kirloskar/Volvo/Cater Pillar/Mitsubishi/MTV</td>
</tr>
<tr>
<td>B)</td>
<td>Alternator</td>
<td>Leroyosmer/Stamford/Kirloskar/Volvo/Mitsubishi/MTV</td>
</tr>
<tr>
<td>S.N.</td>
<td>MATERIALS</td>
<td>I.S.</td>
</tr>
<tr>
<td>------</td>
<td>---------------------------------</td>
<td>--------</td>
</tr>
<tr>
<td>1.</td>
<td>G.I.PIPES/M.S.PIPES</td>
<td>1239</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3589</td>
</tr>
<tr>
<td>2.</td>
<td>G.I.FITTINGS(MALLEABLE CAST IRON)</td>
<td>1879</td>
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<tr>
<td>3.</td>
<td>BALL VALVES</td>
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<tr>
<td>4.</td>
<td>NON RETURN VALVES</td>
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</tr>
<tr>
<td></td>
<td>(DUAL PLATE TYPE)</td>
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<tr>
<td>5.</td>
<td>BUTTERFLY VALVE</td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>EXTERNAL PIPECOATING</td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>ENAMEL, BITUMASTIC</td>
<td></td>
</tr>
</tbody>
</table>

NOTE:
Contractors are requested to take approval from Engineer-in-Charge before procurement from the list of preferred makes. However, if the listed makes is not available in market or due to shortage of supply, contractor may propose the equivalent make for approval of the Engineer-in-Charge. The decision of Engineer-in-Charge will be final and binding on contractors in this regard.
<table>
<thead>
<tr>
<th>S.N.</th>
<th>MATERIALS</th>
<th>I.S.</th>
<th>BRAND NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.</td>
<td>DASH FASTNERS</td>
<td></td>
<td>FISCHER</td>
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<tr>
<td>9.</td>
<td>VIBRATION-ELIMINATOR PADS/ FLEXIBLE PIPE CONNECTIONS</td>
<td></td>
<td>RESISTOFLEX,</td>
</tr>
<tr>
<td>10.</td>
<td>ELECTRICAL CONTROL PANELS</td>
<td></td>
<td>ANY. MANUFACTURER COMPETENT AS PER CPRI APPROVED WORK</td>
</tr>
<tr>
<td>11.</td>
<td>CENTRIFUGAL PUMPS</td>
<td></td>
<td>KIRLOSKAR / GRUNDFOS / EBARA/KPS</td>
</tr>
<tr>
<td>12.</td>
<td>SUBMERSIBLE PUMP</td>
<td></td>
<td>KIRLOSKAR / EBARA/ GRUNDFOS</td>
</tr>
<tr>
<td>13.</td>
<td>FIRE HOSE-PIPE</td>
<td></td>
<td>MINIMAX, OMEX, NEWAGE</td>
</tr>
<tr>
<td>14.</td>
<td>EXTERNAL-FIRE HOSE-BOX</td>
<td></td>
<td>SUPEREX, OMEX, NEWAGE</td>
</tr>
<tr>
<td>15.</td>
<td>FIREMAN AXE</td>
<td></td>
<td>SUPEREX, OMEX, NEWAGE</td>
</tr>
<tr>
<td>16.</td>
<td>HYDRANT VALVES, HOSEREELS, SHORT BRANCH PIPES AND COUPLING</td>
<td></td>
<td>MINIMAX, OMEX, NEWAGE</td>
</tr>
<tr>
<td>17.</td>
<td>FOUR-WAYS AND TWO WAYS COLLECTING HEAD</td>
<td></td>
<td>MINIMAX, OMEX, NEWAGE</td>
</tr>
<tr>
<td>18.</td>
<td>FIRE EXTINGUISHER</td>
<td></td>
<td>MINIMAX, OMEX, NEWAGE</td>
</tr>
<tr>
<td>19.</td>
<td>ANCHOR FASTNERS</td>
<td></td>
<td>HILTI, FISCHER</td>
</tr>
<tr>
<td>20.</td>
<td>PRESSURE SWITCHES</td>
<td></td>
<td>INDFOS DANFOS</td>
</tr>
<tr>
<td>21.</td>
<td>SPRINKLER HEAD, ALARM VALVE</td>
<td></td>
<td>HD FIRE PROTECT TYCO-SPRAYSAFE</td>
</tr>
<tr>
<td>22.</td>
<td>SPRINKLER MAKES</td>
<td></td>
<td>TYCO</td>
</tr>
</tbody>
</table>
NOTES:

1. All the materials should be ISI marked as specified in the schedule of quantities as shown in schedule of approved makes (i.e. whenever “as per ISS” whether in S.O.Q. or elsewhere this would be construed to mean “ISI branded”).

2. The Contractor shall produce samples before procurement of the material for approval of the Consultant/Client for all materials required for works. The material of the makes out of the above as approved by the Consultant shall be used on the work.

3. In respect of materials for which approved makes are not specified as above, the same shall be decided by the Consultant/Client and shall be as per sample got approved from Consultant/Client before procurement.

4. The Contractor shall submit data sheet of all materials before the date of start of work for approval from the Consultant/Client.

5. Any one of the brands in the list above may be used in the work after approval of the same from the Client.