PART 2

EMPLOYER'S REQUIREMENTS

Section - 6 : Employer's Requirements

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1. Overview of the Scope of Works

The work is to be executed on turnkey basis, the scope of which includes survey, network design, supply, manufacturer's quality assurance, testing (where specified/ required), transportation, storage, erection, including all civil/ structural works, site testing, commissioning of all items & materials including all associated activities though not exclusively specified herein and are required for the completion and satisfactory performance of the entire works as intended. The above said work are to be executed in the predefined phase manner work to achieve targets as per Action Plan of RDSS.

The scope of works also include General Technical Instructions enclosed at Annexure-B.

This specification intends to cover but not limited to the following activities, services and works:

- Providing engineering data, and drawing for review, approval and records.
- Supply, testing, packing, transportation and insurance from the manufacturer's work to the site.
- Receipt, storage, insurance, preservation and conservation of equipments at the site.
- Fabrication, pre-assembly (if any), erection, testing and putting into satisfactory operation of all the equipments/ materials including successful commissioning.
- In addition to the requirements indicated in this section, all the requirements as stated in Technical specifications shall also be considered as a part of this specification as if completely bound herewith.
- Providing all materials, equipments and services specified or otherwise, including survey, which are required to fulfill the intent of ensuring operability, maintainability and the reliability of the complete works covered under this specification.
- During warranty period the bidder is required to provide all the services and activities mentioned in the contract.
- Preparation of project completion report/ closure proposal along with a report clearly indicating completion of any outstanding/ remedial work that needs to be carried out.
- Handing over the works to the employer for taking into commercial services.

It is not the intent to specify all aspects of design and construction of equipments mentioned herein. The systems, subsystems and equipments shall conform in all respect to high standards of engineering, design and workmanship and shall be capable of performing in continuous commercial operation. Accordingly, scope of works under this contract is as under:

1.1 Execution of all other works as per tender document. All Steel structure shall be hot dip galvanized as per relevant Indian Standard.

1.2 All the raw materials such as steel, zinc for galvanizing, reinforcement steel and cement for foundation, coke for earthing, bolts, nuts & washers, danger plates, phase plate, number plate etc. required for substations & its structures shall be included in the scope of supply. Bidders shall clearly indicate in their offer, the sources from where they propose to procure the raw materials and the components

1.3 All the Distribution Transformers procured under RDSS are procured with Standard ratings, meeting at least Energy Efficiency Level-1 as specified in IS 1180 (Part-1):2014 and its Amendment 1, 2, 3 & 4, should be manufactured by an authorized licensee and bear BIS certification standard mark.

1.4 A set of drawings are enclosed with this bid document. These are tender drawings and are to be approved by the Employer. These drawings are indicative in nature and therefore, must be referred while preparing drawings for approval.

1.5 All the new assets created under RDSS to be properly GIS tagged with the help of mobile App provided by the employer (GEO URJA App Developed by GUVNL Office, Vadodara).

1.6 The engraving of word "Developed under RDSS" in materials viz., Poles, Transformers (All types), Cables, Energy Meter etc is mandatory requirement. The Employer shall ensure strict compliance of this requirement. Also, while processing payments to the Contractor, suitable documentary evidence / photographs must be asked by the Employer in support of the compliance.

1.7 Major infrastructures like new primery substation, new Distribution Transformer , new lines etc developed under RDSS needs to be clearly denoted by a signboard that should represent / as provided by GoI / MoP:

1.7.1. About the Work:
1.7.2. Date of Commissioning:
1.7.3. Estimated cost:
1.7.4. Scheme
1.7.5. Employer's details
1.7.6. For Transformers, rating in kVA

The signboard shall comply to the technical specifications. Colour coding of the DTs is essential.

1.8 The Manufacturing Quality Plan (MQP) shall be finalized by the Employer in consultation with the contractor/manufacturer in line with the Technical Specifications.

Supply of Plant and Services under this tender covers all interventions required for satisfactory operations of the facilities unless specifically excluded. Scope includes Design, Supply, survey, installation, erection testing and commissioning, on turnkey basis. The types of works envisaged in the RDSS scheme are :

A. Loss Reduction :

- Feeder Segregation – Segregation of Agricultural/Mix feeders
- Feeder Bifurcation
- Reconductoring works
- Cabling in Natural Disaster Prone Areas

- HVDS
- LT Aerial Bunch Cable

B. Modernization and system strengthening:

- New 66/11 kV, 33/11 kV, 22/11 kV, 33/22 kV, 66/33 kV Primary Substation (as applicable)
- New 66 kV Lines
- New 33 kV Lines
- New 22 KV Lines
- New 11 kV Lines
- Augmentation of Power Sub-station and 66kV, 33kV, 22kV, 11kV line
- Renovation
- DTR Substations
- LT Line
- Under-ground cabling works

All items to be supplied and erected shall be strictly as per the specifications given in the Bid and should comply the relevant standards and any amendments thereof.

Any deviation taken by the bidder and not specifically / clearly brought out in the price schedule will not be considered as a valid deviation.

In addition to the works mentioned above the bidder is required to take care of the activities listed below:-

2. Survey

The Contractor shall carry out, and be responsible for, final design of the works, including any site surveys, subsoil investigations and all other things necessary for proper planning design and execution. The initial site surveys will be carried out for tentative freezing of the material requirement and the work content finalization, within one month of commencement of project, and this will be a joint survey, along with the PMA and sample check by the employer. The same shall be reviewed progressively on quarterly basis for freezing of the material requirement and work content. Design shall be prepared by qualified designers who are engineers and experienced in design of transmission and distribution systems. Employer shall provide all options proposed for loss reductions to the contractor. Contractor, while surveying the execution of work, shall keep this requirement in view and suggest best loss reduction options in decending order. Means, maximum loss reduction option shall be proposed on priority. Also, while executing the works, same priority of works must be followed.. The changes in design should be approved by Engineer-in-charge.

- Based on the finalized network design, the Bidder shall carry out the field survey for deciding location of poles, distribution transformers etc. Besides, field survey will also cover the following:
  a. Proposed route of 33 KV, 11KV and LT Line.
  b. Proposed location of 33/11 KV sub-stations along with number, capacity of power transformers and number of 11 KV feeders to be taken out.
  c. Locations of new distribution transformers.
- Feeder wise Bill of Quantity (BOQ), for each proposed work will be prepared by the Bidder and submitted to the Employer's Engineer-in-charge for his approval before commencement of actual work.
- All architectural and civil designs such as control room, foundation for equipment, transformer, isolators, VCB shall be approved by the Employer's Engineer-in-charge.
- Within substation yard, all clamps and connectors used for bus-bar will be crimped. All the clamps and connectors connecting the equipments shall be of bolted type.
- Average number of poles per kM shall be as mentioned below, however in case of any other type of conductor/pole the contractor is required to take approval of line schedule from the employer before installation:

3. Project Management System

3.1. General

The Contractor shall assign a project manager with the authority to make commitments and decisions that are binding on the Contractor. Employer will designate an officer incharge to coordinate all employer project related activities. All communications between employer and the Contractor shall be coordinated through the project manager and officer incharge of Employer. The project managers shall also be assisting employer in communicating project related information to other stake holders.

Bidder shall submit the manpower deployment plan along with the bids, describing the key roles of each person.

The role and responsibilities of contractor shall be as follows:

a) To prepare, maintain and update project detailed Work Execution Plan for successful implementation of project like approval of GTP, approval of sub-contractor, approval of drawings, supply of materials, mobilization of men, material and equipment etc. at site for successful completion of works, Compile and up-load physical as well as financial progresses, compile the progress of works at Employer level and to assist in forwarding it to all stake holders.

b) To actively participate with employer in resolving all issues relating to project implementation including ROW, Forest Clearances and Railway Crossings.

c) To actively participate in monitoring, reviewing and analysing the physical, financial and quality assurances works' progress of RDSS works and also to take suitable measures on compliance of observations being raised during monitoring/review meetings with employer.

d) To upload and up-date project wise physical progress in RDSS web portal. Physical as well as financial progresses shall be uploaded in standard Bill of Material format of the contract. Also, to submit invoices as per released RDSS guidelines to Employer for release of payments/funds.

e) To oversee the progress and compliance of the Quality Assurance Mechanism as per RDSS guidelines.

3.2. Project Schedule

As per the schedule the bidder shall submit a preliminary implementation plan along with the bid. The detailed project implementation schedule shall be submitted by the contractor after the award of contract for employer's approval, which shall include at least the following activities:

(a) Surveying of site.
(b) Documents submission and approval schedule
(c) Pre-Dispatch Inspection schedule
(d) Dispatch Schedule
(e) Installation & commissioning schedule
(f) Training schedule, if any.

The project schedule shall include the estimated period for completion of project and its linkage with other activities etc. It is expected that the contractor should share updated project schedule based on the actual progress done at site, priorities of the employer, availability of material etc once per quarter along with the Progress report.

3.3. Progress Report

A progress report shall be prepared by the Contractor each month against the activities listed in the project schedule. The report shall be made available to employer on a monthly basis, e.g., the 10th of each month. The progress report shall include all the completed, ongoing and scheduled activities.

3.4. Transmittals

Every document, letter, progress report, change order, and any other written transmissions exchanged between the Contractor and employer shall be assigned a unique transmittal number. The Contractor shall maintain a correspondence index and assign transmittal numbers consecutively for all Contractor documents. Employer will maintain a similar correspondence numbering scheme identifying documents and correspondence that employer initiates.

4. Quality Assurance and Evaluation Mechanism

The Quality Assurance (QA) will be carried out by Employer. The Employer may engage an Authorised representative of employer responsible & accountable for assuring quality in RDSS works.

Key activities would include:

- Formulation of a detailed comprehensive Quality Assurance Mechanism (QAM) plan/Guaranteed Technical Particulars as the case may be in the State for the works to be carried out under RDSS scheme with an objective to create quality infrastructure works. The QAM and Inspection Plan shall be integral part of the contract agreement with turnkey contractor or equipment supplier and erection agency as the case may be in case of turnkey/ or departmental execution of works.

- Ensuring that the quality of materials/equipment supplied at site and execution of works carried out at field under RDSS scheme is in accordance to Manufacturing Quality Plan (MQP)/Guaranteed Technical Particulars (GTP) and Field Quality Plan (FQP)/Approved Drawings/Data Sheets respectively.

4.1. Quality checks to be ensured by Turnkey Contractor:

Turnkey Contractor shall strictly ensure QA checks during the day to day course of project execution, which are as follows:

a. Pre-dispatch inspections of all materials viz. as per MQP/ Approved Drawings/ Technical Specifications/Datasheet/GTP/applicable national & international standards as per GCC Clause 23.
b. 100% verification of all 66/11 or 33/11 kV sub stations (New & Augmented) for quality of material as per MQP/Approved Drawings/Technical Specifications/Datasheet/GTP and erection works in the field as per FQP/approved survey drawings/layout.
c. 100% verification of feeders created under the scheme.
d. 100% verification of materials utilised under the scheme.
e. 100% verification of works done in Loss Reduction and Modernization & System Strengthening.

4.1.1. Vendor approval: All the materials procured for RDSS works shall be purchased from the authorised vendors approved by the Quality Assurance Department of Employer. Approved

vendors list is uploaded periodically on the Employer web portal.

New vendors/suppliers may be approved by Employer, provided capability of manufacturer(s) is assessed suitably by visiting the factory premises and checking the testing facility available before accepting it as an approved vendor. If required, State Electricity Board/Power Department/ Distribution Companies may adopt vendors already approved by CPSEs.

4.1.2. FQP for Civil works: Employer shall prepare a separate FQP for civil works supported with drawings which shall be approved by their competent authority which shall be uploaded at web portal. The turnkey contractor shall adhere to this FQP while carrying out physical works.

4.1.3. FQP for testing & commissioning: Employer shall prepare a comprehensive FQP for testing & commissioning of 33/11kV or 66/11kV substation, Distribution transformer Substation etc. The electrical system shall be energized only after performing all tests as described in the FQP and inspection from the electrical inspector of the state (or as the practice may be). Proper records in this regard, including tests on earth resistance, insulation resistance of 11 kV line & Distribution Transformer etc. shall be maintained, jointly signed by Employer and turnkey contractor representatives.

4.1.4. Quality Assurance Mechanism (QAM) to be followed by the Contractor is as below: a. The Contractor shall be responsible and accountable for assuring quality in the scheme works. Accordingly, the Contractor shall formulate a comprehensive Quality Assurance mechanism (QAM) and Inspection Plan with an objective to build quality infrastructure under the project, which should be approved by the Employer. Alternately, the Employer may also provide its QAM which needs to be complied by the Contractor. The QAM and Inspection Plan shall be an integral Part of the contract agreement with turnkey Contractor or equipment supplier/vendor and erection agency as the case may be in case of partial turnkey and departmental execution of works. Documentation with regard to Quality Assurance and Inspection Plan shall be maintained by the Contractor and kept in proper order for scrutiny during the course of project execution and for future reference. The Contractor has to ensure that the quality of materials/equipment's supplied at site and execution of works carried out at field is in accordance to the Manufacturing Quality Plan (MQP)/Guaranteed Technical Particulars (GTP) and Field Quality Plan (FQP)/Approved Drawings/Data Sheets respectively.

b. Some key indicative measures for effective implementation of the QAM by the Contractor are given below. However, these are for reference and need to be followed as per relevant provisions of the contract.

- Supply:

- Verification of qualifications of the subcontractor / manufacturer for supply of plant / equipment and materials. Factory inspections may be conducted if required.
- Verification of material data, specifications, drawings and samples submitted by the subcontractor / manufacturer including GTPs.
- Verification of type test reports including qualifications of the test laboratory, completeness and acceptance of the type test reports.
-Witnessing acceptance tests carried out by the subcontractor/ manufacturer.
-Carrying out pre-dispatch inspections as per relevant guidelines of this tender/ contract.
-Inspection of storage facilities of the subcontractor/ manufacturer.

- Works:

-Carry out field inspections on sample basis during implementation to verify works are carried out in compliance to technical specifications and acceptable quality of workmanship.
-Issue Site Observation Reports (SOR) and follow-up with the subcontractor/ manufacturer for implementation of any remedial actions.
- Upon completion, carry out joint inspections together with the Employer's staff and for final measurements and quality inspections.
-Follow-up any on technical issues for corrective action during defects liability period with the subcontractor/ manufacturer.

c. It should be noted that no functional guarantees are applicable for equipment installed as a part of this contract hence Guarantee Tests are not applicable.

d. The Employer may identify any third party agency including PMA/ TPQMA etc. who would be responsible to monitor the QAM measures including verifications and inspections mentioned above. The project manager may also engage third party inspectors for this purpose in addition if required.

e. The Employer or its appointed third party shall design systems and procedures to implement QAM system including formats for submittals by the Contractor in line with the above requirements and provisions of the Contract.

f. The Contractor shall cooperate with and follow these QAM systems and procedures to ensure proper implementation of an effective quality assurance and evaluation mechanism.

4.1.5. Pre-commissioning test record: All pre-commissioning test check list shall be documented properly and signed by the quality engineer of the turnkey Contractor & countersigned by Employer's representative and shall be kept for future reference. These documents shall be maintained by Employers in proper order and shall be made available at site for verification by

Quality Monitors during inspection and finally be handed over to O&M department) at the time of handing over of energized assets.

4.1.6. Roles and responsibility of Contractor in ensuring Quality of Plant and Facilities:

1) Turnkey contractor shall be primarily be responsible for supply of quality materials. Hence, turnkey contractor shall take all necessary actions including following:

a. To assess the capabilities and capacity of manufacturer to whom they intend to appoint as sub-vendor,
b. To keep strict control over manufacturing of materials by controlling procurements of right raw materials, periodical stage inspections, to ensure process control and to get the materials invariably inspected in manufacturing stage as well as after manufacturing but before dispatch at the works of manufacturer to ensure quality of materials/equipment.
c. To ensure stage inspection and final dispatch inspection, turnkey contractor should deploy his/her quality assurance team to inspect the materials with Employer/third party inspector as well as independently as per requirements.

2) Receipt inspection: On receipt of materials at site, it would be the prime responsibility of turnkey contractor to verify materials physically in accordance to agreed technical specifications. Physical parameters like dimensions (length, width, height, area of conductor), weight per unit, Insulation Value, length of cable/conductor in sample drum(s), clear embossing on cables through sequential marking depicting name of manufacturer, size of cable and length in meter. Once the Contractor is satisfied, materials must be offered for joint inspection to Employer.
3) Earlier, on receipt of materials at site, dispatch documents shall be verified jointly by Employer, Employer's appointed Third Party, Turnkey Contractor and materials supplier (if representative is full time available at site. During inspection, quantities of items, sealing on the materials, serial numbers of the items, sequential embossing (proper visible/legible without any additional efforts) and name plates on the materials shall be checked. Dispatch challans shall be verified for details of consigner and consignee, materials descriptions, quantities transported, pre-dispatch clearance certificate/waiver of inspection. In case of high value equipment, capacity of equipment in terms of current carrying capacity, operating voltage and KVA ratings should be recorded.
4) Clearance for installation: Once, materials on receipt are accepted by turnkey contractor as well as Employer representative, they will be eligible for erection, testing and commissioning.
5) Sampling from field: Any material, including materials listed below, may be picked from site for testing at test laboratory chosen by inspecting official. 1. Distribution Transformer, 2. Overhead Conductor, 3. Energy Meter, 4. Pole, 5. Insulators, 6. Cables, 7. Circuit Breaker.

a. Inspecting official will have right to pick any of the supplied equipment whether it is lying in site stores, is under erection, is under local transportation from site stores to erection location or is

already commissioned. The equipment shall be sealed jointly in presence of representatives of Employer, Employer's appointed Third Party, Contractor, and Supplier/manufacturer (if his representative is available at site). Employer at its discretion may invite manufacturer's representative to participate in sealing of materials.
b. Sealed equipment, on cost of turnkey contractor shall be sent to test laboratory for verification of routine/type test results. At the time of sealing, details of equipment available at site shall be recorded like cable/conductor drum number, power/distribution transformer unique number, status of sequential legible embossing on cables, name of manufacturer etc.

c. For testing of equipment, Employer/Nodal agency shall empanel test laboratories located in or nearer to the state wherefrom sample is picked up.

d. Such picked up materials at a random shall be tested for all routine, acceptance and type tests feasible to conduct in the empaneled laboratory. The laboratory expenses including all other expenditures that shall incurred towards packing, transport, inspection, testing charges etc. are to be borne by the Employer. At least one sample from a lot may be subjected to inspection.

e. In cases, where pre-dispatch and factory test results/NABL accredited lab test report are found mismatched with tests results on the sample picked from field; actions shall be taken against willful defaulted manufacturer and turnkey contractor or both.

f. Willful defaulter shall be those manufacturers and turnkey contractor whose material is found to be manufactured using inferior quality raw materials, second hand core materials, under-size/under-weight of cable/conductor in various parts of cable/conductor drum, not conforming to transformer load losses as defined in agreed technical specifications/contract conditions, improper or no sequential legible embossing on cable etc.

g. This mismatch shall generally be, but not limited to the deviations in results from guaranteed technical specifications of materials in terms of capacity (KVA capacity, current carrying capacity, heating capacity, tensile strength, mechanical strength etc., operational efficiencies (errors in measurements of power, power/load losses, power consumption etc., weights of key component materials (aluminum, copper, insulation materials, steel components etc.), sub-standard specifications of key component (measured specifications are in deviation from guaranteed specifications as per technical specifications of the project and inferior/illegible embossing/sequential marking on cables are found, following two actions shall be taken:

i. Sub-vendors/vendor registration of the manufacturer shall be discontinued in all the power utilities of the country for a period of 5 years including in power utility concerned where this act is found,
ii. Entire lot of materials/equipment supplied by the defaulting manufacturer shall be rejected

whether supplied materials/equipment is lying in site-stores, in transit, under erection, testing & commissioning or has already been commissioned. All costs related to removal of such rejected materials and reinstating fresh lot of materials shall be borne by turnkey contractor without any cost implication to power utility.

iii. Turnkey contractor shall be responsible for repetitive failures of materials in field testing in a turnkey-contract. In such situations, registration of turnkey contractor firm shall be discontinued in all the power utilities of the country for a period of 5 years including in power utility concerned where this act is found,

h. In cases, where field testing results are slightly mismatched with factory test results / predispatch test reports/NABL accredited lab test report but are in permissible limits as per GTP/Data Sheet/Technical Specifications, no action shall be taken against the turnkey contractor/manufacturer.

i. In cases where turnkey contract is reluctant/not willing to support the Employer in selecting sample for testing by way of non-association in sampling, sampling and testing related activities of equipment, all actions related to sample selection, sealing and testing including dismantling, loading, unloading, transportation etc, will be taken by Employer on risk & cost of the turnkey contractor. The non-cooperative act on part of turnkey contractor shall be circulated amongst all power utilities in the country. In such situations, registration of turnkey contractor firm shall be discontinued in all the power utilities of the country for a period of 5 years including in power utility concerned where this act is found.

6) <Optional Clause – delete if not needed>
The Contractor should set up at least one testing laboratory under this contract for testing the materials received at site from its subcontractors/ vendors/ manufacturers etc. The testing laboratory thus setup, should have the facility for carrying out basic tests to ascertain the quality of the following equipments/ materials:
a. Cables/ Conductors
b. Distribution Transformers
c. Insulators
[100%] quantity of each lot shall be tested by the Contractor at its field test laboratory. Post completion of testing of the above items at its laboratory, the Contractor shall submit a report to the Employer, certifying the satisfactory testing results.

7) The Contractor should develop the quality assurance programme which shall generally cover the following:
a. Organization structure for the management and implementation of the proposed quality assurance programme :
b. Documentation control system;

c. Qualification data for bidder's key personnel;
d. 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.
e. System for shop manufacturing and site erection controls including process controls and fabrication and assembly control;
f. Control of non-conforming items and system for corrective actions;
g. Inspection and test procedure both for manufacture and field activities. h. Control of calibration and testing of measuring instruments and field activities;
i. System for indication and appraisal of inspection status;
j. System for quality audits;
k. System for authorizing release of manufactured product to the Employer.
l. System for maintenance of records;
m. System for handling storage and delivery; and
n. A manufacturing 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.
o. A Field quality Plan covering field activities

8) Electrical Inspector inspection: After successful completion of the work permission from State Electrical Inspectorate is required. Necessary fee etc. shall be paid by the Employer. However if Contractor pays such fee it shall be reimbursed on actual basis on documentary evidence. In case of defects / in-complete works notified by Electrical Inspectorate, these shall be completed by the agency at no extra cost implication to Employer.

4.2. Concurrent Quality Monitoring by Nodal agencies: In addition to the in-house quality checks and processes followed by the Employer, the Nodal Agency of RDSS (REC/PFC) shall also carry out concurrent inspection of works through Third Party Quality Monitoring Agency (TPQMA). The Contractor needs to comply with the requirements and cooperate for effective implementation

4.2.1. Scope of Quality Assurance Mechanism by RDSS Nodal Agency (REC/PFC): The Nodal Agency (REC/PFC) shall carry out concurrent inspection of works through TPQMA. To enable the same, the Employers shall share the physical and financial progress of the works through portal of the scheme or otherwise. In addition to the above, the Nodal Agencies may also carry out concurrent quality monitoring on random sample basis as per the need through its own manpower. TPQMA shall also verify quality of works carried out in the Project, which are as follows:

- 100% New Power Substations or at least one in each district/circle.
- 5% Augmented Substations or at least five in each district/circle.
- 15 to 20 spans of 5% of HT feeders

- 2% of DTR Substations (11/0.4kV), including few spans of associated LT Lines
- 1% of Smart meters or 1,000 Meters in a project, whichever is less
- IT/OT/SCADA/DMS infrastructure – primarily at system level for high level functional checks.

4.2.2. Field Works Quality Inspection:

(i) Substation inspection: 100% New and 5% of Augmentation Substations are to be inspected in 2 (two) stages. Stage-I & Stage-II inspections shall cover 50% new substation & 2.5 % of Augmented substations respectively.

- **Stage-I** Inspection of TPQMA shall commence in a project when 50% New & 30% of Augmentation substation works are completed in all respect.
- **Stage-II** inspection of TPQMA shall commence in a project when 100% New & 70 % of Augmentation substation works are completed in all respect.

(ii) **HT Feeders**: 5 % HT Feeder are to be inspected in 2 (two) stages. Stage-I & Stage-II inspections shall cover 2.5 % of HT Feeder respectively.

- **Stage-I** Inspection of TPQMA shall commence in a project when 30% of HT Feeder works are completed in all respect.
- **Stage-II** Inspection of TPQMA shall commence in a project when 70 % of HT Feeder works are completed in all respect.

(iii) DTR Substations: 2% of DTR Substations (11/0.4kV), including few spans of associated LT Lines are to be inspected in 2 (two) stages. Stage-I & Stage-II inspections shall cover 1 % of DTR Substations respectively

- **Stage-I** Inspection of TPQMA shall commence in a project when 30% of DTR Substation including LT Lines works are completed in all respect.
- **Stage-II** Inspection of TPQMA shall commence in a project when 70% of DTR Substation including LT Lines works are completed in all respect.

(iv) IT/OT/SCADA/DMS infrastructure: IT/OT/SCADA/DMS infrastructure are to be inspected when works is completed in all the respect. For this:

1) TPQMA shall submit the report after inspections on RDSS portal along with all BoQ, Photographs, SLD, etc.

2) TPQMA also verify the Contract Management Part once for each project and upload deviations, if any observed in respect of the guidelines/ Standard Bidding Document, adherence to QAM, Contractual provisions pertaining to defects identification and rectification. (In this part TPQMA would give thrust on adherence on systems and procedures of RDSS schemes by turnkey contractors during project implementation).

3) As only random inspections are to be carried out by TPQMA agencies leaving around 90 to 95% materials/works unchecked therefore there should be some stringent penal clause to be made if materials /works verified by TPQMA found faulty/wage. The TKC is required to rectify the observations / defects

detected within 7 days of notification. However based on severity the Employer may direct the Contractor on resolution mechanism / process and timeline.

(v) **Deployment of mobile vans for quality inspection**: The Employer/ Nodal Agency reserves the right to also deploy mobile vans with Testing facility to test the plants and facilities by selecting random samples from store or from site. The Employer may take sample from any lot placed in store including the lot on which Pre-Dispatch Inspection was not carried out or from the installed materials which it feels are not performing as it was intended to. In such a case if the material/ facility fails, the same shall be replaced with new material, and one more random sample would be selected from the same batch for testing. If the material fails the test again, then the whole lot shall be replaced by the Contractor at its own risk and cost.

4.2.2. Cross verification of field /TPQMA works by Nodal Agency: The Nodal Agency also reserves the right to monitor the field /materials to the tune of 1% of total inspections carried out by TPQMA.

4.3. Material Inspection: For the purpose of inspection, materials have been segregated into two categories as mentioned below:

4.3.1 Category – A (Pre-Dispatch Inspection & Testing at NABL accredited Labs):
a) This category shall include high ticket materials (Power Transformers, Distribution Transformers, Circuit Breakers, AB/XLPE Cables, Overhead Conductor (AAAC/ACSR), Insulator which involves more and important testing procedures and hence the inspection of these materials will be carried out in the factory before the dispatch of the material.
b) In addition, Employer shall also ensure that for major materials as discussed above, samples from 1 st lot and one other lot randomly selected by the Employer shall be directly sent to NABL accredited test labs for third party testing. It is also to be noted that material clearance of the lots under testing shall only be given post receipt of successful test results. Contractor shall also mandatorily depute its authorized official for pre – dispatch inspection at manufacturing facility along with the Employer officials. The inspection and testing report would be jointly signed by the Employer and the Contractor. All the expenses related to testing would be bearded by the Contractor.
c) Apart from the above-mentioned protocol any one power transformer shall be selected by Employer from the supply schedule from the vendor, which shall be jointly sealed and tested for short circuit testing on turnkey-Contractor's expenses.

4.3.2 Category – B (On-site inspection): This category includes the materials for which a factory inspection is not warranted and the material can be inspected upon arrival at the site before the installation. In case the Employer is apprehensive about the quality of the material supplied it reserves the right to send the selected lot to the NABL accredited testing lab for third party testing.

4.3.3 Employer also reserves the right to send any installed equipment / materials to the NABL accredited testing lab for testing. The Employer would have to reimburse the expenses related to transportation of material from site to testing lab and all testing expenses in this regard.

4.3.4 The material which has to be tested at laboratory shall be sealed in the presence of authorized official of Employer and Contractor.

4.3.5 If the materials tested at Laboratory fails then the entire lot would be rejected. Contractor shall bear the responsibility of sending back such failed materials from site. Any subsequent delay in contract performance due to failure of materials in the test laboratory would be on account of Contractor and no time extension would be provided by the Employer in this regard. Any LD levies in this regard would be borne by the Contractor.

4.3.6 Pre-dispatch Inspection (PDI) for Category-A

4.3.6.1. Pre-dispatch inspection shall be performed on the identified materials at manufacturer's work place for which Contractor shall be required to raise requisition giving at least 10-day time. Depending on requirement, inspection shall be witnessed by representatives of Employer, TPQMA, Contractor and/or representative of the Nodal Agency. TPQMA shall carry out pre-dispatch inspection of major materials randomly in a single lot containing minimum 10% materials at manufacturer works. The TPQMA shall perform pre – dispatch inspection test of below materials:

1) Power Transformer,
2) Circuit Breaker,
3) Insulators,
4) Cables / Conductors
5) Control & Relay Panel,
6) Distribution Transformer

4.3.6.2. Tests to be conducted during the Pre-dispatch Inspection: All the tests shall be carried out in accordance with the latest relevant IS published from time to time by BIS. An indicative list of IS specification and tests for some of the materials are given below:

Power Transformers

Standards Applicable:-	
IS:2026(Part I to IV)	Power Transformer
IS:5	Colour for ready mixed paints

Standards Applicable:-	
IS:325	Three Phase Induction Motors
IS:335	New insulating oil for transformers, switch gears
IS:1271	Classification of insulating materials for electrical machinery and apparatus in relati on to their stability in services
IS:2071	Method of high voltage testing
IS:2099	High voltage porcelain bushings
IS:2147	Degree of protection
IS:2705	Current Transformers
IS:3202	Code of practice for climate proofing of electrical equipment
IS:3347	Dimensions for porcelain Transformer Bushings
IS:3637	Gas operated relays
IS:3639	Fittings and accessories for power Transformers
IS:5561	Electric Power Connectors
IS:6600/BS:C P‟10:0	Guide for loading of oil immersed Transformers
IS:10028	Code of practice for selection, installation and maintenance of transformers, Part I. II and III
C.B.I.P. Public ation	Manual on Transformers

Proposed Tests as per IS	
1	All standard routine tests in accordance with IS: 2026 with dielectric tests corresponding to latest amendments of IS: 2026 shall be carried out.

2	All auxiliary equipment shall be tested as per the relevant IS. Test certificates shall be submitted for bought out items.
3	High voltage withstand test shall be performed on auxiliary equipment and wiring after complete assembly.
4	Following additional routine tests shall also be carried out on each transformer: a) Magnetic Circuit Test on each core shall be tested for 1 minute at 2000 Volt DC b) Oil leakage test on transformer

Distribution Transformers

Standards Applicable:-	
IS 2026: (Part 1 to 10) as applicable	General Specification of Transformer
IS 1180 (Part1)	Outdoor type oil immersed Distribution transformer upto including 2500 kVA & 33 kV
IS 3347 (Part 1)	Specification upto 1.1 kV Voltage Bushing (for Porcelain)
IS 3347 (Part 3)	Specification upto 17.5 kV Voltage Bushing (for Porcelain)
Type Test	A valid Type test report within 3 years of supply 3 star rated transformer as per BEE
IS -5484	Specification for Aluminum wire Rods
IS 12444	Specification for Copper wire Rods

Proposed Tests as per IS	
1	Measurement of Winding resistance at all Tap Positions
2	Ratio of Tap Position Polarity & Phase Position
3	% Impedance at 75 degree Celsius at 50Hz
4	Load losses at 50% and at 100% Loading as per IS
5	No Load Loss at 50Hz and No load current at rated voltage

Proposed Tests as per IS	
6	Insulation Resistance
7	Induced Overvoltage Withstand
8	Separate source voltage Withstand
9	Magnatizing Current at Rated voltage and frequency an 112.5% of rated voltage
10	Temperature rise test
11	Pressure Test
12	Oil Leakage Test

Circuit Breaker

Standards Applicable:-	
IS: 13118	Specification for HV AC Circuit Breaker
IS: 14658	HV AC Circuit Breakers - Guide for Short-circuit and Switching Test Procedures for Metal-enclosed and Dead Tank Circuit Breakers
IS: 2099	Specification for HV porcelain bushings
IS: 5621	Specification for porcelain hollow insulator.
IS: 8603	Specification for Dimension for Porcelain Transformer Bushing for use in heavily polluted area.
IS: 3347	Specification for Dimension for Porcelain Transformer Bushing for use in normal and lightly polluted area.
IS: 2633	Specification for method for testing uniformity of coating On Zinc coated articles.
IS: 5561	Specification for Electrical Power Connectors
IS: 2147	Specification for Degree of Protection

Proposed Tests as per IS	
1	Single Capacitor bank breaking test
2	Short time withstand and Peak Withstand Current Test
3	Wet power frequency withstand voltage test
4	Lightening Impulse voltage withstand test
5	Temperature rise test
6	Mechanical Endurance Test(M2 Class)
7	Degree of Protection test of Control Cubicle

XLPE Cables

Standards Applicable:-	
IS : 7098 (Part-I) : 1988	Specification for Crosslinked Polyethylene Insulated PVC sheathed Cables for working Voltage upto & including 1100 Volt
IS: 8130 : 1984	Specification for Conductors for insulated electric cables and flexible cords
IS:5831 : 1984	PVC insulation & sheath of electric cables
IS: 3975 : 1970	Specification for Low Carbon Galvanized steel wires, Formed Wires and tapes for armouring of Cables
IS:10810 : 1984	Methods of test for Cables.
IS:10418 : 1982	Cable Drums for Electric Cables.
IS : 694 : 2010	PVC unsheathed and Sheathed cables / Chords with rigid and flexible conductor for rated voltages upto and including 450/ 750 V

Proposed Tests as per IS	
1	Resistance Test on conductor
2	Test for thickness of insulation and sheath
3	Tensile strength and elongation at break test for insulation & outer sheath.
4	Hot set test for insulation.
5	Insulation resistance (Volume resistivity) Test
6	High voltage test

Arial Bunched Conductor

Standards Applicable:-	
IS 14255 : 1995	Specification for Aerial Bunched Cables for working Voltage up to & including 1100 Volts.
IS : 8130 : 1984	Specification for Conductors for Insulated Electric Cables and flexible Cords.
IS : 398 (Part-IV) : 1994	Specification for Aluminum Conductors for overhead transmission purposes: Aluminum Alloy Stranded Conductors (Aluminum Magnesium –Silicon type).
IS:10418:1982	Specification for Drums for Electric Cables

Proposed Tests as per IS	
1	Breaking Load Test for messenger Conductor.

Proposed Tests as per IS	
2	Elongation test for messenger conductor.
3	Conductor resistance test for both messenger and XLPE conductor
4	Test for thickness of insulation of XLPE conductor
5	Tensile Strength and Elongation at Break Test for both messenger and XLPE conductor
6	Hot Set Test for XLPE insulation.
7	Insulation resistance test for XLPE conductor
8	High Voltage Test for XLPE conductor

Overhead Conductors AAAC/ACSR

Standards Applicable:-	
IS: 398 (Part I & II) : 1996	Specification for Aluminum Conductors with Steel Re-inforced.
IS: 4826 : 1968	Coating of the galvanized steel wires shall be applied by the hot process or electrolysis process
IS: 398 (Part-IV): 1994	Specification for All Aluminum Alloy Conductor (AAAC)
IS: 1778 : 1980	Packaging of Overhead conductor in Wooden Drum

Proposed Tests as per IS	
1	Measurement of lay ratio.
2	Measurement of diameters of individual wire
3	Measurement of resistance of individual wire.

4	Breaking load test of individual wire.
5	Elongation test of individual wire.

Porcelein Insulators

Standards Applicable:-	
IS 1445 : 1977	Porcelain insulators for overhead power lines with a nominal voltage up to and including 1000 V
IS 2486 (Part 1) : 1993	Metal fittings of insulators for overhead power lines with nominal voltage greater than 1000 V: Part 1 General requirements and tests
IS 2486 (Part 2) : 1989	Insulator fittings for overhead power lines with nominal voltage greater than 1 000 V: Part 2 Dimensional requirements
IS 2486 (Part 4) : 1989	Insulator Fittings for Overhead Power Lines with a Nominal Voltage Greater than 1 000 V - Part IV : Tests for Locking Devices

Proposed Tests as per IS	
1	Resistance Test on conductor
2	Test for thickness of insulation and sheath
3	Tensile strength and elongation at break test for insulation & outer sheath.
4	Hot set test for insulation.
5	Insulation resistance (Volume resistivity) Test
6	High voltage test

The above list of tests are only indicative in nature, if Employer feels it can add some tests based on latest IS Standards. If the Employer faces any inssues with respect to actual performance of a material then it can issue a notice to Contractor for testing of that material at its sole descrition.

All required tests to be carried out as per technical specifications for concened material.

4.3.6.3. The Contractor shall ensure receipt of material at site within 21 days from date of receipt of dispatch instructions. In case materials are not received within 21 days from date of issue of dispatch instruction, the dispatch instruction shall stand cancelled. All expenditure incurred by Employer in performance of dispatch instruction shall be recovered from turnkey Contractor. A fresh pre – dispatch inspection would be required to issue a dispatch instruction for supplying the same lot at the site.

4.3.6.4. The turnkey Contractor shall ensure that pre-dispatch inspection for materials are intimated only when the material is completely ready for inspection. On due date of inspection, if it is found that materials are not ready in required quantities or the inspection could not be carried out due to nonavailability of requisite calibrated certificate of instruments with manufacturer, closing of works on scheduled date of inspection, non-availability of sufficient testing/material handling staff at manufacturer works etc, all expenditures incurred on deployment of various inspecting officials along with a fine of Rs 50,000/- shall be recovered from the bills of the agency and re-inspection shall be carried out on expense of the Contractor. 2nd such situation at same manufacturer/supplier shall result in rejection of name of manufacturer from list of approved vendors/sub-vendors. In case sub-standard materials (old component, re-cycled materials, re-used core material, re-used transformer coil material etc) offered for inspection and are noticed during the inspection, materials shall be rejected and approval of sub-vendor shall also be cancelled for all RDSS projects.

4.4. Implications for not meeting quality requirements by Contractor

4.4.1. In case of failures in testing:

a) The turnkey Contractor shall ensure that pre-dispatch inspection for materials is intimated only when the material is completely ready for inspection. On due date of inspection, if it is found that materials are not ready in required quantities or the inspection could not be carried out due to nonavailability of requisite calibrated certificate of instruments with manufacturer, closing of works on scheduled date of inspection, non-availability of sufficient testing/material handling staff at manufacturer works etc, all expenditures incurred on deployment of various inspecting officials along with a fine of Rs 50,000/- inclusive of GST shall be recovered from the bills of the agency and re-inspection shall be carried out on expense of Contractor.

b) 2nd such situation at same manufacturer/supplier shall result in rejection of name of manufacturer from list of approved vendors/sub-vendors. In case sub-standard materials (old component, recycled materials, re-used core material, re-used transformer coil material etc) offered for inspection and are noticed during the inspection, materials shall be rejected and approval of subvendor shall also be cancelled for all RDSS projects.

c) In case, a material fails the pre-dispatch inspection as per GCC Clause 23, and also fails the subsequent repeat inspection of the rectified/replaced material, the complete lot of material under inspection will be required to be replaced by the manufacturer/supplier. If in subsequent inspection of the new lot, the material again fails the inspection, then materials shall be rejected, and approval of vendor/sub-vendor shall also be cancelled for all RDSS projects. In such scenario any subsequent delay in contract performance due to failure of materials in the test laboratory would be on account of

Contractor and no time extension would be provided by the Employer in this regard. Any LD levies in this regard would be borne by the Contractor.

d) Apart from the above, in case of default by vendors/manufacturers, Contractor shall also be penalized based on the no. of materials/lots get rejected as per below table:

Sr. No	No. of Material/lot rejected in a project/district	% Penalty imposed on contract price
1	>5	5.0%
2	>3	2.5%
3	>1	1.0%

4.4.2. In case of defects found during Field inspection: There are three categories of defects found in field inspection as defined below:

a) CRITICAL DEFECTS: These defects must be rectified before charging. Critical defects are those which endanger life and property. Dangerous deficiencies on safety, ground clearances, equipment earthing and protection would come this category. These are defects in presence of which the Electrical Inspector would not allow charging of the electrical installation. That is, if equipment are already energized, it should be de-energized and rectified without delay. If critical equipment like distribution transformer HT and LT line have been installed dangerously, the defect type would fall under critical category of defect. *Example : LA is not connected , DT neutral earth is missing , Earth electrodes not installed, Ground clearance not as per IE rule, Oil level low in transformer etc.*

b) MAJOR DEFECTS: These defects must be rectified before operational handover (to Operation and Maintenance wing). These are major deviations from drawing and specification. These are serious deviation with respect to contract. The electrical installation can be charged temporarily. However, the defects should preferably be rectified before charging. *Example : Pole not pitched at proper depth, Brick-bats/ foundation inadequate, use of undersized earth wire, precariously loose electrical connections and mechanical fitting.,*

c) MINOR DEFECTS: These defects are very minor in nature. Such defects in electrical installations keep surfacing during operation and maintenance. The installation may be charged with these defects. However they must be rectified Example: *Danger board not proper, energy meter not installed before contractual handover (before final payment is released and contract is closed), missing barbed wire, stay wire loose, loose fasteners, vegetation too close to HT/Lt line.*

Note:

1. *These defects are broad in nature. Actual field defects need to be defined more accurately by inspectors.*
2. *All pictures depicting defects should be numbered. Their number mentioned in the report shown in the table*
3. *An infrastructure schematic (single line diagram) showing DTRs, HT and LT poles duly numbered by the inspector shall be submitted along with the report. Their number shall be used to describe location of defects to be rectified subsequently.*

The corresponding penalties to be imposed has been captured below:

Sr. No	**Defect Criteria**	**% Penalty imposed on contract price**
1	Critical Defects	1.0%
2	Major Defects	0.5%
3	Minor Defects	0% if rectified within 30 days

Annexure-A

Checklist for Quality Assurance
Distribution Transformer Substation

S. No	Description	Status (Yes/No)	Observations	Location	Picture No.
1	Record capacity of DTR transformer used				
2	Record S. No., make and year of manufacturing of DTR transformer				
3	Safe and adequate access to distribution transformer (DTR) substation				
4	Availability of approved survey report				
5	Proper load survey is performed of the locality for perspective consumers while deciding capacity and location of DTR				
6	Expected loading of transformer using 5 years growth is performed in survey report				
7	Proper alignment of substation structure with 11 KV line				
8	Record type of poles/support used for DTR substation				
9	Record type of foundation used				
10	Proper muffing is provided on steel supports of DTR substation				
11	If DTR substation is in water logging area, its foundation is grouted in cement concrete				
12	Proper verticality of substation supports				
13	Proper pole to pole distance of substation supports.				
14	Proper erection of jumpers and connection to DTR transformers without any bent				
15	Proper binding of insulators				
16	Stay plates are properly grouted in cement concrete mixture to support DTR substation structure (if erected)				
17	Proper tensioning is there on stay set				
18	Proper alignment of stay wire with overhead conductor				
19	Proper erection of stay clamp using 12 mm				

S. No	Description	Status	Observations	Location	Picture
	dia nuts and bolts				
20	Proper galvanization of stay wire				
21	Thimble is provided on turn buckle of stay set				
22	Stay set installation is provided with guy insulator				
23	Proper phase to phase and phase to ground clearances maintained on the substation jumpers				
24	Steel overhead structure is properly earthed using 8 SWG wire/G.I. flat?				
25	Each 11 kV overhead equipment including transformer are individually earthed using 8 SWG Earth wire/ GI flat				
26	Danger plate is installed at appropriate height using proper size clamp. Record type and size of clamp				
27	Proper anti-climbing device (barbed wire/spike) installed at appropriate height on individual support. Record quality of wrapping of barbed wire				
28	Substation is numbered				
29	Individual substation pole is imposed/painted with the name of scheme				
30	Surface of the PCC poles is finished and there are no steel wire visible				
31	No physical damages appeared on PCC pole surface				
32	GI flat to GI flat connection using at least 2 sets of GI nut bolts and washers				
33	8 SWG GI wire/GI Flat is properly dressed with support				
34	GI wire to GI wire jointing is provided using 12 SWG GI nut bolts and washers				
35	GI wire connection to earth pit is using GI nut bolt and washer				
36	GI earth pipe is properly inserted inside earth without hammering				
37	Number of earth pit used for substation				

S. No	Description	Status	Observations	Location	Picture
	earthling.				
38	Pit to pit distance in meters. Is it adequate?				
39	Masonry enclosure is provided over individual earth pits				
40	Funnel is provided over earth pit				
41	Proper jumpering using binding practices/PG clamp				
42	Proper clearances to avoid bird fault on conductors of substation supports				
43	Type and size of overhead conductors used in the substation				
44	Cement-concrete grouting foundation of substation supports				
45	Measure quantum of cement concreting in any one sample support				
46	Measure cement concreting foundation in any one sample of stay set pit				
47	Proper painting/galvanizing done on steel structure				
48	Any sign of rusting found on substation structure/hardware				
49	Any broken insulator found in the substation				
50	Disc Insulators installed precariously (loose bolts/ missing cotter pins)				
51	Separate individual earth connection using GI wire/GI flat is used for neutral earthing with separate pit				
52	Dedicated transformer body earthing using GI wire/GI flat				
53	Bimetallic clamps are provided on 11 kV bushing				
54	No gap between busing seat and bimetallic clamp on LT as well as HT bushing while connecting conductor/cable				
55	Proper lugs are provided on termination of cables				
56	Oil is filled in cup of silica gel breather				
57	Silica gel is blue in colour				

S. No	Description	Status	Observations	Location	Picture
58	Oil control valves are open between transformer tank and breather (wherever used)				
59	Oil leakage from the body/gasket of transformer and from conservator tank				
60	Record level of oil in conservator tank				
61	Transformer installed precariously (Nut / bolts / side bracing missing)				
62	Transformer is fitted with 12 mm dia nut bolts on its base channel				
63	Transformer belting is provided				
64	Dimension of transformer base channel				
65	Individual lightening arrestor are earthed with dedicated separate earth pit				
66	LA jumper connections is missing/ not proper				
67	LA is charged/ installed but not meggared				
68	Isolators/AB switch are properly aligned and its operation is smooth				
69	Operating handle (not missing eye bolt) of isolator/AB switch is earthed using flexible cable				
70	No joint in between entire length of operating pipe of isolator/AB switch				
71	Guiding hook is provided for isolator pipe movement				
72	Alignment of male and female contacts of isolators/AB switch and no spark during normal use				
73	Proper fuse wire is used in DO fuse/HG fuse				
74	Arching Horn is missing/ not aligned / not proper				
75	Proper size of LT cable are used between transformer and LTDB				
76	lockability and proper closing of door of LTDB				
77	Gland plate and glands are used for cable entry in LTDB				

S. No	Description	Status	Observations	Location	Picture
76	No unused holes on gland plates				
77	Availability of LTDB equipment as per approved drawing and scope of work like isolator, fuse, switch, bus bar, MCCB, MCB etc.				
78	Installation of DTR as per BIS specification				
79	LTDB earthing at different points using 8 SWG GI wire				
80	Proper painting and No physical damages on LTDB				
81	Suitable loop length of cables in LTDB				
82	3 Nos earthing pit and earth mat /risers using 50X6mm GI Flat are used as under:				
a	Earth Pit – 1 for Transformer Neutral,				
b	Earth pit - 2 for Lightening Arrester,				
c	Earth pit – 3 for Equipment body earthing				
83	Deleted				
84	Deleted				
85	Quality of painting/galvanizing on substation structure				
86	DTR is newly supplied				
87	PG Clamps are used (wherever needed as per drwg- Jumper etc)				
88	Deleted				
89	Earthing Electrodes short/missing				
90	Commissioning Defect: DT charged/installed but not merged				
91	Fasterers (Nuts/ Bolt/ Clamps /Connector) size not as per drawing /specification				
92	Fasteners (Nuts / bolts/ Clamps / connectors) in precarious state				
93	Poles not erected properly (inadequate or missing brick bat/ foundation)				
94	Stay installation is not proper : guy insulator missing ;inadequate depth				
95	Earthing wire diameter undersize				
96	Danger plate missing/improper				

S. No	Description	Status	Observations	Location	Picture
97	Earthing wire not secured / not dressed				
98	Barbed wire missing/improper				
99	DTR ground electrodes far too close				
100	Earth pit to earth pit clearance not maintained				
101	HT Fuse not provided				
102	HT fuse unit jumpering not connected properly				
103	MCCB of lower rating than specified in LOA				
104	MCCB not installed				
105	Inferior quality of Distribution Board used (makeshift, locally fabricated DBs)				
LT Line					
S. No	**Description**	**Status (Yes/No)**	**Observations**	**Location**	**Picture No.**
1	Availability of approved survey report with Single line diagram				
2	Correct alignment of LT line				
3	Type of poles used as per scope of the work				
4	Type of foundation used as per scope of work				
5	If line is passing through water logging area and its foundation is grouted in cement concrete				
6	Proper verticality of poles				
7	Any deflecting tension on LT pin insulator				
8	Proper tensioning of overhead conductor/LT cable/ABC Cable				
9	Any knot/wrapping of overhead conductor /LT cable /ABC Cable is there during erection				
10	Proper binding of insulators cable both / tension work is done				
11	Stay plates are properly grouted in cement concrete mixture				
12	Proper tensioning is there on stay set				

S. No	Description	Status	Observations	Location	Picture
13	Proper alignment of Stay wire and stay set with overhead conductor is there to nullify tension				
14	Proper erection of stay clamp using 12 mm dia nuts and bolts and 50x6 mm (or more) size clamp				
15	If every 6th pole in a section of line is provided with stay sets to avoid line deflection				
16	Proper galvanization of stay wire/stay set				
17	Thimble is provided on turn buckle of stay set				
18	Proper phase to phase clearances are maintained on the line				
19	Steel overhead structure is properly earthed using 8 SWG wire				
20	Each LT pole individually earthed using 8 SWG Earth wire and separate Earth pit/Earthing coil/Earth spike				
21	Quality and size of danger plates is as per scope of work				
22	Danger plate is installed at appropriate height using proper clamp as per scope of work				
23	Anti-climbing device (barbed wire/spike) are installed at appropriate height on individual support				
24	Individual pole is numbered				
25	Individual pole is imposed/painted with the name of scheme				
26	Surface of the PCC poles is finished and there are no steel wire visible				
27	No physical damages appeared on PCC pole surface				
28	Cradle guard earthing is provided on each road crossing or on each LT line crossing				
29	Proper tensioning of the cradle guard wires				
30	Separate earthing on both the sides of road/line for cradle guarding are there				

S. No	Description	Status	Observations	Location	Picture
31	8 SWG G.I. wire is properly dressed with support for V-Cross arm/Channel/Top clamp earthing				
32	GI wire to GI wire jointing is provided using 12 SWG GI nut bolts and washers				
33	GI wire connection to earth pit is using 12 mm GI nut bolt and washer				
34	Earth pipe is properly inserted inside earth without pipe hammering				
35	Masonry enclosure is provided over individual pipe earth pits				
36	Funnel is provided over pipe earth pit				
37	Jumpering using best binding practices/PG clamp				
38	Proper conductor clearances to ground is there to avoid bird fault on end sectionizer support where disc insulator are used				
39	Average pole to pole span length in the line. It should not be less than 50 m.				
40	If Pole to pole span is less than 50 m, record the reason with pole numbers				
41	Number of poles used per kilometre of the line				
42	Type and size of overhead conductors/ABC cable used in the line				
43	Shuttering is used during casting of cement concrete foundation				
44	Cement-concrete grouting foundation of end supports				
45	Quantum of cement concreting in any one sample support				
46	Cement concreting foundation in any one sample of stay set pit				
47	Proper painting is done on steel structure				
48	Any broken insulator found in the line				
49	Surface finish of painting on Steel tubular pole/RSJ/H Pole/Rail pole about 2 m from bottom and above 2 m				
50	Possible damage on ABC cable surface				

S. No	Description	Status	Observations	Location	Picture
51	Piercing connections are used to take-off connection from ABC cable				
52	Muffing is used in steel steel tubular poles, rail pole, RS joint/H beam Supports				
53	Adequate tree cutting on either side of line done				
54	Pole to pole schedule enclosed with profarma				

11 KV Line

S. No	Description	Status (Yes/No)	Observations	Location	Picture No.
1	Availability of approved survey report with single line diagram				
2	Correct alignment of 11 kV line				
3	Type of poles used as per scope of the work				
4	Type of foundation used as per scope of work				
5	Record whether line is passing through water logging area and its foundation is grouted in cement concrete				
6	Proper verticality of poles				
7	Cross-bracing on Double poles are provided				
8	Conductors are passing through the top grove of the insulator (creepage distance compromised)				
9	More than one joint in one span				
10	Any deflecting tension on 11 KV pin insulator				
11	Proper tensioning of overhead conductor				
12	Any knot/wrapping of overhead conductor is there during erection				
13	Proper binding of insulators is done				
14	Stay plates are properly grouted in cement concrete mixture				
15	Proper tensioning is there on stay set				
16	Proper alignment of Stay wire with overhead conductor is there to nullify tension				
17	Guy insulator, anchor plate/ thimble/ hardware are provided with stay set				
18	Proper erection of stay clamp using 12 mm dia				

S. No	Description	Status	Observations	Location	Picture
	nuts and bolts and 50x6 mm (or more) size clamp				
19	If every 6th pole in a section of line is provided with stay sets to avoid line deflection				
20	Proper galvanization of stay wire and stay set				
21	Thimble is provided on turn buckle of stay set				
22	Proper phase to phase clearances are maintained on the line				
23	Steel overhead structure is properly earthed using 8 SWG wire				
24	Each 11 kV pole individually earthed using 8 SWG Earth wire and separate Earth pit/Earthing coil/Earth spike				
25	Quality and size of danger plates is as per scope of work				
26	Danger plate is installed at appropriate height using proper clamp as per scope of work				
27	Anti-climbing device (barbed wire/spike) are installed at appropriate height on individual support				
28	Individual pole is numbered				
29	Individual pole is imposed/painted with the name of scheme				
30	Surface of the PCC poles is finished and there are no steel wire visible				
31	No physical damages appeared on PCC pole surface				
32	Cradle guard earthing is provided on each road crossing or on each LT line crossing				
33	Proper tensioning of the cradle guard wires				
34	Proper Guard wires are provided in case of Road crossing as per drawing specification				
35	8 SWG G.I. wire is properly dressed with support for V-Cross arm/Channel/Top clamp earthing				
36	GI wire to GI wire jointing is provided using 12 SWG GI nut bolts and washers				
37	GI wire connection to earth pit is using 12 mm GI nut bolt and washer				

S. No	Description	Status	Observations	Location	Picture
38	Earth pipe is properly inserted inside earth without pipe hammering				
39	Masonry enclosure is provided over individua pipe earth pits				
40	Funnel is provided over pipe earth pit				
41	Proper jumpering using binding practices/PG clamp				
42	If under sized conductor used				
43	Proper conductor clearances to ground is there to avoid bird fault on end sectionizer suppor where disc insulator are used				
44	Proper pole to pole span length in the line. I should not be less than 50 m.				
45	If Pole to pole span is less than 50 m, record the reason with pole numbers				
46	Number of poles used per kilometre of the line				
47	Record type and size of overhead conductors used in the line				
48	Shuttering is used during casting of cement concrete foundation				
49	Cement-concrete grouting foundation of end supports				
50	Measure quantum of cement concreting in any one sample support				
51	Measure cement concreting foundation in any one sample of stay set pit				
52	Proper painting is done on steel structure				
53	Disc Insulators are installed precariously (loose bolts/ missing cotter pins)				
54	D -shaped loop for jumpers are maintained				
55	Any broken insulator found in the line				
56	Surface finish and painting on Steel tubular pole/RSJ/H Pole/Rail pole				
57	Adequate tree cutting on either side of line done				
58	Pole to pole schedule enclosed with proforma				
59	Pole numbering with "RDSS " inscription not done (properly)				
60	Engraving of poles (Name of Manufacturer, SI				

S. No	Description	Status	Observations	Location	Picture
	Nos etc.) not done				
61	Line Spacers not used				
62	Guy insulator not used in stay wire				
63	Inadequate length of barbed wire				

Checklist for inspection of REDB (Substation)

S.N.	Description	Status (Yes/No)	Observation	Picture No.	Location as per SLD
1	Major Materials (CT/PT/CB/X'mer/Battery/ Panels /Structures/Conductor) as per specifications				
2	Record S. No., make and year of manufacturing of Power transformer				
3	Major Materials dispatched without inspection				
4	Construction as per Approved Drawing				
5	Civil works FQP documentation maintained during construction				
6	Equipment (name it) provided in the BOQ/ drawing but not installed				
7	Verification of pre-commissioning and commissioning testes of substation equipment i.e. Circuit Breaker, CT, PT, transformer, Charger, Battery, Relays, Control Panels, Switchgear, 11 KV cable etc				
8	Present condition of main equipment				
9	Functional Status of Transformer: WTI, OTI etc, Relays, Battery Charger, Battery, CB, CT, PT, Energy Meter, Control & Relay panel				
10	Transformer oil tested				
11	Transformer Relays, CT, PT , CB , Switchgears, battery sets, etc charged after test				
12	Equipment charged after commissioning test				
13	Gravel size proper				

14	Earthing of main equipment, fence etc done properly				
15	Sub Station fencing provided				
16	Cable trench made with cable trays – or cables lying on trench floor				
17	Whether Cable trenches have suitable slope to ensure automatic draining of rainwater				
18	Proper storage of equipment				
19	Cables tied on cable trays				
20	Glands, lugs used (wherever need - at cable entries)				
21	Dead end marking for cables is done				
22	Earth mat provided				
23	Undersized conductor/ cables used				
24	Correct size of earthing conductor - flats, GI wires etc used				
25	Acid proof floor used in battery room				
26	Fasteners (nut, bolts, clamps connectors, hardwaresetc) as per specification				
27	Switchgear rubber mats, chequer plates not provided				
28	FQP for material receipt and storage maintained by Employer				
29	Name of Feeder on Control Panel.				
30	Name of Feeder on Outgoing DP structure				
31	Working platform on 33 KV and 11 KV outdoor VCB				
32	Name of Substation board on the entrances				
33	Painting of control room, water supply position in Substation				
34	General sanitation arrangement in the control room building				
35	Internal Lighting in the substation control room				
36	Closed fencing of the substation yard				
37	Approach road to Power Transformer foundation				
38	Water logging/ Earth filling in the yard trench				

39	Partition wall between two Power Transformers				
40	Availability of Earthing Rod in the substation				
41	Availability of Permit & Work Book				
42	Tracing of Earth connection of Power/ Distribution Transformer up to Earth Pit				
43	Connection at Earth Pit				
44	Jointing & Clamping of Earth Conductors				
45	All Terminal Blocks at CTs/PTs/Breaker/Panels/Junction Box				
46	Earthing& Fencing is as per specification				
47	Cable trench cover inside the control room and in the yard.				
48	Exhaust Fan in the Battery Room				
49	Inter Battery connections				
50	Battery Charger connection				
51	Earthing of Control Panel				
52	Termination of power cables at 11 KV sides/LT sides of Power and Station Transformer.				
53	Inside pic of distribution board of station transformer				
54	Take Overall picture of station transformer				
55	Connection of Lightning arrestor				
56	Approximate clearance of live part in the substation				
57	Oil leakage in Power/Station Transformer				
58	Area lighting in the substation				
59	Material diagram of substation in the control room				
60	List of authorized operational personnel in the substation				
61	Connection at the bus-bar jumpers				
62	Loop cables LT/HT/Control				
63	Tagging on cable terminals				
64	Work clearance on control panels and sufficient lightening on the control panel				

5. Type and Acceptance test

The following type, acceptance and routine tests and tests during manufacture shall be carried-out on the material. For the purpose of this clause:

5.1. Contractor shall supply the materials of type & design which has already been Type Tested. Contractor shall provide copy of such tests at site in support of type-tested materials supplied under the contract. No extra payment or time shall be granted for type testing of materials. In exceptional case to case basis, employer will decide to permit type testing of material at contractor's cost.

5.2. Acceptance Tests shall mean those tests which are to be carried out on samples taken from each lot offered for pre-dispatch inspection, for the purposes of acceptance of that lot.

5.3. Routine Tests shall mean those tests, which are to be carried out on the material/equipment to check requirements which are likely to vary during production.

5.4. Tests during Manufacture shall mean those tests, which are to be carried out during the process of manufacture and end inspection by the Contractor to ensure the desired quality of the end product to be supplied by him.

5.5. The norms and procedure of sampling for these tests will be as per the Quality Assurance Programme to be mutually agreed to by the Contractor and the Owner.

5.6. The standards and norms to which these tests will be carried out are listed against them. Where a particular test is a specific requirement of this Specification, the norms and procedure of the tests shall be as per IS/IEC Standard this specification or as mutually agreed to between the Contractor and the Owner in the Quality Assurance Programme.

5.7. For all type test and acceptance tests, the acceptance values shall be the values specified in this Specification, Approved Quality Plan or guaranteed by the Bidder, as applicable.

6. Type Testing, Inspection, Testing & Inspection Certificate

6.1 All equipment being supplied shall conform to type tests including additional type tests, if any as per technical specification and shall be subject to routine tests in accordance with requirements stipulated under respective sections. The Contractor shall intimate the Employer the detailed program about the tests at least three (3) weeks in advance in case of domestic supplies & six (6) weeks in advance in case of foreign supplies.

6.2 The reports for all type tests and additional type tests as per technical specification shall be furnished by the Contractor alongwith equipment/material drawings. The type tests conducted earlier should have either been conducted in accredited laboratory (accredited based on ISO/IEC

Guide 25/17025 or EN 45001 by the national accreditation body of the country where laboratory is located) or witnessed by the representative(s) of Employer or Utility. The test-reports submitted shall be of the tests conducted within last 5 (five) years prior to the date of bid opening. In case the test reports are of the test conducted earlier than 5 (five) years prior to the date of bid opening, the contractor shall repeat these test(s) at no extra cost to the Employer, however the delay in supply due to type-test will not be acceptable during the project.

6.3 In the event of any discrepancy in the test reports i.e. any test report not acceptable due to any design/manufacturing changes (including substitution of components) or due to non-compliance with the requirement stipulated in the Technical Specification or any/all additional type tests not carried out, same shall be carried out without any additional cost implication to the Employer.

6.4 The Employer, his duly authorized representative and/or outside inspection agency acting on behalf of the Employer shall have at all reasonable times free access to the Contractor's/sub-vendors 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 for the Engineer and for his duly authorized representative 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 Employer and the equipment if found unsatisfactory due to bad workmanship or quality, material is liable to be rejected.

6.5 The Contractor shall give the Employer/Inspector ten (10) days written notice of any material being ready for joint testing including contractor and Employer. Such tests shall be to the Contractor's account except for the expenses of the Inspector. The Employer/Inspector, 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 alone with the test which shall be deemed to have been made in the Inspector's presence and he shall forthwith forward to the Inspector duly certified copies of tests in triplicate.

6.6 The Employer or Inspector shall, within seven (07) days from the date of inspection as defined herein give notice 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 shall either make the modifications that may be necessary to meet the said objections or shall confirm in writing to the Employer/Inspector giving reasons therein, that no modifications are necessary to comply with the Contract. If any modification is made on the equipment on the basis of test results not in conformity with the contract, the modified equipment shall be subject to same sequence of test again without any additional cost to Employer.

6.7 When the factory tests have been completed at the Contractor's or Sub-Contractor's works, the Employer/Inspector shall issue a certificate to this effect within seven (07) days after completion of

tests but if the tests are not witnessed by the Employer/Inspector, the certificate shall be issued within seven (07) days of receipt of the Contractor's Test certificate by the Engineer/Inspector. Failure of the Employer/Inspector to 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 Employer to accept the equipment should, it, on further tests after erection, be found not to comply with the Contract. The equipment shall be dispatched to site only after approval of test reports and issuance of dispatch instruction by the Employer.

6.8 In all cases where the Contract provides 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 reasonably demanded by the Employer/Inspector or his authorized representative to carry out effectively such tests of the equipment in accordance with the Contract and shall give facilities to the Employer/Inspector or to his authorized representative to accomplish testing.

6.9 The inspection by Employer 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.

6.10 The Employer will have the right of having at his own expenses any other test(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 specification.

6.11 The Employer 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 equipment for these tests shall be provided by the Employer.

7. Pre-Commisioning Tests

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 Employer and the contractor for correctness and completeness of installation and acceptability for charging, leading to initial pre-commissioning tests at Site. The list of pre-commissioning tests shall be provided by the Employer as per its standard practices. or as included in the Contractor's quality assurance programme.

8. Commisioning Tests

All required instrumentation and control equipment will be used during such tests and the contractor will use all such measuring equipment and devices duly calibrated as far as practicable. However, the Contractor, for the requirement of these tests, shall take immeasurable parameters

into account in a reasonable manner. 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.

8.1 Any special equipment, tools and tackles required for the successful completion of the Commissioning tests shall be provided by the contractor, free of cost.

8.2 The specific tests to be conducted on equipment have been brought out in the respective chapters of the technical specification. However where the pre-commissioning tests have not been specified specifically they shall be as per relevant IS code of practice or as mutually agreed.

8.3 The Contractor shall be responsible for obtaining statutory clearances from the concerned authorities for commissioning and operation of the equipment including the Electrical Inspector. Necessary fee to perform these works shall be paid by Employer.

9. GIS mapping & asset tagging

9.1 General Information

The State owned power distribution utilities have implemented GIS based asset tagging activities in the past and migrated asset information into GIS platform. Bidder should update various attributes of new / upgraded infrastructure created under RDSS over the same platform. Various electrical assets i.e Power Transformers, Distribution Transformer, HT & LT lines with over head conductor, poles, insulators, stay wire etc and Underground distribution system consists of Feeder pillar, UG cable etc; automation devises like RMU's FPI, Auto-reclosures etc needs to be updated in the existing GIS platform. The GIS platform and the associated mobile-app will be provided by the Employer. The scope of the bidder is limited to updating the GIS co-ordinates and the associated mapping information of the new assets created/upgraded on the platform provided by the Employer using the mobile app. However no additional payment shall be made to the contractor for these works.

9.2 Key activities under the scope:

1. After successful award of the contract and finalization of Bill of Quantity (BoQ), the TKC should collect list of attributes (Data Model) for each of the assets purposed under the scheme from the project nodal / GIS incharge of the Utility.
2. The purposed methodology for delivery of these attributes as well as GPS coordinates of the assets up to the defined accuracy level to be decided mutually so that updating the same in existing GIS platform would not be a challenges at the later stage. A point of contact (PoC) is recommended at this stage to avoid any future complicacy.
3. The vendor should create a physical marking procedure with consultation and approval of Employer and mark each assets and consumer that have been surveyed

4. Vendor will start collecting intended data from newly commissioned and / or upgraded infrastructure commissioned in RDSS and submit the same with the Employer nodal / team for approval.
5. The Employer's project in charge would get these data verified through their team, once completed they will get duly verified by Executive Engineer and circle SE and shall submit same to IT office for further review.
6. It is to be noted that updating of GIS asset information is mandatory requirement for the issuance of completion certificate by the employer.

10. Documentation

10.1. General

10.1.1. To ensure that the proposed systems conform to the specific provisions and general intent of the Specification, the Contractor shall submit documentation describing the systems to employer for review and approval. The contractor shall obtain approval of employer for the relevant document at each stage before proceeding for manufacturing, system development, factory testing, site testing, training etc. The schedule for submission/approval of each document shall be finalised during the discussions before placement of the contract, this schedule shall be in line to overall project schedule.

10.1.2. Each document shall be identified by a Contractor document number, the employer document number, and the employer purchase order number. Where a document is revised for any reason, each revision shall be indicated by a number, date, and description in a revision block along with an indication of official approval by the Contractor's project manager. Each revision of a document shall highlight all changes made since the previous revision.

10.1.3. All technical description, specifications, literature, correspondence, prints, drawings, instruction manuals, test reports(both factory and at site), progress photographs, booklets, schedules and all supplementary data or documents furnished in compliance with the requirements of the Contract, shall become the property of the Employer and the costs shall be considered as included in the Contract price.

10.1.4. The Contractor shall be responsible for any time delay, misinterpretation, error and conflict during design, manufacturing, testing and erection of the Works resulting from non-compliance with the requirements of this Specification.

10.1.5. The Employer shall have the right to make copies of any documents, data, reports, information etc. supplied by the Contractor in connection with the Works. The Employer shall not impart the information of these documents to any other manufacturer or competitor but he shall be free to use these for preparation of technical papers, reports etc.

10.1.6. All documentation shall be in English language.

10.2. Requirements for submission of documents, information and data by the contractor

10.2.1. The Contractor shall submit to the Employer all documents in accordance with an approved schedule of submissions and shall submit any further information (in the form of drawings, documents, manuals, literature, reports etc.) when asked by the Employer while commenting/approving any drawings/documents etc.

10.2.2. The documents which are subject to the approval of the Employer shall be identified by the Contractor with the stamp "FOR APPROVAL". All other documents shall be submitted to the Employer for information and shall be identified by the Contractor with the stamp "FOR INFORMATION".

10.2.3. The sequence of submission of the documents shall be subject to the approval of the Employer. The sequence of submissions of all documents shall be such that the necessary information is available to enable the Employer to approve or comment the document.

10.2.4. The Contractor shall supply 4 hard copies of all drawings and documents.

10.2.5. In case a "SUBSEQUENT" revision of any document is made due to any reason whatsoever, a revision of the same, highlighting the changes shall be resubmitted for the Employer's specific approval/ information.

10.3. Documents for approval

10.3.1. The Employer shall be allowed fifteen (15) calendar days to approve the Contractor's submissions. The submissions for approval, shall be returned to the Contractor marked in one of the following ways :

Category I:	Approved
Category II:	Approved with Comments.
Category III:	Returned for correction.
Category IV :	For information

10.3.2. The first notations "I" or "II" shall be deemed to permit the Contractor to proceed with the work shown on the document, except in the case of notation "III" the work shall be done subject to the corrections indicated thereon and/or described in the letter of transmittal. The Contractor shall bear the full responsibility for proceeding with the Works prior to receipt of the release in notation "I" from the Employer.

10.3.3. In case of notation "II", the Contractor shall include the alterations required & resubmit the document within fifteen (15) days from date of Employer's letter of transmittal.

10.3.4. In case of notation "III", the Contractor shall include the alterations required and resubmit the document to the Employer, within fifteen (15) days, from date of letter of transmittal, so that such document can be returned with the notation "I" or "II".

10.3.5. It may also be noted that the approval/commenting by the Employer does not relieve the Contractor of any of his contractual obligations and his responsibilities for correctness of dimensions, materials, weights quantities or any other information contained therein, as well as the conformity of designs with Indian Statutory Laws and the Technical Specifications as may be applicable. The approval also does not limit the Employer's rights under the Contract.

10.3.6. The approved documents shall be considered as the working documents. However the Technical Specification and connected documents shall prevail over these documents in case a decision is required on interpretation.

10.4. Documents for information

The Contractor shall not delay the Works pending the receipt by the Contractor of the comments on documents submitted to the Employer for information. However, the Employer shall have the right to comment on all the documents submitted by the Contractor, when, in the opinion of the Employer the document does not comply with the Contract or otherwise. The Contractor shall satisfactorily demonstrate that the information contained in the aforesaid document does meet the requirements of the Contract or revise the document in order that the information shall comply with the requirements of the Contract.

10.5. Basic reference drawings

10.5.1. The reference drawings are enclosed with the bid document, which forms a part of the specification. The contractor shall develop a new layout in line with the specification and take the approval of the EMPLOYER. The contractor shall maintain the overall dimensions of the substation, buildings, bay length, bay width, phase to earth clearance, phase to phase clearance and sectional clearances, clearances between buses, bus heights but may alter the locations of equipment to obtain the statutory electrical clearances as required for the substation.

10.5.2. All drawings submitted by the Contractor including those submitted at the time of bid shall be in sufficient detail to indicate the type, size, arrangement, material description, Bill of Materials, weight of each component, break-up for packing and shipment, dimensions, internal & the external connections, fixing arrangement required and any other information specifically

requested in the specifications.

10.5.3. Each drawing submitted by the Contractor shall be clearly marked with the name of the Employer, the unit designation, the specifications title, the specification number and the name of the Project. If standard catalogue pages are submitted, the applicable items shall be indicated therein. All titles, noting, markings and writings on the drawing shall be in English. All the dimensions should be in metric units.

10.5.4. Further work by the Contractor shall be in strict accordance with these drawings and no deviation shall be permitted without the written approval of the Employer, if so required.

10.5.5. The review of these data by the Employer will cover only general conformance of the data to the specifications and documents interfaces with the equipment provided under the specifications. This review by the Employer may not indicate a thorough review of all dimensions, quantities and details of the equipment, materials, any devices or items indicated or the accuracy of the information submitted. This review and/or approval by the Employer shall not be considered by the Contractor, as limiting any of his responsibilities and liabilities for mistakes and deviations from the requirements, specified under these specifications and documents.

10.5.6. All manufacturing and fabrication work in connection with the equipment prior to the approval of the drawings shall be at the Contractor's risk. The Contractor may make any changes in the design which are necessary to make the equipment conform to the provisions and intent of the Contract and such changes will again be subject to approval by the Employer. Approval of Contractor's drawing or work by the Employer shall not relieve the contractor of any of his responsibilities and liabilities under the Contract.

10.5.7. All engineering data submitted by the Contractor after final process including review and approval by the Employer shall form part of the Contract Document and the entire works performed under these specifications shall be performed in strict conformity, unless otherwise expressly requested by the Employer in Writing.

11. Return of replaced old materials to the area stores of Employer

- Old PVC wire will be rolled into bundles. The bundles should be tightened firmly and properly with PVC sticker strip or string. A tag should be attached with each bundle to indicate the weight of the bundle. As far as possible, bundle should consist of wire of the same size and same metal. Similar action is required to be taken in case of GI wire.
- Old conductor of same size shall be rolled into bundles. Bundles should be tightened firmly and PVC sticker strip or string regarding size of conductor shall be mentioned. Size, type & Weight of each bundle shall also be indicated on the sticker strip.

- Materials released due to bay capacity augmentation and/or due to replacement like power transformers, distribution transformers, insulator, meter board, cut outs etc are also required to be returned to Employer's stores through proper documentation.
- All other line materials released like, conductors, poles, cross arms; fabricated material, etc. shall be properly accounted for and returned to Employers store after recording all necessary details including weight, length etc. wherever necessary. A detailed procedure for return of the old materials shall be prescribed by Project Management Agency.
- In respect of accountal of devolution of released material, the process as formulated by Employer time to time shall be followed by the contractor

12. Miscellaneous activities

- Commencement of Supply & Works: The Contractor shall ensure that the supply and installation of material and service under the contract is as per approved PERT / completion schedule of works. The Contractor is to commence supply with the type tested materials with necessary routine test/ acceptance test certificates for a particular lot duly approved by EMPLOYER or the EMPLOYER's authorized agencies.
- The contractor shall submit Type test and routine test certificates as applicable, issued by NABL accredited / third party independent standard laboratories like CPRI, NPL etc.
- Unit rates: The unit rates quoted shall include details which are obviously and fairly intended, and which may not have been included in these documents but are essential for the satisfactory completion of work. The unit rate quoted shall be inclusive of deployment of all plants, equipments, men, materials, skilled & unskilled labour etc. essential for satisfactory completion of work.
- The prices for fabricated materials shall include all works relating to fabrication, galvanizing and delivery ex-contractors stores, unloading and loading. The quoted prices shall also include the cost of necessary quantity of steel and zinc, freight charges up to site store and other indirect charges incurred in connection with supply of finished materials.
- Quantities/ length of 33 KV, 11 KV line and LT line, distribution transformers sub stations, 33/11 KV sub-station etc. indicated in the price schedules are provisional. Any quantity variation in individual item and in contract value shall be governed as per GCC clause 39. The Contractor shall execute the work based on the actual survey and as approved by the Engineer-in-charge or person authorized by him. The scope of work also covers supply of other items, not specifically mentioned in this specification and/or bill of materials but are required for the successful installation, testing, commissioning and satisfactory performance of the 33 KV & 11 KV lines, 33/11 KV sub stations, distribution transformer sub stations, LT lines, service lines etc.

The following works & services shall also be provided by the contractor.

a) Unloading the equipments from the rail or road transport and moving those to storage area. Demurrage/ wharf age charge, if any incurred, shall be paid by the contractor

b) Opening of packing cases, inspection and checking of materials for any damage or loss in transit shall be the responsibility of the contractor. All claims with the concerned authorities e.g. rail, transport, insurance etc. shall be lodged by the contractor.

c) Complete erection of equipments, etc covered under the contract, final preparation for testing, commissioning, final run and acceptance tests and putting the sub-station/ plant/line etc. into operation.

d) All consumable, stores required for the above erection and commissioning works.

e) All erection tools, lifting tackles, and all equipments, tools & tackles for transportation at site.

f) Workshop, as required within the work area.

g) Third party insurance [1] at site and insurance of personnel employed at site as required under Workman's Compensation Act. Security arrangement for watch and guard as required shall be made by Bidder at his own cost.

h) All the technical/ skilled staff deployed for the job must possess the required qualifications and necessary licenses and permits.

i) Contractor shall take all safety precautions during work and the workmen must use safety belts, hand gloves, masks and other safety devices as may be necessary for safety of the personnel.

j) The contractor shall provide operating personnel during trial tests and till the PSS, DSS, lines and equipments etc. are taken over by EMPLOYER as specified in taking over Clause, defined later.

k) Any other work not covered above but required for successful completion of the project has to be carried out by the contractor at his own cost.

[1] **Note**: Before receipt of equipment at site but without limiting his obligations and responsibilities under this clause hereof, the Contractor shall insure against his liability for any equipment, material or physical damage, loss or injury which may occur to any property, including that of EMPLOYER and project management agency, or to any person including employee of the EMPLOYER, by or arising out of the execution of the contract or in the carrying out of contract. The third party insurance cover shall be provided for the period from date of Ex-factory dispatch till taking over of the entire equipment after testing, commissioning and trial operation, if any.

Third party insurance shall be affected for an adequate amount to cover for all marine, transportation, field transportation, erection, testing and commissioning till handing over to Employer,. Terms shall include a provision whereby, in the event of any claim being brought or made against EMPLOYER in respect of which the Contractor would be entitled to receive indemnity under the policy, the insurer will indemnify EMPLOYER and project management agency against such claims and any costs, charges and expenses in respect hereof. Contractor shall lodge the claim if need so arise, the employer shall be the owner of the equipment/materials and the claims shall be settled in the name of Employer.

13. Individual work components

<To be modified by the Employer as per the works envisaged>

13.1. New 33 KV Lines

1.00 Survey

Mapping of route of proposed new 33 kV line by foot survey in rural/urban areas be performed mentioning various milestones. While surveying, existing electrical infrastructure in the locality should also be mapped. Line alignment (single line diagram) on political map with fair correctness, be prepared. SLD and foot survey report shall be approved by Project Manager and shall be used as basic document for assessment of works under the contract. On completion of line work, as built Single Line Diagram and pole wise line diagram showing pole wise materials used and pole-to-pole span should be submitted to Project Manager. This details shall be used as reference documents by Quality and Quantity Inspecting officials to execute inspection works.

2.00 Support (pole):

Following type of supports are envisaged for new 33 KV overhead lines-

a. 9.1 meter long /280 KG PCC Poles (PCC Pole as per state practice)
b. 11/13 m long galvanized H-Beam 152x152 mm 37.1 kg/m
c. 11 M long steel Tubular poles of Designation 540 SP 52 (IS 2713, Pt I, II, III 1980)
d. 13 M long steel Tubular poles of Designation 540 SP 72 (IS 2713, Pt I, II, III 1980)
e. 11/33 m Wide Galvanized Parallel Beam GI Poles (160x160 mm) extendable with jointing plates – 30.44kg per meter

In rural area, PCC poles are to be used. In urban area, PCC or H-Beam or STP or Wide Parallel Beam supports are to be used of suitable length. In hilly areas where handling of material is a challenge, tubular, or Wide Parallel Beam GI poles expandable with jointing plates may be used. In location specific conditions like forest area, vicinity of other existing overhead lines or permanent structures etc., H- beam or tubular poles or Wide Parallel Beam supports may be used of suable length. Steel bottom plate shall be used in steel tubular poles/H-Beam / Wide parallel Beam and cement concrete reinforced plate shall be used as base plate for PCC poles. Steel tubular poles shall be cleaned till good surface finish and painted with 2 or more coats of red oxide paint and 2 or more coats of aluminum paint till good finish. Steel tubular poles and H-Beams shall also be painted with 2 or more coats till good surface finish with anti-corrosive paint (in case of tubular poles shall also be painted on the inner walls) which goes in to the foundation. Project Manager shall approved brand and shade of paints.

~~teel tubular poles shall be cleaned till good surface finish and painted with 2 or more coats of red oxide paint and 2 or more coats of aluminum paint till good finish. Steel tubular poles and H-Beams shall also be painted with 2 or more coats till good surface finish with anti-corrosive paint (in case of tubular poles shall also be painted on the inner walls) which goes in to the foundation. Project Manager shall approved brand and shade of paints.~~

~~Painting of H-Beams and Steel Tubular Poles shall be performed at stores. Before shifting to site for erection, poles shall be offered for inspection and approval by Project Manager. In water bound areas and in NE areas, galvanized poles may be used~~. The minimum coating of the zinc on steel tubular poles or Wide Parallel Beam supports shall comply with IS: 2629 and IS: 2633 (with latest amendments). Galvanizing shall be checked and tested in accordance with IS: 2633.

The H beam poles shall be hot-dip galvanized thoroughly internally and externally as per according to IS: 2629 and IS: 2633 (with latest amendments). Galvanizing shall be checked and tested in accordance with IS: 2633.

Poles and other hollow items shall be galvanized both inside and out. The zinc coating shall be smooth, continuous and uniform. It shall be free from acid spots and shall not scale, blister or be removable by handling or packing. There shall be no impurities in the zinc or additives to the smelter bath that could have a detrimental effect on the durability of the zinc coating. Before pickling, all welding, drilling, cutting and grinding shall be completed and all grease, paint, varnish, oil and welding slag shall be completely removed.

All protuberances which could affect the life of galvanizing shall also be removed. To avoid the formation of white rust all galvanized material shall be packaged in such a way to ensure adequate ventilation between parts during shipping and storage.

Testing of galvanizing shall be performed for Uniformity of thickness as per IS 2633/1986, Mass of coating as per IS 6745/1972 and quantity of zinc, water quenching & centrifuging as per IS 2629/1985.

3.00 Fabricated steel items:

The fabricated steel structures materials shall be hot-dip galvanized thoroughly internally and externally according to IS: 2629 and IS: 2633 (with latest amendments). Galvanizing shall be checked and tested in accordance with IS: 2633.

Fabricated steel structure items shall be galvanized both inside and out. The zinc coating shall be smooth, continuous and uniform. It shall be free from acid spots and shall not scale, blister or be removable by handling or packing. There shall be no impurities in the zinc or additives to the smelter bath that could have a detrimental effect on the durability of the zinc

coating. Before pickling, all welding, drilling, cutting and grinding shall be completed and all grease, paint, varnish, oil and welding slag shall be completely removed.

All protuberances which could affect the life of galvanizing shall also be removed. To avoid the formation of white rust all galvanized material shall be packaged in such a way to ensure adequate ventilation between parts during shipping and storage.

Testing of galvanizing shall be performed for Uniformity of thickness as per IS 2633/1986, Mass of coating as per IS 6745/1972 and quantity of zinc, water quenching & centrifuging as per IS 2629/1985.

4.00 Hardware:

MS Nuts, bolts and washers (Galvanized) – 16 mm dia nuts, bolts & washers shall be used for tying of overhead structure items like cross arms, top clamps, brackets, clamps, bracing, strain plates etc.

While erecting, proper dimensions of nut-bolts and washers must be ensured. 2 to 3 threads only be visible of the bolt after full tightening of nut on requisite torque. The hardware shall be hot dip galvanized. The minimum coating of the zinc shall comply with IS: 2629 and IS: 2633. Galvanizing shall be checked and tested in accordance with IS: 2633. Before shifting them to site for erection, they shall be offered for inspection and approval by Project Manager.

5.00 Stay Set:

Galvanized Stay Set with 50x8 mm stay clamp, guy insulator (2Nos.), anchor plate (300x300x8mm) , nut-bolts, 2 Nos turn-buckles, 1.8 m long, 20 mm diameter solid GS stay rod & 7/4.00 mm dia GI stranded wire complete.

Stay set shall be used at all turning locations, conductor dead end location, double pole structure, triple pole structure, four pole structure to nullify the tension of conductor. At dead end locations, stay sets shall be used in pairs in separate foundations. Erection of storm guys at suitable location in straight line may also be provided.

0.3 cmt cement concreting in mixture 1 part cement, 3 part coarse sand, 6 part 40mm size aggregate stone chips (1:3:6) shall be provided in each stay set foundation. 2 Nos. guy insulator shall be provided in stranded GI wire at middle location between two turn buckles. Shuttering and vibrator shall be used for cement concreting works.

6.00 Earthing:

Following earthing arrangements are envisaged for new 33 kV lines:

a. 40 mm dia., 3000 mm long GI pipe earth electrode with test link, RCC pit, RCC cover plate on GI frame, bentonite powder and other accessories complete
b. GI Earthing spike made of 20mm solid rod
c. Chemical rod earthing using Carbon powder/Bentonite powder / Conductive concrete powder including electrode with 2000mm long, 50 mm diameter GI pipe, GI Strip of 24x3mm minimum.
d. 8 SWG GI Earthing Coil.
e. 6 SWG GI wire for earthing and guarding
f. 8 SWG GI wire for earthing and guarding

Each 33 kV line support shall be provided with one GI earthing spike made of 20 mm solid rod or 8 SWG GI Earthing Coil and connected with 8 SWG GI wire. Overhead line structure shall be connected to GI earthing spike or GI Earthing Coil using 8 SWG GI wire. GI nuts, bolts & washers shall be used to join two GI wires and 20 mm solid spike rod. Project Manager shall decide use of GI Earthing Coil or GI Solid earth Road for earthing of individual poles.

At railway crossing, line crossing and other specific locations 40 mm dia, 3000 mm long GI pipe earth electrode with test link, RCC pit, RCC cover plate on GI frame, bentonite powder and other accessories shall be used. Overhead line structure at these locations shall be connected to GI earth pipe using 8 SWG GI wire. GI nuts, bolts & washers shall be used to join two GI wires and 40 mm GI earth pipe.

In rocky soil where getting required earth resistance is a challenge, chemical rod earthing shall be used. Overhead line structure shall be connected to chemical earth electrode using 8SWG GI wire. GI nuts, bolts & washers shall be used to join two GI wires and 20 mm solid spike rod.

GI flats and GI wires must be properly dressed, bundled and fixed on supporting structure at 1 to 2 feet intervals.

7.00 Insulator and hardware –

33 KV polymer/porcelain Disc/Pin insulator with suitable hardware fittings shall be used. Insulator should be tied properly using binding wire and tape/helical form fitting. In road crossing and line crossing locations bridling cross arms and pin insulator shall be used.

The individual insulator shall be checked for insulation resistance before overhead line installation. Insulator should properly be cleaned before installation. No damage/crack insulator should be used.

8.00 ACSR/AAAC Conductors:

Following ACSR Conductors (or equivalent AAAC conductor) are envisaged for new 33 kV lines:

a. 6/4.09 + 1/4.09 mm (80 mm² Al. Area) - Raccoon
b. 6/4.72 mm + 7/1.57 mm (100 mm² Al. Area) – Dog
c. 30/2.59 mm + 7/2.59 mm (150 mm² Al. Area) – Wolf
d. 30/3.00 + 7/3.00 mm (200 mm² Al. Area) - Panther

Care should be taken while drawing conductor from the drum. Proper roller should be used while handling conductors during erection. Jointing sleeves, binding materials, PG clamps, bi-metallic conductor shall be used for conductor jointing, insulators fixing, jumpering and termination at equipment respectively.

Proper sag should be maintained using sag chart table. While tensioning, care should be taken to avoid tension on pin insulator. Therefore, proper alignment of line to be ensured. Conductor joint should not be in the middle span but may be planned nearer the support.

At terminal location, care should be taken while connecting two sections to avoid bird faults. Therefore, pin insulator is to be used to handle the conductor on DC cross arm (as per state practice).

9.00 Pole numbering:

Each support pole should be numbered properly labelled using yellow base and black indication marks (number or digits). 40/50 mm height digits/words should be used for this purpose. Base shall be made using 2 or more coats of yellow enamel paint till good surface finish. Base preparation shall be completed before shifting of poles to site for erection. Base painting and marking of digits should be performed by a skilled and trained painter using branded enamel paint, Project Manager shall approve type and brand of enamel paint. Warning instruction, if any, of availability of two sources of 33 kV supply on same structure, at source structure, at cut points should exclusively be provided as per state practice.

10.00 Anti-climbing device:

3.5 kgs, 2.5mm dia (12 SWG) galvanized barbed wire shall be used on each 33 kV support. Galvanized barbed wire should be properly dressed and crimped at termination. While wrapping the wire on support, proper tension should be maintained.

11.00 Danger board:

Each support should be provided with a danger board with pole clamps as per approved drawing. Danger board should be in bi-lingual languages (local language and English). Clamp for danger board, nut-bolts and washers shall be painted with two or more coats of red-oxide and aluminum paints respectively till smooth surface before installation.

12.00 33 KV AB Switch:

33 kV, 3-ph, 600 A, 3 Pin type, Vertical/Horizontal Mounting type, Gang Operated, AB Switch shall be installed at cut points and at suitable locations as per instructions of Project Manager. B Class GI pipe shall be used (without any joints) for operation of switch. AB Switch structure and handle must be earthed using 8 SWG GI wire.

13.00 Support foundation:

Cement concrete in mixture 1 part cement, 3 part coarse sand, 6 part 40mm size aggregate stone chips (1:3:6) shall be used in all the types of 33 kV line supports.

While erecting supports (poles), shuttering must be used for concreting so that proper quantity of cement concrete mixture be used and assessed during inspection. During concreting proper compaction by means of mobile vibrator be provided. While starting work of support erection, gang wise shuttering and mobile vibrator shall be offered for inspection to Project Manager. While erecting support, mercury level gauge must be used to ensure vertical erection of support.

250mm dia X 12" inch size muffing shall be provided on steel tubular/ H-Beam poles/wide parallel beam support to prevent direct entry of rain water along the poles. Cement Concrete of 1:2:4 (1 part Cement, 2 parts coarse sand and 4 parts 20mm aggregate stones chips) shall be used for individual poles

Steel plate shall be used in steel tubular poles/Wide parallel Beam/ H-beam supports and cement concrete reinforced plate shall be used as base plate for PCC poles.

14.00 33 kV line for underground railway crossing –

A separate composite item of railway crossing is kept in BoQ. 2 Nos. separate cables shall be laid in separate GI pipe enclosures. At a time, one shall be used and another shall be kept idle as spare in ready to join condition. Cable termination, cable identification, protective covering, laying of jumpering cable etc. shall all be completed in this head. This composite item shall contain following key items:

a. 3Cx300 Sqmm XLPE armored cable (approx. length is 0.3 km each) – 2 sets
b. 150mm dia GI pipe of A class (red color painted on edges) for cable protection in underground laying – 2 sets
c. 150mm dia GI pipe of B class (blue color painted on edges) for cable support at DP structure – 2 sets
d. Outdoor heat shrinkable cable jointing kits for main cable and jumpering cable – 4 Nos for main cable, 8 Nos for jumpering cables.
e. 33 kV lightening arrestor station class 10kA (6 nos.),
f. 4 Nos GI 3-meters long pipe earthing/chemical earthing,
g. 6 SWG GI wires with GI nuts, bolts & washers,
h. Cable markers,
i. Bi-metallic clamps,
j. Jumpering with 33 kV Arial Bunched Cables 200 Sqmm dia (10 mtr) etc. – 4 sets

Detail survey of location of railway crossing be performed by Contractor to avoid multi-crossing at nearby location. Prior railway permission for execution of this work shall be obtained by Project Manager for which necessary technical support shall be provided by Contractor. Line crossing shall be performed using underground cabling. Block on railway traffic shall be arranged by Project Manager. Contractor should ensure timely completion of work during block period by mobilizing requisite man, materials and machine at crossing locations.

Horizontal drilling machine shall be used for horizontal bore below railway tracks.

15.00 Quality & Quantity inspection and compliance to the observation:

The line works, before or after commissioning/energization, shall be inspected by Quality Inspectors and State Inspection Inspectorate. Contractor shall provide all requisite details of line like approved survey report, as built drawings and joint measurement sheet etc. to the inspector. Contractor shall rectify defects/deficiencies and submit compliance to the

observations with supporting photographs in digital form within one month from receipt of observations.

16.00 Tree-cutting/trimming of tree:

The Contractor shall count, mark and put proper numbers with suitable quality of paint at his own cost on all the trees that are to be cut/trim to obtain required tree clearance. Contractor shall pay compensation for any loss or damage for tree cutting due to Contractor's work. Wherever forest clearance is envisaged for execution of work, clearance of forest department for tree cutting, if required, shall be arranged by the Project Manager and compensation shall also be paid by the Project Manager. Necessary fee if required to pay to Govt. dept. for arranging such clearances shall paid by Project Manager. However, the Contractor would require to provide all necessary assistance for execution of this work.

17.00 Statutory clearances:

During execution of 33 KV Line work, all statutory clearances shall be ensured for ground clearance, line-to-line clearance, road crossing clearance, horizontal and vertical clearances from buildings/objects etc. All road crossings and line crossings shall be guarded as per specifications. Conductor joint should not be provided in mid span length. Instead, it should be nearer to the support.

13.2. 66/11KV new Substation

1.00 Electrical Details of New 66/11 KV Grid Substations –

No	Name of Proposed Substation	Circle/ town	66 KV line LILO or Radial	Capacity in MVA	Nos of proposed 11 KV outgoing feeders

2.00 Following works are in the scope of Employer:

a) Acquisition of land for the substation and its possession to start constructional activities,

b) Approach road to the substation land,

c) Availability of up-stream source and plan for incomer 66KV line (if the same is not part of package)

d) General layout of the substation

e) Three (3phase) 415V AC power supply at one point on Contractor's expense & as per prevailing electricity tariff provided LT network is available in the vicinity of the proposed substation.

f) Space for construction office & store yard for agency provided free of charge provided it is available at site.

Since above works are not covered under substation works, Employer shall provide all above input before start of substation work by turnkey Contractor. A format protocol note for handing over/taking over of sub-station land, approach road, retaining wall(wherever needed) and layout plan shall be signed between Project Manager and authorized representative of Turnkey Contractor.

3.00 Following works are in the scope of Contractor:

The scope of works include on turnkey basis for design, engineering, manufacturing, shop testing, transportation, supply, storage, erection, testing & commissioning of the following:

i. 66/11 KV new Sub-station at specified locations with 66 KV outdoor switchyard comprising of ……nos. bays with …….nos. 66/11 KV 16/20/25/30 MVA Power Transformers, 66/11 KV transforms bays, 66 KV bus coupler bay and 11 KV indoor switchgear along with switchyard control room and all associated facilities (to be modified suitably by utility).

The Scope includes:

a) Complete design and engineering of all the systems, sub-systems, equipment, material and services.

b) Providing engineering data, drawings and O&M manuals for Employer's review, approval and records.

c) Manufacturing, supply, testing, packing, transportation and insurance from the manufacturer's work to the site including port and customs clearance, if required.

d) Receipt, storage, insurance, preservation and conservation of equipment at site.

e) All civil and structural works as required.

f) Fabrication, pre-assembly (if any), erection, testing and putting into satisfactory operation of all the equipment/material including successful commissioning

g) Satisfactory conclusion of the contract.

h) Enabling work as per the site requirement.

In addition to the requirements indicated herein, all the requirements as stated in other sections shall also be considered as a part of this specification as if completely bound herewith.

The Bidder shall be responsible for providing all material, equipment and services specified or otherwise which are required to fulfill the intent of ensuring operability, maintainability and the reliability of the complete work covered under this specification.

It is not the intent to specify all aspects of design and construction of equipment mentioned herein. The systems, sub-systems and equipment shall conform in all respect to high standards of engineering, design and workmanship, and shall be capable of performing in continuous commercial operation.

Whenever a material or article is specified or described by the name of a particular brand, manufacturer or trade mark, the specific item shall be understood as establishing type, function and quality desired. Products of other manufacturers may also be considered, provided sufficient information is furnished so as to enable the Employer to determine that the products are equivalent to those named.

The scope of work shall comprise, but not limited to the design, engineering, manufacture, testing and inspection at manufacture's works, packing, supply, transportation, transit insurance, delivery to site, unloading, and storage and equipment erection including associated civil and structural works. Further it

shall include the cabling, lighting, earthing, supervision, site testing, inspection and commissioning of Sub-Station. The scope shall also include all enabling works required for modification to existing facilities within the project area.

a. Bay Details:

The Sub-Station shall comprise of …….nos. of 66/11 kV Transformer bay, 1 No. 66 kV Bus-Coupler bay. The Sub-Station shall be with Double-Main bus-switching scheme for 66 kV (to be modified suitably by utility).

66 kV Bus bar shall be of ACSR zebra/…… conductor (to be filled by utility).

The equipment and materials to be supplied by the Bidder shall form a complete 66 kV Sub-Station.

Any items though not specifically mentioned but which are required to make the switchyard complete in all respects for its safe, efficient, reliable and trouble free operation shall also be deemed to be included and the same shall be supplied and erected by the Bidder without any additional cost to Employer. The following items of works are covered under scope-

- 66 kV equipment including structures: Circuit Breakers, Isolators with/without earth-switch, current transformers, surge arresters, bus-post insulators and capacitor voltage transformers.
- Sub-Station Control Room Building or extension of existing one.
- 66/11 kV Power Transformer of rating as specified (16/20/25/30 MVA as specified in BOQ)
- Structures for supporting XLPE Power Cables connected to Secondary Terminals of Power Transformer.
- 11 KV …….. MVAR Capacitor bank, isolator, series reactor & associated equipments for ……..banks of …….. MVAR with structure (details to be filled by utility).
- 100 kVA, 11 kV / 415V Station Transformer.
- 11kV metal clad indoor switchgear with draw out type VCB, CT and PT, all control, protection and mimic arrangement.
- Vacuum Contactor Panel for capacitor feeder.
- DC System: 220V.
- 66 kV Sub-Station including internal roads, drains, boundary wall, gates, Barbed wire fencing for complete substation boundary & Chain Link fencing for Switchyard, Borewell, oil sump pit, Geo Technical Survey, soil investigation, Soil filling & compaction including construction

of retaining wall for Civil Works as required.

- Supply & Erection of material for all Civil Works including equipment & gantry structure complete for 66KV outdoor yard equipment for transformer bay & line bay including earthing system & lightening protection etc. Erection including supply of material for transformer foundation, cable trench extension, fire wall for new power transformer.
- 66 kV Sub-Station Materials.
- ACSR Zebra Conductor.
- G.S. Earth wire.
- Insulators and Hardware.
- Clamps, Connectors and Spacers.
- Bay Marshalling Box.
- Fire Fighting Equipment
- Complete earthing grid for a system fault current of 31.5 KA and 1s duration (to be modified suitably by utility if required), earthing of all switchyard equipment including transformers and direct stroke lightning protection system and its connection to earthing grid.
- Bidder shall make earth resistivity measurements at site and design the earthing grid as per latest edition of relevant standards.
- Complete Direct Stroke Lightning Protection using Lightning Mast and/or shield wire and its connection to earth mat.
- Power & Control cables, cabling (including inter pole and inter panel), Cabling between equipment and panels, cable support angles, cable trays and accessories necessary for cable erection such as glands, lugs, clamps for cables, ferrules, cable ties, hume pipe etc., cable route markers for buried cables, cable trench with covers also included in the scope.
- Power & Control cable schedule & termination schedules shall be prepared by the Bidder.
- Internal and outdoor lighting system for control room building and 66 kV Sub-Station. The substation area inside the fencing should be illuminated provided with 100 Watts LED flood light fittings. Tubular poles 12m high as per IS: 2713 (Latest Version) shall be used for installation of area light fixtures in Urban as well as Rural substations. Internal electrification of the control room includes provision of fans, exhaust fans, LED illumination fixtures, switches and sockets. Control Room lighting shall be designed to ensure 300 lux illumination level through LED lamp fittings. The bidder shall submit calculation for achieving the above illumination before start of lighting work for approval of project manager.
- Control, protection and metering system.

b. Services and Items:

The scope includes but not limited to the following services/items described herein and elsewhere in specification:

a) System design and engineering
b) Supply of equipment and material
c) Civil works
d) Structural works
e) Erection works
f) Project management and site supervision
g) Testing and commissioning
h) Clearances from statutory authorities.

c. System Design and Engineering:

i. The Bidder shall be responsible for detailed design and engineering of overall system, sub-systems, elements, system facilities, equipments, auxiliary services, etc. It shall include proper definition and execution of all interfaces with systems, equipment, material and services of Employer for proper and correct design, performance and operation of the project.
ii. Bidder shall provide complete engineering data, drawings, reports, manuals etc. for Employer's review, approval and records.
iii. The scope shall also include the design and engineering as per details elaborated elsewhere in this specification.
iv. The Bidder shall carry out earth resistivity measurements at the switchyard site
v. Relay setting calculations shall also be submitted by the Bidder for approval.
vi. For all civil and structural works, the Bidder shall carry out design calculations; prepare all the detailed construction and fabrication drawings.

4.00 Arrangement by the Contractor

Contractor shall make his own necessary arrangements for the following and for those not listed anywhere else:

1. Distributions of power supply at all work areas in the substation premises.
2. Construction of office and store (open & covered)
3. Construction of workshop and material/field testing laboratory
4. Fire protection and security arrangements during construction stage

5.00 Civil works:

Details scope under civil works have been provided in this Part 2, Section 6 – "Civil Works and Soil Investigation" mentioned subsequently.

6.00 Basic Reference Drawings

The reference drawings, which are indicative of the type of specifications Employer intends to accept, shall be developed by Contractor and approved by Project Manager. The Contractor shall maintain the overall dimensions of the substation, buildings, bay length, bay width, phase to earth clearance, phase to phase clearance and sectional clearances, clearances between buses, bus heights but may alter the locations of equipment to obtain the statutory electrical clearances required for the substation.

13.3. New 33/11 kV Power Substation

1.00 Electrical Details of New 33/11 KV Grid Substations –

No	Name of Proposed Substation	Division	33KV line LILO or Radial	Capacity in KVA	Nos of proposed 11 KV outgoing feeders

2.00 Following works are in the scope of Employer and shall be executed by Project Manager:

a) Acquisition of land for the substation and its possession to start constructional activities,

b) Approach road to the substation land,

c) Leveling of the substation land,

d) Construction of retaining wall wherever required including cutting, digging or filling of earth as required,

e) Availability of up-stream source and plan for incomer 33 KV line (if the same is not part of package)

f) General layout of the substation

g) Three (3phase) 415V AC power supply at one point on Contractor's expense & as per prevailing electricity tariff provided LT network is available in the vicinity of the proposed substation.

h) Space for construction office & store yard for agency provided free of charge provided it is available at site.

Since above works are not covered under substation works, Employer/Employer shall provide all above input before start of substation work by turnkey Contractor. A format protocol note for handing over/taking over of sub-station land, approach road, retaining wall(wherever needed) and layout plan shall be signed between Project Manager and authorized representative of Turnkey Contractor.

3.00 Types of substation: Two types of substations are envisaged under this head as per following:

a. **Partly-Outdoor substation** – in this type, 33KV section comprising breakers, isolators, 11/0.4 KV station transformer, CTs, PT, Lightening Arrester, Power Transformer & 11 KV Capacitor Bank, 33KV gantry shall be installed in out-door switch yard. Control panels of breakers shall be installed inside the control room. All 11KV equipment like CTs, Breakers and control panels, feeder meter shall be installed inside the control room. 11 KV cables shall be used for connection of power transformer and breaker and Breaker to outgoing isolators. 11KV feeder isolators and 11KV Lightening Arresters shall be installed outdoor.

b. **Fully-Outdoor substation** – in this type, all 33KV and 11 KV equipment comprising Breakers, Isolators, CTs, PT, 11/0.4 KV Station Transformer, Lightening Arrester, Power Transformer, metering equipment and 11 kV capacitor bank shall be installed in substation yard i.e. outdoor. Control panels and feeder meter shall be installed indoor. Fully outdoor substation shall be constructed using H-beam support or gantry structure supports as decided by Project Manager.

4.00 Power Transformers:

Power Transformers shall be 33/11 kV, 3 ph, 50 Hz, ONAN, Cu Wound, Outdoor Conventional type Power Transformer along with transformer oil, Buchholtz relay, breather, OTI & WTI, Marshalling Box, Conservator tank, oil level indicator, valves, Vent explosion plug, control wiring between sensing equipment and marshalling box, cable supporting tray on the body of transformer, transformer wheels, LV/HV bushing etc. as required. Following type and capacity of power transformers are envisaged under the scheme:

a) 1.60 MVA without tap changer
b) 3.15 MVA without tap changer
c) 5.00 MVA with off load / on load tap changer
d) 6.3 MVA with off load / on load tap changer
e) 8.00 MVA with off load / on load tap changer

f) 10.0 MVA with off load / on load tap changer
g) 12.5 MVA with off load / on load tap changer

Or any other rating as per latest Indian Standard Specification. Corresponding bus conductor, gantry structures, LA, CT, Breaker, Isolators, Earth-switch, Power Cables may be added as per the requirement of the equipment.

Transformer foundations shall be designed by turnkey Contractor considering manufacturer's recommendations. Cement concrete including reinforcement steel shall be used for the foundation. Project Manager shall approved design and drawings of foundations. Proper shuttering, vibrator, curing shall be performed while constructing the foundations. Transformer rails shall also be provided for mounting of transformers on wheels.

2 sets of 50x8 mm galvanized neutral earthing strips shall be supplied with the transformer along with braided copper conductor links for connections at bushing ends. Two distinct earth connection shall be provided for neutral earthing. The earthing strips shall be mounted on 11KV post insulators. An isolating link shall be provided on individual earth strips for testing purposes.

Transformer protective equipment like OTI, WTI and Buchholtz relay shall be tested during pre-commissioning stage. Their electric connection upto marshalling box shall be performed as per Original Equipment Manufacturer recommendations. Cable tray shall be installed for laying of control cable shall be laid on cable tray on transformer body so that cable shall not get heated by transformer temperature. While commissioning the transformer tripping of breaker through all these equipment must be checked.

5.00 Breaker:

33 kV & 11 kV Vacuum Circuit Breakers shall be used for protection and control of power circuits. In partly outdoor substation, all 11 KV switchgears shall be indoor mounted type and 33 KV breakers shall be outdoor mounting type whereas in fully outdoor substation, 11 KV as well as 33 KV breakers shall be outdoor mounting type. In both the type of substation, control panels shall be indoor type. Outdoor breakers are to be supplied with Current Transformers. The outdoor mounting type breakers shall be supplied with its mounting galvanized steel structures.

Detailed cable schedules, termination details and circuit diagrams of control panels, transformer marshalling box, breaker marshalling box, and capacitor banks equipment shall be prepared and submitted by turnkey Contractor for approval of Project Manager before commencing the work.

Cement concrete including reinforcement steel shall be used for the foundation. Project Manager shall approved design and drawings of foundations. Proper shuttering, vibrator, curing shall be performed while constructing the foundations for breaker.

Permanent maintenance platform shall be constructed for outdoor breakers and CT. Project Manager shall approve design of platform.

Control wiring between CT/breaker and control panel for outdoor mounting breakers/CT shall be routed through Junction box. Metallic Junction box shall be installed on support gantry structure of substation or on MS angle (50x50x6 mm) support. The boxes are to be erected, electrically connected with the existing system, properly earthed, and labeled. The test report of pre-commissioning checks shall be prepared and submitted. All CT terminals are to be ring type and other terminals are of fork type. 2.5 sqmm copper multi stands wiring 1.1 KV grade, ISI marked, IS 694 shall be used for control wiring. A terminal block be provided between CT and Meter keeping 20% spare terminals. The Junction box are to be earthed using 8 SWG GI wire direct connection to the earthing. 2 Nos Earthing bolts on the Distribution Box/SMC Distribution Box shall be provided of 10mm dia.

6.00 Station Transformer:

100 KVA, aluminum / copper wound, 11/0.4 KV (or 33/0.4 KV) Station Transformers shall be installed on DP structure made of H-Beam 152x152 mm 37.1 kg 8 meter long or parallel flanged beams WPB 160X30.44. Outdoor type Distribution Box/SMC Distribution Box/SMC Distribution Box/SMC Distribution Box complying to IS 13410 for station transformer shall be comprising of 200 A switch fuse unit, 6 Nos SP MCCB– 90 A, 2 Nos 32 A SP MCCB, 3-ph, 63A, contactor controlled yard lighting timer unit, tri-vector electronic energy meter (mounted in separate metallic LTCT cum meter box) with suitable CT, control/power cabling and terminals, 1 No 20 A Industrial socket and switch for local power supply requirements, mounting channel, clamps and hardware.

The Station Transformer substation shall be provided with Station Class LA, 33KV / 11KV AB Switch and 33KV / 11KV DO Fuse. Except type of Distribution Board, Lightening Arresters, and DP Structures, all other scope of work as mentioned under 100 KVA capacity Distribution Transformer work shall be the scope of work under 100 KVA Station Transformer on LT side.

7.00 Gantry structures:

There are two type of gantry structures envisaged under the scheme.

a) Gantry structures made of H-Beam 152x152 mm 37.1 kg 8 meter long or parallel flanged beams WPB 160X30.44 kg/m, double MS Channel 100x50mm for bus bar supports (Beam), 65x65x6mm angle for cross arms/supporting structures and 50x8mm flats for clamps along with hardware items duly painted etc., and

b) Gantry structures made of Lattice structures of equal angles sections, flat as per approved drawings. State practices are to be adopted in the design. All structural steel members and bolts shall be galvanized after fabrication as per IS:4759 and zinc coating shall not be less than 610gm/sq. meter for all structural steel members. All L45x45x5 will have 23 mm back mark. All L50x50x6 will have 28mm back mark. 3.5mm spring washers are to be used under each nut, structural steel shall conform to IS 2026. All weld shall be 6mm filled weld unless specified otherwise. All nuts and bolts shall be of property class 5.6 of IS 1367. Plain washers shall be as per IS 2016 & spring washers shall be IS: 3063.

The gantry steel structures materials shall be hot-dip galvanized thoroughly internally and externally as per according to IS: 2629 and IS: 2633 (with latest amendments). Galvanizing shall be checked and tested in accordance with IS: 2633.

The gantry steel structure items shall be galvanized both inside and out. The zinc coating shall be smooth, continuous and uniform. It shall be free from acid spots and shall not scale, blister or be removable by handling or packing. There shall be no impurities in the zinc or additives to the smelter bath that could have a detrimental effect on the durability of the zinc coating. Before pickling, all welding, drilling, cutting and grinding shall be completed and all grease, paint, varnish, oil and welding slag shall be completely removed.

All protuberances which could affect the life of galvanizing shall also be removed. To avoid the formation of white rust all galvanized material shall be packaged in such a way to ensure adequate ventilation between parts during shipping and storage.

Testing of galvanizing shall be performed for Uniformity of thickness as per IS 2633/1986, Mass of coating as per IS 6745/1972 and quantity of zinc, water quenching & centrifuging as per IS 2629/1985.

0.5m3 cement concrete in mixture 1 part cement, 3 part coarse sand, 4 part 20mm size aggregate stone chips (1:3:4) shall be used in all the types of gantry supports.

While erecting supports (poles), shuttering must be used for concreting so that proper quantity of cement concrete mixture be used and assessed during inspection. During concreting proper compaction by means of mobile vibrator be provider. While starting work of support erection, gang wise shutting and mobile vibrator shall be offered for inspection to Project Manager.

While erecting support, mercury level gauge must be used to ensure vertical erection of support.

300x300mm X 12" inch height muffing shall be provided on gantry support to prevent direct entry of rain water along the support. Cement Concrete of 1:2:4 (1 part Cement, 4 parts coarse sand and 4 parts 20mm aggregate stones chips) shall be used for individual poles.

8.00 AC Distribution board (ACDB)

415 Volts, ACDB (IP 54 protection) shall be indoor floor mounted with mounting arrangements, three phase-neutral voltmeter, three phase ammeter and Selector switches, 63 Amps TPN switch fuse unit in incomer circuit, 32 Amps TPN switches in outgoing circuits equals the number of indoor breaker control panels plus number of outdoor VCB kiosk panel and having 20% spare outgoing circuits, etc. Alternatively, ACDB can also be erected on separate MS frame made of 50x50x6 angle.

Substation flooring shall be provided with suitable inserts to fix ISMC 75 channel. This channel shall hold ACDB board. The board shall be installed on indoor trench. Cables shall have bottom entry. The board shall be grounded by 50x6mm GI strip at two distinct connections.

9.00 DC Distribution board (DCDB)

Indoor floor mounted, IP 54 protection, two pole 100 Amp 2 pole DC Switch Fuse unit as incomer, two pole 40 Amp Switch Fuse units in outgoing circuits equals the numbers of indoor breaker control panels plus numbers of outdoor VCB kiosks panels plus control room lighting panel and 20% spares outgoing circuits. Direct Current Distribution Board shall be installed in each substation. It would comprise of DC voltmeter including mounting arrangements etc as required as per technical specifications, approved drawings, and scope of works. Alternatively, DCDB can also be erected on separate MS frame made of 50x50x6 angle.

Substation flooring shall be provided with suitable inserts to fix ISMC 75 channel. This channel shall hold DCDB board. The board shall be installed on indoor trench. Cables shall have bottom entry. The board shall be grounded by 50x6mm GI strip at two distinct connections.

10.00 Cables:

a. **Control cables**: 1.1 KV grade 2.5 mm^2 PVC insulated and PVC sheathed, armored, stranded, copper control cable with 2 core, 6 core and 10 core are envisaged in the substation.

b. **HT Power Cables:** In partly outdoor substation, 11KV XLPE Cables shall be used as per following requirements;

- Between Power Transformer and Main transformer breaker
- Between Feeder breaker and outdoor feeder DP structures
- Between capacitor bank switch and capacitor bank

c. **LT Power cables**: 1.1 KV grade, armored, stranded, aluminum power cable PVC insulated and PVC sheathed with complete accessories as per detailed engineering

- 3.5Cx150mm^2 (between station transformer & Distribution Box/SMC Distribution Box/SMC Distribution Box/SMC Distribution Box)
- 3.5Cx70mm^2 (between Distribution Box/SMC Distribution Box & yard receptacles)
- 3.5Cx35mm^2 to be used from Station Transformer Distribution Board to:
  - Control room building Internal Electrification DB,
  - ACDB Board,
  - Tube well Start Panel,
  - Outdoor area lighting control and distribution panel
- 2 core x16 mm^2 for supply to area lighting masts.

d. **LT cable for Internal Electrification works**: following cables shall be used for internal electrification purpose:

- 1.1 KV PVC insulated PVC sheathed ISI marked, IS 694, 10mm^2, copper conductor, stranded, for internal electrification works between main DB and Sub DB or Sub DB to switch board,
- 1.1 KV PVC insulated PVC sheathed ISI marked, IS 694, 2.5mm^2 /4.00mm^2, copper conductor, stranded, for internal electrification works light & Fan and Power circuits respectively,
- 1.1 KV PVC insulated PVC sheathed ISI marked, IS 694, 4.00mm^2, copper conductor, stranded weather proof cable for connection between outdoor area lighting luminary fixtures and its junction boxes,

Power Cables are to be laid as per best engineering practices. Power and control cables are to be laid in different alignments in cable trench. However, in case power/control cable is required to extend up to the equipment where cable trench is not constructed, they shall be laid in underground trench of width 300 – mm wide, provided with 2nd class brick protection (Approx. 10 bricks per meter length of laying) and sand protective covering (200 mm thick) and laid at the depth of 750mm minimum for LT cables and 1000mm for 11 kV cables. Laying specification of cable shall be as detailed in CPWD specification of laying power cables. Suitable loop length of 1.5 meter to be kept at the end points. Excessive loop lengths shall not be paid.

11.00Metering & metering equipment:

Following two types of metering equipment are envisaged in the work comprising of:

a. 33 kV/110 V Metering equipment (CTPT unit) with CT of ratio 400-200/5 A
b. 11 kV/110 V Metering equipment (CTPT unit) with CT of ratio 300-150/5 A

Meter shall be HT trivector DLMS compliant category suitable for substation/feeder metering. Meter shall be 3 ph 4 w 110 V 5 A accuracy class 0.5s with GSM (GPRS compatible) modem.

12.00Junction Box and Control Cabling:

Junction box is to be installed on support gantry structure of substation or erected on separate galvanized steel structures in the yard nearer to metering equipment. The boxes are to be erected, electrically connected with the existing system, properly earthed, and labeled. The test report of pre-commissioning checks shall be prepared and submitted.

All CT terminals are to be ring type and other terminals are of fork type. 2.5 sqmm copper multi stands wiring 1.1 KV grade, ISI marked, IS 694 shall be used for control wiring. A terminal block be provided between CT and Meter keeping 20% spare terminals.

The Meter-cum-meter box are to be earthed using 8 SWG GI wire direct connection to the earthing. 2 Nos Earthing bolts on the distribution boards shall be provided of 10mm dia.

13.00 Capacitor banks:

Capacitor banks of 600 KVAr, 1200 KVAr and 1500 KVAr capacity shall be provided with 3.15 MVA, 5.0 MVA and 8.0 MVA capacity power Transformer respectively. Capacitor bank shall comprises of switching vacuum circuit breaker, current transformers (100-50/5-5A), fully automatic control panel mounted inside the substation buildings, 11 KV residual voltage transformer, 11 KV three phase Isolator, Earthing system, capacitor banks complete with individual fuses, interconnection mounting rakes, external fuses mounting arrangement, base insulators & accessories, 3 Nos. 11 KV single phase Metal oxide (Gap less) lighting arresters, isolators etc as per requirements. Hot dip galvanized mounting structure made of sections of 100x50x6 mm channel or 75x40x6 mm channel or 75x75x8 mm equal angles only.

14.00 DC emergency lighting:

At-least four Philips make LED bulbs are to be provided of 7 watts {2 Nos in control room, 1 No in station battery room, 1 No in yard area). These bulbs shall be fed by DC station battery. The wiring of these bulbs shall be so designed that it will automatically turn ON in event of failure of normal power supply. Provision for putting these bulbs OFF by operator is also to be provided. Wiring is to be performed concealed using PVC insulated PVC sheathed 2.5 mm^2 stranded copper wire. An automatic change over switch is envisaged for this purpose. This may be installed at prominent location, generally easily approachable by operator in the substation control room.

15.00Station Battery and battery Charger:

Station battery are to be supplied with wooden racks made of teak/sal wood planks of thickness not less than 25mm, support legs made of size not less than 2 inches X 2 inches. The battery may be placed on two-tier formation of stand. The construction of battery rack shall suit site conditions of their placement. The rack shall be painted with three coat of acid proof paint of reputed make as approved by Project Manager. No metal fasteners / nails shall be used for construction of battery racks. The stand shall be supported on insulators to obtain necessary insulation from the earth and there shall be insulators between each cell and stand.

Initial charging of stationary battery shall strictly be as per Original Equipment Manufacturer (OEM) recommendations. Detail charging and discharging cycle readings shall be recorded and submitted to Project Manager for approval.

Battery room shall be provided with exhaust fan of air displacement capacity more than six times volume of battery room per hour. Wooden doors and windows shall be provided in the battery room. Anti-acid tiles shall be used in the floor and upto six feet height of the wall of the battery room.

The battery connections / terminals are to be cleaned and provided with petroleum jelly. Terminals hardware is to be provided with connecting cables. The inter-battery wiring cable shall be neatly dressed using cable ties, clamped and wired using ferrules, tag mark. New battery sets are to be provided with battery chargers as per detail specifications enclosed. Interconnecting cables and power supply cables originating / terminating at the battery charger, shall be neatly dressed using cable ties, clamped and wired using ferrules, tag marks, double compression glands etc as applicable. Connecting cable and associated materials needed for commissioning of charger shall be treated as part of the battery charger. 1.1 KV multi-strands, 30 sqmm, copper conductors, PVC insulated and PVC sheathed cable for DC wiring between DCDB and Battery bank.

The agency shall provide following equipment at all the substations:

a) Two copies of battery instruction sheet duly laminated,
b) Two sets of ISI marked electrical hand gloves,
c) One cell testing voltmeter 3 – 0 – 3 volts,
d) Two syringe hydrometers
e) One thermometer with specific gravity correction scale,
f) One set of suitable spanners,
g) Two acid resistant funnel,
h) One acid resisting jar of 2 liters capacity,

16.00 Outdoor type Current Transformer and Potential Transformer:

Outdoor type CTs are to be erected on supporting structure provided on the breaker structure or suitable structure as per state practices. Potential Transformers shall be erected on gantry structures and connected with bus. In both the case, separate metallic Junction Box shall be installed on support gantry structure of substation or erected on separate galvanized steel structures in the yard nearer to equipment. The boxes are to be erected, electrically connected with the existing system, properly earthed, and labeled. The test report of pre-commissioning checks shall be prepared and submitted for approval of Project Manager.

All CT terminals are to be ring type and other terminals are of fork type. 2.5 sqmm copper multi stands wiring 1.1 KV grade, ISI marked, IS 694 shall be used for control wiring. A terminal block be provided in the junction box keeping 20% each spare ring type/fork type terminals.

The junction box shall be earthed using 8 SWG GI wire direct connection to the earthing. 2 Nos Earthing bolts on the junction box of 10mm dia.

Testing and pre commissioning checks shall be conducted in accordance with OEM recommendations and as approved by the Employer. Terminal connectors at HT as well as LT side shall be provided with the CT/PT equipment.

17.00 Control Panels:

New panels as per the requirement of protection like feeder protection, transformer protection or incomer protection are to be supplied with each newly supplied breaker:

a. In case of fully outdoor type substation, control Panel to be erected on ISMC75 (75x40x6 mm) MS channel duly welded on MS angle inserted on indoor trench. Panels shall then be properly aligned, Cables shall enter with double compression glands, codified, lugged, and dressed.

b. Breaker cum control panel shall be erected on ISMC 100(75x50x6 mm) MS channel duly welded on MS angle inserted on indoor trench. Panels shall then be properly aligned, Cables shall enter with double compression glands, codified, lugged, and dressed.
c. Functional checks shall be performed on the control panel as per control wiring diagram.
d. All alarm, annunciation and trip circuits / indication & alarm circuits shall be tested and made operative,
e. The indication lamp shall be LED type lamp as per given specifications and shall be made operative,
f. Indicating instruments shall be calibrated,
g. Grounding of panel at two different locations by 50x6mm flat shall be provided. ,
h. Control relays shall be calibrated and checked for tripping and closing operations,
i. Pick up time / trip time and tripping at normal and reduced voltages shall be checked, properly adjusted and recorded,
j. Latching arrangement of relays shall be checked for operation,

18.00 Lightning Arrester:

Station Class LAs will be used in 33 KV and 11 KV with base steel structure, terminals bi – metallic connectors / PG clamps and earth connectors. LAs are to be connected with separate earth connection using 50x6mm GS flat. All LA terminals / connections are to be tightened. All lightening arresters installed in grid substations shall be Station Class Lightening Arresters.

19.00 Internal Electrification:

Indoor Distribution Board having 63A TPN MCB, outgoing MCBs of suitable ratings for power and light & fan circuits are to be installed. Internal electrification of the control room includes provision of fans, exhaust fans, LED illumination fixtures, switches and sockets.

Two nos separate 3 m long 40 mm dia earthing shall be provided for internal electrification works. 8 SWG GI wires shall connect following equipment:

a. Main Distribution Board and Sub-Distribution Boards,
b. ACDB, DCDB, Battery Chargers each at 2 distinct locations

Internal Electrification works' wiring shall be provided with single core PVC insulated & PVC sheathed 2.5 mm2 stranded ISI 694 marked copper flexible wire (for light and fan circuits) and 4.0 mm2 stranded ISI 694 marked copper flexible wire (for power points) in conceal arrangement in 25 mm dia 2 mm thick PVC ISI marked pipe and 2.5mm thick switch boards in flash arrangement. Neutral links are to be used in each switchboards. Jointing in neutral conductor other than at switching board shall not be permitted.

Iron junction box made of 18 gauges CRCA sheet shall be used for switchboard; 2 mm thick cotton impregnated hylum sheet is to be used for the purpose of switch board. ISI marked switched and sockets are to be used for Internal Electrification works. Earth wire must be made available duly connected with earth circuit for Earthing in each and every switchboard.

Reputed make indoor double door Miniature circuit breaker DB fitted with Miniature Circuit Breakers of MDS/ Havells/ Standard make or equivalent ISI marked shall be used for the protection. Reputed make LED fittings and 5-star energy efficient BLDC fans are to be used for the substation. These materials are to be procured from authorized dealer of the materials manufacturers only. Documentary evidence may be submitted for source of supply of all electrical materials. Before procurement of materials Project Manager shall approve make, type and quality of materials.

Control Room lighting shall be designed to ensure 300 lux illumination level through LED lamp fittings. The bidder shall submit calculation for achieving the above illumination before start of lighting work for approval of project manager.

20.00Yard Lighting:

The substation area inside the fencing shall be illuminated provided with 100 Watts LED flood light fittings. Each fitting and its Junction box enclosures shall be IP 55 protection type. Water and vermin proof-ness is a must. At least 4 Nos. fittings at all the four corners shall be provided. Acceptable make of fitting, fixtures and lamp are Philips, Crompton, Alstom, and Bajaj only.

Area light supply from Substation DB to be extended through 2X16 mm2 PVC insulated PVC Sheathed aluminum stranded armored power cable laid in underground trench of width 300 – mm wide, provided with 2nd class brick protection (Appro. 10 bricks per meter length of laying) and sand protective covering (200 mm thick) and laid at the depth of 750mm minimum. Laying specification of cable shall be as detailed in CPWD specification of laying power cables. Suitable loop length of 1.5 metre to be kept at the end points.

Pole mounted junction box (and not the Control Gear Box supplied with the fitting) shall be made of 2mm thick CR steel sheet of size 300X300X200mm fitted with SPN terminal block of 32A capacity, 10A SPN miniature circuit breaker of ISI mark and reputed manufacture. The JB shall be hot dip galvanized. The JB shall also conform to IP 55 protection for enclosure. Neoprene gasket shall be used in JB. 2 Nos. earthing terminals of 10 – mm dia shall be provided with 25X6mm size of mounting clamps. Bidders shall get JB drawing approved before start of manufacturing.

4 Sq.mm, 1100V grade, weather proof three core (One core for phase, one core for Neutral and one core for earthing) aluminum stranded flexible conductor PVC sheathed and PVC insulated cable conforming to IS 694 shall be used for connection of fitting and its Control Gear Box from pole mounted Junction Box. Control Gear box must provide ISI approved components. Copper wound heavy chocks shall be acceptable.

Tubular poles 12m high as per IS: 2713 (Latest Version) or WPB 160x23.83 kg/m parallel flanged beams. embossed with ISI certification mark and pole designation shall be used for installation of area light fixtures in Urban as well as Rural substations. Pole shall be designated as 410 – SP - 60. Poles and fitting structures shall be painted with two coat of anti – rusting bitumen paint inside and outside up to the planting depth and two coat zinc oxide paint followed by 2 or more coats of aluminum paint of approved make, brand and shade on portion of pole which will remain above ground level.

Steel tubular Poles/Wide Parallel Beams shall be hot-dip galvanized thoroughly internally and externally as per according to IS: 2629 and IS: 2633 (with latest amendments). Galvanizing shall be checked and tested in accordance with IS: 2633.

Steel tubular Poles/Wide Parallel Beams shall be galvanized both inside and out. The zinc coating shall be smooth, continuous and uniform. It shall be free from acid spots and shall not scale, blister or be removable by handling or packing. There shall be no impurities in the zinc or additives to the smelter bath that could have a detrimental effect on the durability of the zinc coating. Before pickling, all welding, drilling, cutting and grinding shall be completed and all grease, paint, varnish, oil and welding slag shall be completely removed.

All protuberances which could affect the life of galvanizing shall also be removed. To avoid the formation of white rust all galvanized material shall be packaged in such a way to ensure adequate ventilation between parts during shipping and storage.

Testing of galvanizing shall be performed for Uniformity of thickness as per IS 2633/1986, Mass of coating as per IS 6745/1972 and quantity of zinc, water quenching & centriguging as per IS 2629/1985.

21.00ACSR / AAAC Conductor:

Following ACSR conductors (or equivalent AAAC conductor) are envisaged for bus bars, jumpers, droppers:

a. 6/4.72 mm + 7/1.57 mm (100 sqmm Dog conductor),
b. 30/2.59 mm + 7/2.59 mm (150 sqmm Wolf conductor), and
c. 30/3.00 mm + 7/3.00 mm (200 sqmm Panther conductor)

Conductor shall be provided with hardware fittings, T-clamps, bi-metallic clamps and PG clamps as per requirements. T – Clamps shall be provided on each jumper on bus bars. Line jumpers shall be provided with adequate size of PG Clamps (Two numbers PG Clamps at each end of jumper). Clamp shall be made of aluminum grade T-1F as per IS – 8309 having good electrical quality aluminum material and shall not be brittle in nature. Suitable Bi – metallic clamps shall be provided at bushings of transformers and circuit breakers. Also at all those points where joining of two different materials is found, bi –metallic clamps shall be provided.

Care shall be taken while drawing conductor from the drum. Proper roller shall be used while handling conductors during erection.

22.00Insulator, hardware and connections to equipment:

33 KV and 11 KV polymer/porcelain Disc/Pin insulator with suitable hardware fittings shall be used. Insulator shall be tied properly using binding wire/helical form fitting. In road crossing and line crossing locations bridling cross arms and pin insulator shall be used.

The individual insulator shall be checked for insulation resistance before overhead line installation. Insulator shall properly be cleaned before installation. No damage/crack insulator shall be used.

23.00Power receptacles:

Two power receptacles are envisages in switch yard area to provide power supply to Transformer Oil Filtration machine and other testing and commissioning related works. Each receptacles shall house 63A MCCB as incomer, 40A 3 phase socket/switch and 1 No, 20A single phase Industrial type socket/switch of reputed brand and type.

24.00Tube well:

Deep Tube is envisaged for all the substations. Depending on the depth of the bore, suitable capacity of submerged pump shall be installed. Bore diameter shall be 6" which must be penetrated vertically in all type of soil condition. Before digging the bore, soil Resistivity needs to be checked to ascertain the location of the best site for the tube well. Following works are envisaged under this scope:

- Digging bore of diameter six inches. Providing MS casing on bore up to the suitable depth finalized during detailed engineering.
- Providing new 3 phase submersible pump 32 stages or 30 stages depending on technical requirements.
- Providing Start Panel of reputed make like L&T, Havells or equivalent make having single phase protection, Over load protection, Pre – set timer of L&T make, Star Delta Starter, Indications for Load currents in all three phases, Indications for Supply voltages in all three phases etc. Starting panel must conform to IP 52 protection for enclosure. It shall be mounted indoor inside the Control room on 50x50x6 mm GS angle supports. Start panel must be earthed with 2 Nos 8 SWG wires. 4 core 16 Sq mm aluminum armored cable must be used for energizing this Start Panel.
- Three phase, 4 wires, copper flexible supply cables suitable for submersible pump operations, ISI marked, 1100V grade shall be connected to submersible pump through underground trench up to the well as per CPWD specifications duly protected from brick and sand cushioning.
- A Heavy-duty gunmetal wheel valve (tap) may be provided on the discharge line for drinking water requirements.
- Provision for lifting the pump in case of overhauling / breakdown maintenance may also be provided.
- ISI marked PVC or 2nd GI Pipes are to be used for suction as well as discharge water lines.
- An open drain must be provided in the vicinity of the tube well. Detail arrangement shall be finalized in detailed engineering.

25.00Yard Earthing:

Earthing shall be provided with GI earth pipe, GS solid rod 25 mm dia and 75x8mm GS flat forming earth mat. 50x6mm GI flat shall be used for earth-riser along with GI wires / Stay wires as per requirement of Project Manager. Project Manager shall approve arrangement of earthing network. Following arrangement envisaged for grid/earth rod/ earth pipe: (Indicative drawing is enclosed with the document)

Description of equipment	**Fully outdoor Substation**
Earth Pit made of 3 m long, 40 mm dia GI pipe	2 Nos for power transformer neutral direct connection, 1 No for 33 kV & 11 kV Lightening Arresters direct connection, 3 Nos. for station transformer, 2 Nos. for indoor panels, 2 Nos. for internal electrification works of control room, and 2 Nos. for substation fencing

Earth rod GI solid 25 mm dia	19 Nos (+/-) 20%
Earth mat	75X8 mm GS Flat
Laying of earth mat	Below ground 0.5 meter
Earth riser	50x6mm and 25x3 mm GI Flats

Description of equipment	**Partly outdoor Substation**
Earth Pit made of 3 m long, 40 mm dia GI pipe//Chemical earthing	2 Nos for power transformer neutral direct connection, 1 No for 33 kV & 11 kV Lightening Arresters **direct connection**, 3 Nos. for station transformer, 2 Nos. for indoor panels, 2 Nos. for internal electrification works of control room, and 2 Nos. for substation fencing Earth circuit should not be connected with Grid mesh/other earthing pits.
Earth rod GS solid 25 mm dia	14 Nos (+/-) 20%
Earth mat	75X8 mm GS Flat
Laying of earth mat	Below ground 0.5 meter
Earth riser	50x6mm and 25x3 mm GI Flats

Standard requirements / provisions of earthing are enclosed herewith. Connections of earth-grid / earth – pit with Lightning Arrester and Power Transformer Neutral and Transformer body (at two distinct points) are to be made using 50X6mm GS flat. Connections of other equipment may be provided with 8 SWG GI wire or GI Stay wire as per approval of Project Manager. Following arrangements are envisaged for earth connection:

1. Power Transformer Neutral (Two distinct connections)	50x8 mm GS Flat
2. Transformer Body	50x6 mm GS Flat
3. Breaker body / legs (Two distinct connections)	50x6 mm GS Flat
4. Lightning Arrester	50x6 mm GS Flat
5. Station transformer Neutral (Two distinct connections)	25x3 mm GI flat
6. Fencing	50x6 mm GI Flat
7. Control Panels (Two distinct connections)	50x6 mm GI Flat
8. Isolator structure / handle	50x6 mm GI Flat
9. Steel structure of substation	50x6 mm GI Flat
10. Line meters	25x3 mm GI Flat
11. CT, PT and Cable Tray	25x3 mm GI Flat

Fencing and gate shall be grounded. Moving portion of gate shall be grounded with flexible braided conductors of equivalent aluminum 25 mm^2 sizes of conductors duly lugged and bolted.

In rocky soil where getting required earth resistance is a challenge, chemical rod earthing shall be used. Overhead line structure shall be connected to chemical earth electrode using 8SWG GI wire. GI nuts, bolts & washers shall be used to join two GI wires and 20 mm solid spike rod.

In areas with poor with poor earth resistance where it is generally difficult to perform maintenance activities, maintenance free earth pits shall be provided.

GI flats and GI wires must be properly dressed, bundled and fixed on supporting structure at 1 to 2 feet intervals.

26.0033 KV & 11 KV Isolators:

33 KV & 11 kV, 3-ph, 3 Pin type, Horizontal Mounting type, Gang Operated, Isolator Switch shall be installed at suitable locations as per instructions of Project Manager to isolate line section, power transformer, bus bars etc. B Class GI pipe shall be used (without any joints) for operation of isolator switch. Isolator Switch structure and handle must be earthed using 50x6 GI flat.
Isolator cum earth switch – The employer may also opt for 33kV and 11kV Isolator cum earth switch, In this case the Contractor is required to make provision for its power supply, control supply and indications in control panel.

27.00Fabricated steel items:

The fabricated steel structures materials shall be hot-dip galvanized thoroughly internally and externally as per according to IS: 2629 and IS: 2633 (with latest amendments). Galvanizing shall be checked and tested in accordance with IS: 2633.

Fabricated steel structure items shall be galvanized both inside and out. The zinc coating shall be smooth, continuous and uniform. It shall be free from acid spots and shall not scale, blister or be removable by handling or packing. There shall be no impurities in the zinc or additives to the smelter bath that could have a detrimental effect on the durability of the zinc coating. Before pickling, all welding, drilling, cutting and grinding shall be completed and all grease, paint, varnish, oil and welding slag shall be completely removed.

All protuberances which could affect the life of galvanizing shall also be removed. To avoid the formation of white rust all galvanized material shall be packaged in such a way to ensure adequate ventilation between parts during shipping and storage.

Testing of galvanizing shall be performed for Uniformity of thickness as per IS 2633/1986, Mass of coating as per IS 6745/1972 and quantity of zinc, water quenching & centriguging as per IS 2629/1985. .

28.00Hardware:

MS Nuts, bolts and washers (Galvanized) – 16 mm dia nuts, bolts & washers shall be used for tying of overhead structure items like cross arms, top clamps, brackets, clamps, bracing, strain plates etc.

While erecting, proper dimensions of nut-bolts and washers must be ensured. 2 to 3 threads only be visible of the bolt after full tightening of nut on requisite torque. The hardware shall be hot dip galvanized. The minimum coating of the zinc shall comply with IS: 2629 and IS: 2633. Galvanizing shall be checked and tested in accordance with IS: 2633. Before shifting them to site for erection, they shall be offered for inspection and approval by Project Manager.

29.00Fire Protection System:

Fire Buckets filled with sand: The fire buckets confirming to IS 2546/1974 filled with sand shall be installed at two places in new s/s – in control room and in switchyard near power transformer. There shall be 4 no. of buckets at each location in a s/s. The buckets shall be hanging on a steel stand. The buckets and the stand shall be as per relevant standards and will be filled with sand.
In case of 66 kV power substation, The Contractor is required to make the provision of sprinkler system, deluge valves, jockey pumps, Diesel pump etc including oil sock pits etc.

30.00Portable Fire Extinguishers:

Carbon dioxide type and Dry chemical powder type fire extinguishers are also to be installed in newly constructed substation. All the portable extinguishers shall be of free standing type and shall be capable of discharging freely and completely in upright position. Each extinguisher shall have the instructions for operating the extinguishers on its body itself. All extinguishers shall be supplied with initial charge and accessories as required. Portable type extinguishers shall be provided with suitable clamps for mounting on walls or columns. All extinguishers shall be painted with durable enamel paint of fire red color conforming to relevant Indian

Standards. Capacities of each type shall be as indicated in the schedule of quantities. Carbon dioxide (CO2, type) extinguisher shall of 4.5 kg for control room conform to IS:2878. Dry chemical powder type extinguisher shall be of 6 kg capacity for control room conform to IS:2171.

31.00Safety and operation equipment:

The substation shall be equipped with one following equipment for smooth operation and maintenance:

a. Megger 1000 Volt (Electrically as well as manually operated) of Megger/Fluke/Motwane or equivalent make
b. Earth resistance meter, Megger/Fluke/Motwane or equivalent make
c. Crimping tool for cable from 2.5 sqmm to 185 sqmm,
d. Torque wrench M8 to M16
e. Multi-meter Motwane make analogue type,
f. Tong tester digital 0-600A capacity,
g. Allen key set,
h. ISI marked, Discharge rod 66 KV rating with discharging copper cables & terminals – 6 Nos
i. Electrician tool box – Taparia standard kit
j. Set of D-spanners
k. 12'' size electrical screw driver
l. 12'' size electrical hexagonal head screw driver
m. Pipe wrench suitable for 2 ½ inch dia pipe
n. ISI marked rubber mat rated for 11 KV insulation, ¾'' thick, size 1000mm x 2000 mm – in front of all the control panels.

Project Manager shall approve make and type of equipment.

32.00Following details shall be provided at each substations:

For suitable information to operating staff or the other related persons visiting the substation, following facilities shall be provided before commissioning of substation or on date of inauguration of the substation.

- Sketch of substations electrical circuit inside the substation in white cotton impregnated 2 mm thick hylum sheet 2x2 feet size installed on the wall,
- Notice board 3x3 feet made out of 10 mm thick water proof ply, painted suitably and provided with 1st class teak wood ribs at the sides of 2 x ½ inches size,
- Electrical safety charts,

- Provision for notifying name, address, telephone numbers, qualification details etc of the operational staff Employer intends to post at the substations and their officials in hierarchy,
- Depicting working drawings of cable terminals details and cable laying details in laminated sheets
- Color coding of bus bars and terminal conductors of the feeders using enamel painting round marks and labeling name of feeders, equipment, etc as defined.

33.00Others:

Buildings for substation control room – shall be 10mx12m size. Details are enclosed in the tender drawing. The buildings should also has provision for dedicated washrooms for female employees in addition to male washrooms.

Indoor trenches covered with 6 mm thick chequirred plates: Concrete trench are required inside control room with 50x50x6 mm GS angle inserted at the edges for erection of control panels. Unused part of cable trench shall be covered with 6mm thick MS chequirred plates inside control room. At the entry point of trench in control room, proper sealing arrangement shall be provided so as to stop entry of reptiles and rainwater inside control room through trench.

Bi-metallic connectors shall be provided wherever there is a connection between two metal parts on all electrical equipment like 33/11 KV Power transformer, 11/0.4 KV station transformer, vacuum circuit breakers, isolators, DO Fuse, Lighting Arrester, etc.

34.00Labelling:

Each substation equipment shall be labelled using yellow base and black indication marks (number or digits). 40/50 mm height digits/words shall be used for this purpose. Base shall be made using 2 or more coats of yellow enamel paint till good surface finish. Base preparation shall be completed before shifting of poles and equipment to site for erection. Base painting and marking of digits shall be performed by a skilled and trained painter using branded enamel paint, Project Manager shall approve type and brand of enamel paint. The identification of phases through Red, Yellow and Blue circles shall be provided on transformer, CT, PT, 33 KV and 11 KV feeder Double Pole structures.

Control panels shall be labelled from front as well as from the back by providing serial number and name of feeder/transformer. The color coding sign on two adjacent panels shall also be provided with 100mm dia color circle overlapping two adjacent panel sheet for safety purpose.

Labeling of following information is intended by the Employer preferably in local HINDI language:

1. Transformer capacity and designated name like T - 1 or T – 2,
2. VCB designated name
3. Identification of CT & PT
4. Color coding of bus bars, transformer terminals, feeders phases (R-Y-B)
5. Name of incoming / outgoing feeder – like 11 KV *Nandlapur Feeder I*
6. Warning instruction, if any, of availability of two sources of HT supply on same structure.
7. Earth pit designation and date of checking,

35.00 Danger board:

Each substation equipment and structures shall be provided with a danger board as per approved drawing. Danger board shall be in bi-lingual languages (local language and English). Clamp for danger board, nut-bolts and washers shall be painted with two or more coats of red-oxide and aluminum paints respectively till smooth surface before installation.

36.00 Site Testing and Pre – Commissioning Checks:

An indicative list of tests is given below. Contractor shall perform any additional test based on specialties of the items as per the Field Quality Plan/ instructions of the equipment manufacturer or Employer without any extra cost to the Employer. The Contractor shall arrange all instruments required for conducting these tests along with calibration certificates and shall furnish the list of instruments to the Employer for approval. Detail test certificates duly signed by Employer's representative & agency representative of tests jointly carried out at site before putting the equipment in use, shall be submitted by the Contractor in three copies.

Agency shall also be responsible to prepare Single Line Diagram of substations and an overall power distribution network of the circle showing 400KV, 220KV, 132KV, 33 KV network and point of metering. A set of drawings which includes drawing of Single phasing AB Switch, Substation earthing arrangement are enclosed for basic information. These drawings are not necessarily showing the exact dimensions of the substations.

37.00 Equipment test records, commissioning test records and drawings –

Factory test certificates of equipment, test certificates at the time of pre-dispatch inspections, pre-dispatch inspection reports, pre-commissioning check results and post commissioning check results shall be compiled and provided in three sets to Project Manager for his approval and records.

A copy of such test record shall be offered to electrical inspector and other inspecting officials during his/her visit to substation for inspection.

38.00Electrical Inspection by state Electrical Inspectorate:

The substations shall be subjected to the inspection of state owned Electrical Inspectorate for which payment of fees shall be made by Employer.

The responsibility of Contractor shall include rectification / alteration / addition of installation as per advice of electrical inspector for successful commissioning of the substations within time limit.

39.00Arrangement by the Contractor:

Contractor shall project-wise make his own separate arrangements for the following:

1. Opening of a site office-cum-store,
2. Distributions of power supply at all work areas in the substation premises.
3. Construction of office and store (open & covered)
4. Construction of steel fabrication workshop and material/field testing laboratory
5. Round the clock fire protection and security arrangements for site store-cum-office during construction stage

40.00Civil works:

Details scope under civil works have been provided in **"Civil Works and Soil Investigation" at Section 6 of Part 2.**

Foundation design for power transformer, outdoor type vacuum circuit breaker, control room building, fencing, gantry structure etc shall be submitted by Contractor. While designing OEM recommendations must be considered. Foundation for power transformer, outdoor type vacuum circuit breaker, control room building and fencing shall be provided with reinforcement steel. Project Manager shall approve foundation designs.

41.00Basic Reference Drawings:

The reference drawings, which are indicative of the type of specifications Employer intends to accept, are annexed with the specification. The Contractor shall maintain the overall dimensions of the substation, buildings, bay length, bay width, phase to earth clearance, phase to phase clearance and sectional clearances, clearances between buses, bus heights but may

alter the locations of equipment to obtain the statutory electrical clearances required for the substation.

The enclosed drawings give the basic scheme, layout of substation, associated services, earthing arrangement. These drawings are provided for general information only.

Note: The insulation and RIV levels of the equipment shall be as per values given in the respective chapter of the equipment.

42.00Commissioning spares:

The Contractor shall supply spares, which he expects to consume during installation testing and commissioning of system. The quantity of these spares shall be decided based on his previous experience, such that site works shall not be hampered due to non-availability of these spares. Contractor shall submit a complete list of such spares along with the bid, the cost of which shall be deemed to have been included in the lump-sum proposal price of the package. The Contractor, if so agreed at a cost to be negotiated may leave the unused commissioning spares at the site for use of Employer.

43.00Recommended spares:

The Contractor shall provide a list of recommended spares giving unit prices and total prices for 3 years of normal continuous operation of equipment. This list shall take into consideration and shall be given in a separate list. The Employer reserves the right to buy any or all the recommended spares. The recommended spares parts shall be delivered at the site. The list of recommended spares to be furnished by the Bidder shall also contain the following:

1. Location of each item installed along with reference drawing number.
2. Service life expectancy of each item.
3. Offer validity period

Price of recommended spares will <u>not</u> be used for evaluation of bids. The prices of these spares will remain valid for a period of not less than 120 days after the date on which the validity of main bid expires. Whenever recommended spares are the same as mandatory spares, then the prices of the mandatory spares and such common recommended spares shall be the same. Further, the prices of any recommended spares shall be subject to review by the Employer and shall be finalized after mutual discussions.

13.4. New 11 KV Lines

1.00 Survey

Mapping of route of proposed new 11 kV line by foot survey in rural/urban areas be performed mentioning various milestones. While surveying, existing electrical infrastructure in the locality should also be mapped. Line alignment (single line diagram) on political map with fair correctness, be prepared. SLD and foot survey report shall be approved by Project Manager and shall be used as basic document for assessment of works under the contract. On completion of line work, as built Single Line Diagram and pole wise line diagram showing pole wise materials used and pole-to-pole span should be submitted to Project Manager. This details shall be used as reference documents by Quality Inspecting officials to execute inspection works.

In case of feeder separation, existing agriculture load shall be mapped during survey. A report to be presented indicating location wise pumps to be fed through separate feeder. Percentage voltage regulation at farthest point on various spur sections shall be examined during survey and submitted to project manager who will take a decision for feeder separation works.

2.00 Support (pole):

Following types of support are envisaged for 11 KV overhead line:

a. 8 meter long /200 KG PSC Poles (PSC Pole as per state practice)
b. 10 meter long /270 KG PSC Poles (PSC Pole as per state practice)
c. 13 m long H-Beam 150x150 mm 34.6 kg/m
d. 9 m long H-Beam 116x100 mm 23 kg/m
e. 11 m long H-Beam 116x100 mm 23 kg/m

In rural area, Employers may use PCC poles are to be used. In urban area, Employer may use PCC or Galvanized H-Beam or STP or Wide Parallel Beam supports of suitable length. In hilly areas where handling of material is a challenge, tubular poles, or Wide Parallel Beam GI poles expandable with jointing plates may be used. In location specific conditions like forest area, vicinity of other existing overhead lines or permanent structures etc, H- beam or tubular poles or Wide Parallel Beam supports may be used of suable length.

Steel bottom plate shall be used in steel tubular poles/H-Beam / Wide parallel Beam and cement concrete reinforced plate shall be used as base plate for PCC poles.

Steel tubular poles shall be cleaned till good surface finish and painted with 2 or more coats of red oxide paint and 2 or more coats of aluminum paint till good finish. Steel tubular poles and H-Beams shall also be painted with 2 or more coats till good surface finish with anti-corrosive paint (in case of tubular poles shall also be painted on the inner walls) which goes in to the foundation. Project Manager shall approved brand and shade of paints.

3.00 Fabricated steel items:

Fabricated steel items like V cross arm, top clamp, DC cross arm, bracket, clamps, cross bracings, bracings, strain plate, guarding channels, back clamp, transformer mounting structure etc shall be made of MS Channels, MS angle, MS flats as per approved drawings. While fabricating, good quality electrical cutting tools and drill machine shall be used to ensure no sharp edges and perfect holes as per approved drawings. Gas cutting set should not be used for fabrication of MS steel items. Weld material shall be distributed equally between the two materials that were joined. The weld shall be free of waste materials such as slag. The weld surface should not have any irregularities or any porous holes (called porosity). The joint shall be tight. Most welds need to demonstrate the required strength. One way to ensure proper strength is to start with a filler metal and electrode rating that is higher than your strength requirement.

The fabricated steel structures materials shall be hot-dip galvanized thoroughly internally and externally according to IS: 2629 and IS: 2633 (with latest amendments). Galvanizing shall be checked and tested in accordance with IS: 2633.

Fabricated steel structure items shall be galvanized both inside and out. The zinc coating shall be smooth, continuous and uniform. It shall be free from acid spots and shall not scale, blister or be removable by handling or packing. There shall be no impurities in the zinc or additives to the smelter bath that could have a detrimental effect on the durability of the zinc coating. Before pickling, all welding, drilling, cutting and grinding shall be completed and all grease, paint, varnish, oil and welding slag shall be completely removed.

All protuberances which could affect the life of galvanizing shall also be removed. To avoid the formation of white rust all galvanized material shall be packaged in such a way to ensure adequate ventilation between parts during shipping and storage.

Testing of galvanizing shall be performed for Uniformity of thickness as per IS 2633/1986, Mass of coating as per IS 6745/1972 and quantity of zinc, water quenching & centriguging as per IS 2629/1985.

4.00 Hardware:

MS Nuts, bolts and washers (Galvanized) – 16 mm dia nuts, bolts & washers shall be used for tying of overhead structure items like cross arms, top clamps, brackets, clamps, bracing, strain plates etc.

While erecting, proper dimensions of nut-bolts and washers must be ensured. 2 to 3 threads only be visible of the bolt after full tightening of nut on requisite torque. The hardware shall be hot dip galvanized. The minimum coating of the zinc shall comply with IS: 2629 and IS: 2633. Galvanizing shall be checked and tested in accordance with IS: 2633. Before shifting them to site for erection, they shall be offered for inspection and approval by Project Manager.

5.00 Stay Set:

Galvanized Stay Set with 50x8 mm stay clamp, guy insulator (2Nos.), anchor plate (200x200x6mm) , nut-bolts, 2 Nos turn-buckles, 1.8 m long, 16 mm diameter solid GS stay rod & 7/3.15 mm dia GI stranded wire complete.

Stay set shall be used at all turning locations, conductor dead end supports, double pole structure, triple pole structure, four pole structure to nullify the tension of conductor. Erection of storm guys at suitable location in straight line may also be provided. Erection of storm guys at suitable location in straight line may also be provided.

0.2 cmt cement concreting in mixture 1 part cement, 3 part coarse sand, 6 part 40mm size aggregate stone chips (1:3:6). 2 Nos. guy insulator shall be provided in stranded GI wire at middle location between two turn buckles.

6.00 Earthing:

Following earthing arrangements are envisaged for new 11 kV lines:

a) 40 mm dia., 3000 mm long GI pipe earth electrode with test link, RCC pit, RCC cover plate on GI frame, bentonite powder and other accessories complete
b) GI Earthing spike made of 20mm solid rod Chemical rod earthing including electrode, chemical, with 2000mm long, 50 mm diameter GI pipe, GI Strip of 24x3mm minimum in hard rock locations only. 6 SWG GI wire for earthing and guarding
c) 8 SWG GI wire for earthing and guarding
d) Maintenance free type earthing

Each 11 kV line support shall be provided with one GI earthing spike made of 20 mm solid rod or GI Earth Coil and connected with 8 SWG GI wire. Overhead line structure shall be connected to GI earthing spike or GI Earth Coil using 8 SWG GI wire. GI nuts, bolts & washers shall be used to join two GI wires and 20 mm solid spike rod. Project Manager shall decide use of GI Earth Coil or 20mm dia GI Solid Rod for individual pole earthing.

At railway crossing, line crossing and other specific locations 40 mm dia, 3000 mm long GI pipe earth electrode with test link, RCC pit, RCC cover plate on GI frame, bentonite powder and other accessories shall be used. Overhead line structure at these locations shall be connected to GI earth pipe using 8 SWG GI wire. GI nuts, bolts & washers shall be used to join two GI wires and 40 mm GI earth pipe.

In rocky soil where getting required earth resistance is a challenge, chemical rod earthing shall be used. Overhead line structure shall be connected to chemical earth electrode using 8SWG GI wire. GI nuts, bolts & washers shall be used to join two GI wires and 20 mm solid spike rod.

In road crossings and line crossings, 6 SWG GI wire shall be used for cross lacing and 8 SWG wire shall be used for guard wires.

GI flats and GI wires must be properly dressed, bundled and fixed on supporting structure at 1 to 2 feet intervals.

7.00 Insulator and hardware –

11 KV polymer/porcelain Disc/Pin insulator with suitable hardware fittings shall be used. Insulator should be tied properly using binding wire & tape/helical form fitting. In road crossing and line crossing locations bridling cross arms and pin insulator shall be used.

The individual insulator shall be checked for insulation resistance before overhead line installation. Insulator should properly be cleaned before installation. No damage/crack insulator should be used.

8.00 ACSR / AAAC Conductors:

Following ACSR Conductors (or equivalent AAAC Conductor) are envisaged for new 11 kV lines:

a. 100 sqmm Dog conductor,
b. 55 sqmm AAAC

Project Manager shall decide size of conductor on proposed 11 KV line.

Care should be taken while drawing conductor from the drum. Proper roller should be used while handling conductors during erection. Jointing sleeves, binding materials, PG clamps, bi-metallic conductor shall be used for conductor jointing, insulators fixing, jumpering and termination at equipment respectively. There must not be uneven sag between conductor/spans.

Proper sag should be maintained using sag chart table. While tensioning, care should be taken to avoid tension on pin insulator. Therefore, proper alignment of line to be ensured.

At terminal location, care should be taken while connecting two sections to avoid bird faults. Therefore, pin insulator is to be used to handle the conductor on DC cross channel.

9.00 11 KV AB Switch:

11 kV, 3-ph, 600 A, 3 Pin type, Vertical/Horizontal Mounting type, Gang Operated, AB Switch shall be installed at cut points and at suitable locations as per instructions of Project Manager. B Class GI pipe shall be used (without any joints) for operation of switch. AB Switch structure and handle must be earthed using 8 SWG GI wire.

10.00 Pole numbering:

Each support pole shall be numbered properly labelled using yellow base and black indication marks (number or digits). 40/50 mm height digits/words should be used for this purpose. Base shall be made using 2 or more coats of yellow enamel paint till good surface finish. Base preparation shall be completed before shifting of poles to site for erection. Base painting and marking of digits should be performed by a skilled and trained painter using branded enamel paint, Project Manager shall approve type and brand of enamel paint. Warning instruction, if any, of availability of two sources of 33 kV supply on same structure, at source structure, at cut points should exclusively be provided as per state practice.

11.00 Anti-climbing device:

3.5 kgs, 2.5mm dia (12 SWG) galvanized barbed wire shall be used on each 11 kV support. Galvanized barbed wire should be properly dressed and crimped at termination. While wrapping the wire on support, proper tension should be maintained.

12.00 Danger board:

Each support shall be provided with a danger board with pole clamps as per approved drawing. Danger board should be in bi-lingual languages (local language and English). Clamp for danger board, nut-bolts and washers shall be painted with two or more coats of red-oxide and aluminium paints respectively till smooth surface before installation.

13.00 Support foundation:

0.5m^3 Cement concrete in mixture 1 part cement, 3 part coarse sand, 6 part 40 mm size aggregate stone chips (1:3:6) shall be used in steel tubular poles and H-Beam 11 kV line supports.

In rural areas, PCC pole pit shall be refilled with 200 mm average size of bolder mixed with excavated earth. Proper ramming shall be performed for better compaction. All Double pole (DP), Triple pole (TP), cut point poles, Distribution Transformer substation poles and poles erected on water logging area shall be grouted using cement concrete mixture similar to H-Beam & Tubular poles. Prior approval of Project Manager shall be obtained for concreting of PCC poles in water logging area. While preparing route survey report, water logging areas shall be earmarked.

While erecting supports (poles), shuttering must be used for concreting so that proper quantity of cement concrete mixture be used and assessed during inspection. During concreting proper compaction by means of mobile vibrator be provided. While starting work of support erection, gang wise shuttering and mobile vibrator shall be offered for inspection to Project Manager. While erecting support, mercury level gauge must be used to ensure vertical erection of support.

250mm dia X 12" inch size muffing shall be provided on steel tubular and H-Beam poles to prevent direct entry of rain water along the poles. Cement Concrete of 1:2:4 (1 part Cement, 2 parts coarse sand and 4 parts 20mm aggregate stones chips) shall be used for individual poles.

Steel plate shall be used in steel tubular poles and cement concrete reinforced plate shall be used as base plate for PCC poles.

14.00 11 kV line for underground railway crossing –

Two separate composite items of 11 kV line railway crossing is kept in BoQ. One is with 300 sq.mm cable & another one with 185 sq.mm cable.

2 Nos. separate cables shall be laid in separate GI pipe enclosures. At a time, one shall be used and another shall be kept idle as spare in ready to connect condition. Cable termination, cable identification, protective covering, laying of jumpering cable etc shall all be completed in this head. These composite items shall contain following sub-items:

a) 3Cx185 sqmm XLPE armored cable (approx. length is 0.3 km each) – 2 sets
b) 150mm dia GI pipe of A class (red color painted on edges) for cable protection in underground laying – 2 sets
c) 150mm dia GI pipe of B class (blue color painted on edges) for cable support at DP structure – 2 sets
d) Outdoor heat shrinkable cable jointing kits for main cable and jumpering cable – 4 Nos for main cable and 8 Nos for jumpering cables.
e) 11 kV lightening arrestor station class 10kA (6 nos.),
f) 4 Nos GI 3-meters long pipe earthing,
g) 6 SWG GI wires with GI nuts, bolts & washers,
h) Cable markers,
i) Bi-metallic clamps,
j) Jumpering with 11 kV Arial Bunched Cables 200 Sqmm dia (10 mtr) etc – 4 sets
k) Maintenance free type earthing

Detail survey of location of railway crossing be performed by contractor to avoid multi-crossing at nearby location. Prior railway permission for execution of this work shall be obtained by Project Manager for which necessary technical support shall be provided by contractor. Line crossing shall be performed using underground cabling. Block on railway traffic shall be arranged by Project Manager. Contractor should ensure timely completion of work during block period by mobilizing requisite man, materials and machine at crossing locations.

Horizontal drilling machine shall be used for horizontal bore below railway tracks.

15.00 Quality & Quantity inspection and compliance to the observation:

The line works, before or after commissioning/energisation, shall be inspected by Quality Inspectors and State Inspection Inspectorate. Contractor shall provide all requisite details of line like approved survey report, as built drawings and joint measurement sheet to the inspector to conduct. Contractor shall rectify defects/deficiencies and submit compliance to the observations with supporting photographs in digital form within one month from receipt of observations.

16.00 Tree-cutting/trimming of tree:

The Contractor shall count, mark and put proper numbers with suitable quality of paint at his own cost on all the trees that are to be cut/trim to obtain required tree clearance. Contractor shall pay compensation for any loss or damage for tree cutting due to Contractor's work. Wherever forest clearance is envisaged for execution of work, clearance of forest department for tree cutting, if required, shall be arranged by the Project Manager and compensation shall also be paid by the Project Manager. Necessary fee if required to pay to Govt. dept. for arranging such clearances shall paid by Project Manager. However, the contractor would require to provide all necessary assistance for execution of this work.

17.00 Statutory clearances:

During execution of 11 KV Line work, all statutory clearances shall be ensured for ground clearance, line-to-line clearance, road crossing clearance, horizontal and vertical clearances from buildings/objects etc. All road crossings and line crossings shall be guarded as per specifications. Conductor joint should not be provided in mid span length. Instead, it should be nearer to the support.

13.5. Distribution Transformer Substations

1.00 Survey of Distribution Transformer Substations:

A detailed survey of existing habitation shall be performed in presentable document showing population residing in the un-electrified area/existing electrified area of habitation, best location of installation of a new distribution transformer substation and the capacity of transformers to be selected for installation. The capacity of DTR shall be governed by following technical aspects:

a) Optimistic lengths of LT lines needed to feed the beneficiaries,
b) Space available for installation of support/transformers,
c) Probable load expected to come on the transformer due to existing BPL beneficiaries /others connected /un-connected probable beneficiaries in the locality taking care of their expected load growth in next 5 years.
d) Distribution Transformers of capacity 16 KVA to 500 KVA (single phase as well as three phase) shall be decided as per standard rating of distribution transformer as depicted in IS specifications. Nonstandard ratings of DTR shall not be installed.
e) Distribution Transformers of capacity 16 KVA to 500 KVA (single phase as well as three phase) shall be installed on double pole structures. Hence, three phase 11 KV lines shall be laid for 16 KVA to 500 KVA (single phase as well as three phase) capacity sub-stations. Single phase lines shall only be permitted for 10 KVA single phase transformers mounted on single pole structure.
f) Double pole support galvanized steel structures for 16 KVA and 25 KVA distribution transformers shall be designed in such a way that they can be augmented to 63 KVA transformer structures without any addition in near future on technical requirements.

Based on survey report, Project Manager shall decide type, capacity and location of Distribution Transformer sub-station.

2.00 Following types of support are envisaged for 11/0.4 or 11/0.25 KV Distribution Transformer Substation support:

a) 8 meter long /200 KG PSC Poles (PSC Pole as per state practice)
b) 10 meter long /270 KG PSC Poles (PSC Pole as per state practice)
c) 13 m long H-Beam 150x150 mm 34.6 kg/m
d) 9 m long H-Beam 116x100 mm 23 kg/m
e) 11 m long H-Beam 116x100 mm 23 kg/m

In rural area, Employer may use PCC poles are to be used. In urban area, Employer may use PCC or H-Beam or STP or Wide Parallel Beam supports of suitable length. In hilly areas where handling of material is a challenge, tubular poles, or Wide Parallel Beam GI poles expandable with jointing plates may be used. In location specific conditions like forest area, vicinity of other existing overhead lines or permanent structures etc, H- beam or tubular poles or Wide Parallel Beam supports may be used of suable length. Steel bottom plate shall be used in steel tubular poles/H-Beam / Wide parallel Beam and cement concrete reinforced plate shall be used as base plate for PCC poles.

PCC supports shall be used for distribution transformer substation up to 100 KVA capacity only. Beyond 100 KVA rating, Galvanized Wide parallel beams 160x30.44 kg/m supports shall be used for mounting of distribution transformer.

Steel tubular poles shall be cleaned till good surface finish and painted with 2 or more coats of red oxide paint and 2 or more coats of aluminum paint till good finish. Steel tubular poles and H-Beams shall also be painted with 2 or more coats till good surface finish with anti-corrosive paint (in case of tubular poles shall also be painted on the inner walls) which goes in to the foundation. Project Manager shall approved brand and shade of paints.

3.00 Fabricated steel items:

Fabricated steel items like DC cross arm (100x50x6 mm), back clamps (65x8 mm), pole clamp (65x8 mm), DO mounting channel (100x50x6 mm), transformer mounting channel (100x50x6 mm), transformer clamping set (50x50x6 mm), transformer belting set (50x50x6 mm), V cross arm, top clamp, DC cross arm, bracket, clamps, cross bracings, bracings, strain plate, back clamp, transformer mounting structure etc shall be made of MS Channels, MS angle, MS flats as per approved drawings.

While fabricating, good quality electric cutting tools and drill machine shall be used to ensure no sharp edges and perfect holes as per approved drawings. Gas cutting set should not be used for fabrication of MS steel items. Weld material shall be distributed equally between the two materials that were joined. The weld shall be free of waste materials such as slag. The weld surface should not have any irregularities or any porous holes (called porosity). The joint shall be tight. Most welds need to demonstrate the required strength. One way to ensure proper strength is to start with a filler metal and electrode rating that is higher than your strength requirement.

The minimum coating of the zinc on steel tubular poles or Wide Parallel Beam supports shall comply with IS: 2629 and IS: 2633 (with latest amendments). Galvanizing shall be checked and tested in accordance with IS: 2633.

Poles and other hollow items shall be galvanized both inside and out. The zinc coating shall be smooth, continuous and uniform. It shall be free from acid spots and shall not scale, blister or be removable by handling or packing. There shall be no impurities in the zinc or additives to the smelter bath that could have a detrimental effect on the durability of the zinc coating. Before pickling, all welding, drilling, cutting and grinding shall be completed and all grease, paint, varnish, oil and welding slag shall be completely removed.

All protuberances which could affect the life of galvanizing shall also be removed. To avoid the formation of white rust all galvanized material shall be packaged in such a way to ensure adequate ventilation between parts during shipping and storage.

Testing of galvanizing shall be performed for Uniformity of thickness as per IS 2633/1986, Mass of coating as per IS 6745/1972 and quantity of zinc, water quenching & centriguging as per IS 2629/1985.

4.00 Hardware:

MS Nuts, bolts and washers (Galvanized) – 16 mm dia nuts, bolts & washers shall be used for tying of overhead structure items like cross arms, top clamps, brackets, clamps, bracing, strain plates etc.

While erecting, proper dimensions of nut-bolts and washers must be ensured. 2 to 3 threads only be visible of the bolt after full tightening of nut on requisite torque. The hardware shall be hot dip galvanized. The minimum coating of the zinc shall comply with IS: 2629 and IS: 2633. Galvanizing shall be checked and tested in accordance with IS: 2633. Before shifting them to site for erection, they shall be offered for inspection and approval by Project Manager.

5.00 Stay Set:

Galvanized Stay Set with 50x8 mm stay clamp, guy insulator (2Nos.), anchor plate (200x200x6mm) , nut-bolts, 2 Nos turn-buckles, 1.8 m long, 16 mm diameter solid GS stay rod & 7/3.15 mm dia GI stranded wire complete.

Stay set shall be used at all sub-station location to nullify the tension of conductor/cable/transformer on the supports. 0.2 cmt cement concreting in mixture 1 part cement, 3 part coarse sand and 6 part 40mm size aggregate stone chips (1:3:6) shall be provided in the foundation of the stay set. 2 Nos. guy insulator shall be provided in 7/3.15 mm dia stranded GI wire at middle locations between two turn buckles.

6.00 Distribution Transformer:

Following type and sizes of minimum 3 star rated {as per Bureau of Energy Efficiency (BEE)}, BIS stamped, distribution transformers are standardized in the project:

a) 5/6 KVA 1 phase Aluminium / Copper wound DTR
b) 10 KVA 1 phase / 3 phase Aluminium / Copper wound DTR
c) 16 KVA 1 phase / 3 phase Aluminium / Copper wound DTR
d) 25 KVA 1 phase / 3 phase Aluminium / Copper wound DTR
e) 63 KVA 3 phase Aluminium / Copper wound DTR
f) 100 KVA 3 phase Aluminium / Copper wound DTR
g) 200 KVA 3 phase Aluminium / Copper wound DTR
h) 250 KVA 3 phase Aluminium / Copper wound DTR
i) 315 KVA 3 phase Aluminium / copper wound DTR

Or any other rating as per latest Indian Standard Specification

The Distribution Transformers shall be 11/0.4 KV or 11KV/230 V or 22/0.44 KV non-sealed type, double wound, three phase, CRGO or amorphous core type having energy efficiency level 1 as specified in latest IS:1980 (Part-1) 2014 with Amendments 1,2 3 &4.

Distribution Transformers shall be subject to inspection during manufacturing (stage inspection), pre-delivery inspection, and inspection at site during pre-erection/post erection/post commissioning conditions. Project Manager shall select samples from the core laminations and get the same tested in CPRI/ NABL Accredited laboratory to prove the quality of the core material.

The distribution transformers shall be supplied with transformer oil filled up-to maximum permissible level and breather with silica gel.

The distribution transformers must have been successfully type tested within five years from date of Letter of Intent and the designs should have been in satisfactory operation for a period not less than two years as on the date of bid opening. Compliance shall be demonstrated by submitting, (i) authenticated copies of the type test reports and (ii) performance certificates from the users, specifically from Central Govt./State Govt. or their undertakings.

The losses in Distribution Transformer should be as per **Energy Efficiency Level 1 as specified in IS 1180 (Part-1):2014 and amendment 1,2,3 &4** for all kVA ratings of distribution transformers

Bimetallic connectors of suitable capacities are to be provided on LT side and on HT side of the transformer.

Transformers must be of standard preferred ratings as specified in scope of works

T-Clamps should be provided on each jumper on bus bars. Line jumpers should be provided with adequate size of PG Clamps (Two numbers PG Clamps at each end of jumper). Clamp should be made of aluminum grade T-1F as per IS-8309 having good electrical quality aluminum material and should not be brittle in nature.

Transformers should be tested for pre-commissioning checks which includes Insulation Resistance Test, ratio test and oil breakdown voltage test. Before formal energisation, oil leakages from the parts of the transformer, oil level in conservator tank, condition of silica gel, earth connection (two separate) between neutral and earthing, proper jointing of earth wires/flats at the joints and earth resistance of the individual earthing pits are to be checked and recorded. On commissioning of the transformer, phase current and phase to phase voltage, phase to neutral voltage are to be recorded. The loading on the transformers should be balanced. The quantum of neutral current flowing through neutral shall be recorded. A record of pre-commissioning checks/tests are to be prepared and submitted to the Project Manager.

7.00 ACSR / AAAC Conductor:

ACSR raccoon conductor (or equivalent AAAC Conductor) is to be used for connection between overhead lines to transformer studs/bushing upto 100 KVA ratings. For transformers having ratings more then 100KVA, higher size of conductors matching with its current carrying rating be used.

8.00 Distribution Box/SMC Distribution Box and Power Cabling:

Distribution Box/SMC Distribution Boxes are to be installed as per specifications enclosed. The boxes are to be erected, electrically connected with the existing system, properly earthed, and labeled. The test report of pre-commissioning checks should be prepared and submitted.

All CT terminals are to be ring type and other terminals are fork type. 2.5 sqmm copper multi stands wiring 1.1 KV grade, ISI marked, IS 694 shall be used for control wiring. A terminal block be provided between CT and Meter keeping 20% spare terminals.

The Distribution Box/SMC Distribution Boxes are to be earthed using 8 SWG GI wire direct connection to the earthing. 2 Nos Earthing bolts on the distribution boards should be provided of 10mm dia.

The single core power cables should be terminated with proper size lugs and gland. Necessary tagging, identification of cores and dressing of cables with nylon cable ties shall be in the scope of work. The unutilized holes in the DBs provided for cable entry needs to be plugged properly in a manner that it must stop access to reptiles, dust and water ingress.

The Low Tension bus bars are to be painted with two or more coats of brush-able epoxy compound suitable to insulate the bus bars for 415 volts exposure.

The Distribution Box/SMC Distribution Box, for transformers upto and including 25 KVA, should also house three phase tri-vector energy meter / single phase meter depending on capacity and type of distribution transformer as per specifications. For higher capacity transformers where CT operated meters are to be installed, separate LTCT cum Meter Box at eye height shall be installed for housing of meter, CTs, terminal block and wiring.

The single core un-armored power cables shall be used for connection from Distribution Transformer to Distribution Box/SMC Distribution Box and Distribution Box/SMC Distribution Box to Outgoing LT lines. Cable should not be used in underground laying arrangement. Cables should be dressed & tied properly using clamps /cable ties at 1 meter intervals and tied with substation structure/poles. At-least one meter cable is to be kept as spare at the individual ends.

Following arrangements shall be made for LT Distribution Transformers and LT Cables:

No	**Type of DTR**	**Incomer**		**Outgoing**	**Cable**	
		MCB/Isolator	***HRC fuse***	***MCCB***	***1***	***2***
1	5/6/10 KVA 1 Ph	45A SPN MCCB		2x32A SP MCCB	1Cx16 sqmm UA	
2	16 KVA 1 Ph	80A SPN MCCB		2x50A SP MCCB	1Cx16 sqmm UA	
3	16 KVA 3 Ph	25A TPN MCCB		6x16A SP MCCB	1Cx16 sqmm UA	

4	25 KVA 1 Ph	40A SPN MCCB		3x25A SP MCCB	1Cx35 sqmm UA	
5	25 KVA 3 Ph	40A TPN MCCB		6x25A SP MCCB	1Cx35 sqmm UA	
6	63 KVA 3 Ph	200A TPN Isolator	100 A	6x60A SP MCCB	1Cx50/70 sqmm UA	1Cx70 sqmm UA
7	100 KVA 3 Ph	200A TPN Isolator	160 A	6x90A SP MCCB	1Cx50/70 sqmm UA	1Cx150 sqmm UA
8	200 KVA 3 Ph	600A TPN Isolator	315 A	9x120A SP MCCB	1Cx150 sqmm UA	1Cx300 sqmm UA
9	315 KVA 3 Ph	600A TPN Isolator	500 A	12X120A SP MCCB	1CX150 sqmm UA	1CX300 sqmm UA

1.1 KV XLPE Aluminum Conductor, Stranded, un-armored cable be used for connection of transformer LV bushing to Distribution Box/SMC Distribution Box and Distribution Box/SMC Distribution Box to overhead line.

9.00 Earthing:

Distribution Transformer Earthing shall be provided with 3 Nos earthing and making earth mat /risers using 50X6mm GI Flat. Earthing should be provided with GI earth pipe or Chemical Earthing depending of strata of soil in the location. Project Manager shall decide the type of earthing.

25x3mm GI Flat and 8 SWG GI shall be used for making earthing connection to various sub-station equipment as per given details. GI Flat and GI wire shall be properly dressed, bunched and clamped with the support at 2 feet intervals. An overlapping of 35mm shall be used at the place of flat to flat joint. Two sets of GI nuts, bolts and washers shall be used for flat-to-flat joints. GI nuts, bolts and washers must be used for GI Flat–to-GI wire & GI wire-to-GI wire joints.

Substation wise measurement of earth resistance of earth pits / mesh and corresponding drawing of existing earthing arrangement shall be recorded and submitted to Project Manager.

Description of equipment	Earth connection
Earthing pits	3 Nos. Earth Pipe 3 m long, 40 mm dia or Chemical Earthing
Earth mat and riser	50X6 mm GI Flat / 8 SWG GI wire
Laying of earth mat	Below ground 0.5 meter

Standard requirements of earthing shall be as under:

a) Earth Pit – 1 for Transformer Neutral,
b) Earth pit - 2 for Lightening Arrester,
c) Earth pit – 3 for Equipment body earthing.
d) Maintenance free earthing

Following arrangement is envisaged for various equipment of distribution transformer substation:

a) Transformer Neutral (Two distinct connections) : GS Flat 25X3mm
b) Transformer Body : GS Flat 25X3mm
c) Lightning Arrester : GS Flat 25X3mm
d) Fencing (Wherever required) : GI wire 8 SWG
e) LT Distribution Box (Two distinct connections) : GI wire 8 SWG
f) AB Switch handle : GI wire 8 SWG
g) Steel structure of substation : GI wire 8 SWG
h) Line meters : GS wire 8 SWG

The location of earth pits should be at-least 3m apart, so that they their earth conductive areas do not overlap. In rocky soil where getting required earth resistance is a challenge, chemical rod earthing shall be used in place of normal GI pipe type earthing. Project Manager shall decide type of earthing pits.

10.00 Insulator and hardware:

11 KV polymer/porcelain Disc/Pin insulator with suitable hardware fittings shall be used. Insulator should be tied properly using binding wire/helical form fitting. Bi-metallic clamps must be used at terminals.

The individual insulator shall be checked for insulation resistance before overhead line installation. Insulator should properly be cleaned before installation. No damage/crack insulator should be used.

11.00 Substation numbering:

Each Substation should be numbered properly labelled using yellow base and black indication marks (number or digits). 40/50 mm height digits/words should be used for this purpose. Base shall be made using 2 or more coats of yellow enamel paint till good surface finish. Base preparation shall be completed before shifting of poles to site for erection. Base painting and marking of digits should be performed by a skilled and trained painter using branded enamel paint, Project Manager shall approve type and brand of enamel paint.

12.00 Anti-climbing device:

3.5 kgs, 2.5mm dia (12 SWG) galvanized barbed wire shall be used on each sub-station support. Galvanized barbed wire should be properly dressed and crimped at termination. While wrapping the wire on support, proper tension should be maintained.

13.00 Danger board:

Each support should be provided with a danger board with pole clamps as per approved drawing. Danger board should be in bi-lingual languages (local language and English). Clamp for danger board, nut-bolts and washers shall be painted with two or more coats of red-oxide and aluminium paints respectively till smooth surface before installation.

14.00 Support foundation:

0.5 m^3 Cement concrete in mixture 1 part cement, 3 part coarse sand, 6 part 40 mm size aggregate stone chips (1:3:6) shall be used in PCC Pole, steel tubular poles and H-Beam support foundation.

While erecting supports (poles), shuttering must be used for concreting so that proper quantity of cement concrete mixture be used and assessed during inspection. During concreting proper compaction by means of mobile vibrator be provided. While starting work of support erection, gang wise shuttering and mobile vibrator shall be offered for inspection to Project Manager. While erecting support, mercury level gauge must be used to ensure vertical erection of support.

250mm dia X 12" inch size muffing shall be provided on steel tubular and H-Beam poles to prevent direct entry of rain water along the poles. Cement Concrete of 1:2:4 (1 part Cement, 2 parts coarse sand and 4 parts 20mm aggregate stones chips) shall be used for individual poles.

Steel plate shall be used in steel tubular poles and cement concrete reinforced plate shall be used as base plate for PCC poles.

15.00 11 KV AB Switch:

11 kV, 3-ph, 200 A, 3 Pin type, Horizontal/Vertical Mounting type, Gang Operated, AB Switch shall be installed on 100 KVA and more capacity distribution transformer substation only. B Class GI pipe shall be used (without any joints) for operation of switch. AB Switch structure and handle must be earthed using 8 SWG GI wire.

16.00 11 KV Drop Out Fuses:

11 kV, 3-ph, Drop Out fuse units (set of 3 units) along with Support Insulators, Base Channel, fuse barrel etc. shall be used for all capacity Distribution Transformer Substations. DO Fuse structure shall be earthed using 8 SWG GI wire.

17.00 Lighting Arrester:

Distribution Class LAs on each phase shall be provided in the sub-station with base steel structure, terminals bi – metallic connectors / PG clamps and earth connectors. LAs are to be connected with separate earth connection. 25x3 mm GI flat shall be used for earth connection.

13.6. New LT Line

1. Survey:

   Mapping of route of proposed new LT line by foot survey in rural/urban areas be performed mentioning various milestones. While surveying, existing electrical infrastructure in the locality should also be mapped. Line alignment (single line diagram) on political map with fair correctness, be prepared. SLD and foot survey report shall be approved by Project Manager and shall be used as basic document for assessment of works under the contract. On completion of line work, as built Single Line Diagram and pole wise line diagram showing pole wise materials used and pole-to-pole span should be submitted to Project Manager. This details shall be used as reference documents by Quality & Quantity Inspecting officials to execute inspection works.

2. The LT line between distribution transformer and consumers shall be on LT Areal Bunched cables.

3. Support for LT overhead Line:

   a) 8 meter long /200 KG PSC Poles (PSC Pole as per state practice)
   b) 10 meter long /270 KG PSC Poles (PSC Pole as per state practice)
   c) 13 m long H-Beam 150x150 mm 34.6 kg/m
   d) 9 m long H-Beam 116x100 mm 23 kg/m
   e) 11 m long H-Beam 116x100 mm 23 kg/m

   In rural area, Employer may use PCC poles are to be used. In urban area, Employer may use PCC or H-Beam or STP or Wide Parallel Beam supports are to be used of suitable length. In hilly areas where handling of material is a challenge, tubular poles, or Wide Parallel Beam GI poles expandable with jointing plates may be used. In location specific conditions like forest area, vicinity of other existing overhead lines or permanent structures etc, H- beam or tubular poles or Wide Parallel Beam supports may be used of suable length. Steel bottom plate shall be used in steel tubular poles/H-Beam / Wide parallel Beam and cement concrete reinforced plate shall be used as base plate for PCC poles. Steel tubular poles shall be cleaned till good surface finish and painted with 2 or more coats of red oxide paint and 2 or more coats of aluminum paint till good finish. Steel tubular poles and H-Beams shall also be painted with 2 or more coats till good surface finish with anti-corrosive paint (in case of tubular poles shall also be painted on the inner walls) which goes in to the foundation. Project Manager shall approved brand and shade of paints.

4. Fabricated steel items:

Fabricated steel items like clamps, stay clamp, etc shall be made of MS Channels, MS angle, MS flats as per approved drawings.

While fabricating, good quality electrical cutting tools and drill machine shall be used to ensure no sharp edges and perfect holes as per approved drawings. Gas cutting set should not be used for fabrication of MS steel items. Weld material shall be distributed equally between the two materials that were joined. The weld shall be free of waste materials such as slag. The weld surface should not have any irregularities or any porous holes (called porosity). The joint shall be tight. Most welds need to demonstrate the required strength. One way to ensure proper strength is to start with a filler metal and electrode rating that is higher than your strength requirement.

The fabricated steel structures materials shall be hot-dip galvanized thoroughly internally and externally according to IS: 2629 and IS: 2633 (with latest amendments). Galvanizing shall be checked and tested in accordance with IS: 2633.

Fabricated steel structure items shall be galvanized both inside and out. The zinc coating shall be smooth, continuous and uniform. It shall be free from acid spots and shall not scale, blister or be removable by handling or packing. There shall be no impurities in the zinc or additives to the smelter bath that could have a detrimental effect on the durability of the zinc coating. Before pickling, all welding, drilling, cutting and grinding shall be completed and all grease, paint, varnish, oil and welding slag shall be completely removed.

All protuberances which could affect the life of galvanizing shall also be removed. To avoid the formation of white rust all galvanized material shall be packaged in such a way to ensure adequate ventilation between parts during shipping and storage.

Testing of galvanizing shall be performed for Uniformity of thickness as per IS 2633/1986, Mass of coating as per IS 6745/1972 and quantity of zinc, water quenching & centriguging as per IS 2629/1985.

5. Hardware:

MS Nuts, bolts and washers (Galvanized) – 16 mm dia nuts, bolts & washers shall be used for tying of overhead structure wherever required.

While erecting, proper dimensions of nut-bolts and washers must be ensured. 2 to 3 threads only be visible of the bolt after full tightening of nut on requisite torque. The hardware shall

be hot dip galvanized. The minimum coating of the zinc shall comply with IS: 2629 and IS: 2633. Galvanizing shall be checked and tested in accordance with IS: 2633. Before shifting them to site for erection, they shall be offered for inspection and approval by Project Manager.

6. Galvanized Stay Set with 50x8 mm stay clamp, guy insulator (1 No.), anchor plate (200x200x6mm), nut-bolts, 2 Nos turn-buckles, 1.8 m long, 16 mm diameter solid GS stay rod shall be used with 7/3.15 mm dia GI stranded wire.

Stay set shall be used at all turning locations, cable dead end locations to nullify the tension of the cable. Erection of storm guys at suitable location in straight line may also be provided. Erection of storm guys at suitable location in straight line may also be provided.

0.2 cmt cement concreting in mixture 1 part cement, 3 part coarse sand, 6 part 40mm size aggregate stone chips (1:3:6). 2 Nos. guy insulator shall be provided in stranded GI wire at middle location between two turn buckles.

7. Following earthing arrangements are envisaged for new LT lines:

7.1.1. 40 mm dia., 3000 mm long GI pipe earth electrode with test link, RCC pit, RCC cover plate on GI frame, bentonite powder and other accessories complete
7.1.2. GI Earthing spike made of 20mm solid rod or 8 SWG, 50 turns earthing coil
7.1.3. Chemical rod earthing using Carbon powder/Bentonite powder / Conductive concrete powder including electrode with 2000mm long, 50 mm diameter GI pipe, GI Strip of 24x3mm minimum.8 SWG GI wire for earthing and guarding

Every sixth LT line support shall be provided with one GI earthing spike made of 20 mm solid rod or GI Earth Coil and connected with 8 SWG GI wire. Overhead steel items shall be connected to GI earthing spike or GI Earth Coil using 8 SWG GI wire. GI nuts, bolts & washers shall be used to join two GI wires and 20 mm solid spike rod. Project Manager shall decide use of GI Earth Coil or 20mm dia GI Solid Rod for individual pole earthing.

In rocky soil where getting required earth resistance is a challenge, chemical rod earthing shall be used. Overhead line structure shall be connected to chemical earth electrode using 8SWG GI wire. GI nuts, bolts & washers shall be used to join two GI wires and 20 mm solid spike rod.

GI wires must be properly dressed and fixed on supporting structure at 1 to 2 feet intervals.

8. LT line shall form following areal bunched XLPE cables:

8.01	1X16 (Ph) + 1X25 (bare messenger cum neutral) SQ. MM.
8.02	1X16 (Ph) + 1X25 (bare messenger cum neutral) + 1x16 (insulated Street lighting)SQ. MM.
8.03	3X16(Ph)+1X25 (bare messenger cum neutral) SQ. MM.
8.04	3 X 16(Ph) +1x25 (bare messenger cum neutral) + 1x16 (insulated Street lighting) SQ. MM.
8.05	1X25(Ph)+1x25 (bare messenger cum neutral) SQ. MM.
8.06	1X25(Ph) + 1X25 (bare messenger cum neutral) + 1x16 (insulated Street lighting) SQ. MM.
8.07	3X25(Ph)+1X25 (bare messenger cum neutral) SQ. MM.
8.08	3 X 25(Ph) +1x25 (bare messenger cum neutral) + 1x16 (insulated Street lighting) SQ. MM.
8.09	1X35(Ph)+1X25 (bare messenger cum neutral) SQ. MM.
8.10	1x35(Ph) + 1X25 (bare messenger cum neutral) + 1x16 (insulated Street lighting) SQ. MM.
8.11	3X35(Ph)+1X25 (bare messenger cum neutral) SQ. MM.
8.12	3X35 (Ph) + 1x25 (bare messenger cum neutral)+ 1x16 (insulated Street lighting) SQ. MM.
8.13	3X50(Ph)+1X35 (bare messenger cum neutral) SQ. MM.
8.14	3X50 (Ph)+1x35 (bare messenger cum neutral) +1x16 (insulated Street lighting) SQ. MM.
8.15	3X95(Ph)+1X70 (bare messenger cum neutral) SQ. MM.
8.16	3X95(Ph)+1X70 (bare messenger cum neutral) +1x16 (insulated Street lighting) SQ. MM.

9. Distribution Box/SMC Distribution Box:

Single phase or three phase Distribution Box/SMC Distribution Box/SMC Distribution Box/SMC Distribution Box shall be provided for extending power supply to LT consumers. Distribution Box/SMC Distribution Box (DB) shall be mounted on LT pole with galvanized MS clamp of 40x3 mm size. DB shall be earthed using 8 SWG GI wire.

Single phase DB shall be suited for two core 25 sqmm aluminum conductor cable as incomer and 8 nos. two core 10 sqmm conductor cables as outgoing cables. Three phase DB shall be suited for four core 35 sqmm aluminum conductor cable as incomer and 4 nos. four core 16 sqmm conductor cables as outgoing cables.

The Distribution Box/SMC Distribution Box shall be installed only at locations where BPL connections are provided.

10. Connection from ABC cable:

2Cx25 sqmm **stranded** cable or 4Cx35 sqmm **stranded** cable shall be used between LT line and Distribution Box/SMC Distribution Box. T-connector shall be used at LT line for tapping. While tapping connection from ABC cable, highly skilled lineman/wireman shall be deployed along with sophisticated cutting plier/tool so that no damage should result in AB cable conductor. T-connector should be crimped properly for resistance free/maintenance free electric connection. Alternately, piercing type connector may be used for tapping of LT connection from ABC cable conductor.

11. Distribution Box / SMC Distribution Box Pole numbering:

Each support pole should be numbered properly labelled using yellow base and black indication marks (number or digits). 40/50 mm height digits/words should be used for this purpose. Base shall be made using 2 or more coats of yellow enamel paint till good surface finish. Base preparation shall be completed before shifting of poles to site for erection. Base painting and marking of digits should be performed by a skilled and trained painter using branded enamel paint, Project Manager shall approve type and brand of enamel paint.

12. Anti-climbing device:

3.5 kgs, 2.5mm dia (12 SWG) galvanized barbed wire shall be used on each LT line support. Galvanized barbed wire should be properly dressed and crimped at termination. While wrapping the wire on support, proper tension should be maintained.

13. Danger board:

Each support should be provided with a danger board with pole clamps as per approved drawing. Danger board should be in bi-lingual languages (local language and English). Clamp for danger board, nut-bolts and washers shall be painted with two or more coats of red-oxide and aluminium paints respectively till smooth surface before installation.

14. Support foundation:

0.5 m^3 Cement concrete in mixture 1 part cement, 3 part coarse sand, 6 part 40 mm size aggregate stone chips (1:3:6) shall be used in steel tubular poles and H-Beam LT line supports.

In rural areas, PCC pole pit shall be refilled with 200 mm average size of bolder mixed with excavated earth. Proper ramming shall be performed for better compaction. PCC pole at cut point and PCC poles erected on water logging area shall be grouted using cement concrete

mixture similar to H-Beam & Tubular poles. Prior approval of Project Manager shall be obtained for concreting of PCC poles in water logging area. While preparing route survey report, water logging areas shall be earmarked.

While erecting supports (poles), shuttering must be used for concreting so that proper quantity of cement concrete mixture be used and assessed during inspection. During concreting proper compaction by means of mobile vibrator be provided. While starting work of support erection, gang wise shuttering and mobile vibrator shall be offered for inspection to Project Manager. While erecting support, mercury level gauge must be used to ensure vertical erection of support.

250mm dia X 12" inch size muffing shall be provided on steel tubular and H-Beam poles to prevent direct entry of rain water along the poles. Cement Concrete of 1:2:4 (1 part Cement, 2 parts coarse sand and 4 parts 20mm aggregate stones chips) shall be used for individual poles.

Steel plate shall be used in steel tubular poles and cement concrete reinforced plate shall be used as base plate for PCC poles.

15. Quality & Quantity inspection and compliance to the observation:

The line works, before or after commissioning/energisation, shall be inspected by Quality Inspectors and State Inspection Inspectorate. Contractor shall provide all requisite details of line like approved survey report, as built drawings and joint measurement sheet to the inspector to conduct. Contractor shall rectify defects/deficiencies and submit compliance to the observations with supporting photographs in digital form within one month from receipt of observations.

16. Tree-cutting/trimming of tree:

The Contractor shall count, mark and put proper numbers with suitable quality of paint at his own cost on all the trees that are to be cut/trim to obtain required tree clearance. Contractor shall pay compensation for any loss or damage for tree cutting due to Contractor's work. Wherever forest clearance is envisaged for execution of work, clearance of forest department for tree cutting, if required, shall be arranged by the Project Manager and compensation shall also be paid by the Project Manager. Necessary fee if required to pay to Govt. dept. for arranging such clearances shall paid by Project Manager. However, the contractor would require to provide all necessary assistance for execution of this work.

17. Statutory clearances:

    During execution of LT Line works, all statutory clearances shall be ensured for ground clearance, line-to-line clearance, road crossing clearance etc.

18. The earthing point of distribution transformer should be extended to the single phase beneficiary premises having en-route earth connection at every 6th supports. The earth conductor is to be connected with earth point provided in the premises of single phase consumers. The bearer wire shall be earthed at every sixth pole.

19. Bearer wire of LT AB cable shall be anchored through eyehook or dead end (anchor) clamps.

20. Extra length of continuous AB cable along with messenger / bearer wire shall be properly dressed and clamped.

13.7. Augmentation and Renovation

1. 33/11 kV substation augmentation

Following types of augmentation works are envisaged in 33/11 kV substation:

a. Installation of additional 3.15 MVA Transformer with two additional bay on 11 KV side.
b. Installation of additional 5 MVA Transformer with two additional bay on 11 KV side.
c. Installation of additional 6.3 MVA Transformer with three additional bay on 11 KV side.
d. Installation of additional 8 MVA Transformer with four additional bay on 11 KV side.
e. Installation of additional 10 MVA Transformer with four additional bay on 11 KV side.
f. 11 KV out-door yard extension for additional bay H-beam structure.
g. 11 KV out-door yard extension for additional bay by providing PCC support (pole).
h. 33 KV out-door yard extension for additional bay by providing H-beam structure.
i. Installation of 33 KV VCB for 1.6 MVA, 3.15 MVA, 5.0 MVA Transformer.
j. Augmentation of Power Transformer without additional bay on 11 KV side 1.65 MVA to 3.15 MVA.
k. Augmentation of Power Transformer without additional bay on 11 KV side 3.15 MVA to 5.0 MVA.
l. Augmentation of Power Transformer without additional bay on 11 KV side 5.00 MVA to 8.0 MVA.
m. Augmentation of Power Transformer without additional bay on 11 KV side with old transformer 1.6 MVA to 3.15 MVA.

n. Augmentation of Power Transformer without additional bay on 11 KV side with old transformer 3.15 MVA to 5.0 MVA.
o. Augmentation of Power Transformer using old transformer with 2 no. additional bay on 11 KV side 1.6 MVA to 3.15 MVA.
p. Augmentation of Power Transformer using old transformer with 2 no. additional bay on 11 KV side 3.15 MVA to 5.0 MVA.
q. Augmentation of Power Transformer with 2 no. additional bay on 11 KV side 1.6 MVA to 3.15 MVA.
r. Augmentation of Power Transformer with 2 no. additional bay on 11 KV side 3.15 MVA to 5.0 MVA.
s. Augmentation of Power Transformer with 2 no. additional bay on 11 KV side 5.00 MVA to 8.0 MVA.
t. Capacitor Bank 600 KVAR - Fixed type.
u. Capacitor Bank 1200 KVAR - Auto type.
v. Capacitor Bank 1500 KVAR - Auto type.
w. Revamping of 33/11 kV substation earth mat.

Above list is of various options of substation renovation/augmentation. The list of works is indicative. Employer shall provide location wise exact details of works to be executed on existing substation. Accordingly, various BoQ items (extracted from items of new 33/11 kV substations) shall be utilized. Item-wise scope of works under new 33/11 kV substations is detailed out under scope of new substation. It shall be utilized on item to item requirement under renovation/augmentation of 33/11 kV substation also. Under this head, only damaged/defective items with approval of Project Manager shall be replaced by good ones. All removed defective/damaged items and good replaced power transformers received should be returned to employer's stores within a time limit decided by the Project Manager in the same condition as replaced.

2. Renovation/Augmentation of 33 kV line

1.00 Augmentation of 3 phase 33 kV line using additional supports matching with length and type of existing support is envisaged on following type of supports:

i. 9.1 meter long /280 KG PCC Poles (PCC Pole as per state practice)
ii. 11 m or 13 m long H-Beam 152x152 mm 37.1 kg/m
iii. 11 M long steel Tubular poles with welded steel base plate of Designation 540 SP 52 (IS 2713, Pt I, II, III 1980)
iv. 13 M long steel Tubular poles with welded steel base plate of Designation 540 SP 72 (IS 2713, Pt I, II, III 1980)

2.00 Augmentation of existing conductor with following type of new ACSR conductor including jointing sleeves, binding materials and helical formed fittings etc as required are envisaged under this work-

i. 6/4.72 mm+7/1.57 mm (100 mm² Al. Area) - Dog replacing existing raccoon conductor
ii. 6/4.09 + 1/4.09 mm (80 mm² Al. Area) - Raccoon replacing existing rabbit/weasel conductor
iii. 30/2.59 + 7/2.59 mm (150 mm² Al. Area) - Wolf replacing existing dog/raccoon conductor
iv. 30/3.00 + 7/3.00 mm (200 mm² Al. Area) - Panther replacing existing dog/raccoon/wolf conductor

3.00 While executing this work, mid span pole with all fittings may be provided matching with existing poles of the line.

4.00 Following works shall also be executed by contractor under this head –

a. Replacement of damaged insulators
b. Straightening of tilted supports by providing additional foundation or by providing boulders etc as required.
c. Revamping of pole earthing and replacement of GI earth wire.
d. Labelling, providing danger board, providing anti climbing device and painting of all the poles shall be in the scope of work
e. Replacement of damaged/bent V-cross arms & top clamps with new ones
f. Providing of stay set wherever required
g. Providing of guarding wherever required
h. Removal of old conductor in coil form, removal of old steel structure, removal of old conductor fittings, removal of any other worn out/defective material and deposit them in Employer's store within a reasonable time as decided by Project Manager

Item-wise scope of works under renovation/augmentation of 33 kV line is detailed out under scope of new 33 kV line. It shall be utilized on item to item requirement under renovation/augmentation of 33 kV line also.

3. Renovation/Augmentation of 11 kV line

1.00 Augmentation of 3 phase 11 kV line using additional supports matching with length and type of existing support is envisaged on following type of supports:

a) 8 meter long /200 KG PSC Poles (PSC Pole as per state practice)
b) 10 meter long /270 KG PSC Poles (PSC Pole as per state practice)
c) 13 m long H-Beam 150x150 mm 34.6 kg/m

d) 9 m long H-Beam 116x100 mm 23 kg/m
e) 11 m long H-Beam 116x100 mm 23 kg/m

2.00 Augmentation of existing conductor with following type of new ACSR conductor including jointing sleeves, binding materials and helical formed fittings etc as required are envisaged under this work-

a. 100 sqmm Dog conductor,
b. 55 sqmm AAAC

3.00 While executing this work, mid span pole with all fittings may be provided matching with existing poles of the line.

4.00 Following works shall also be executed by contractor under this head –

a. Replacement of damaged insulators
b. Straightening of tilted supports by providing additional foundation or by providing boulders etc as required.
c. Revamping of pole earthing and replacement of GI earth wire.
d. Labelling, providing danger board, providing anti climbing device and painting of all the poles shall be in the scope of work
e. Replacement of damaged/bent V-cross arms & top clamps with new ones
f. Providing of stay set wherever required
g. Providing of guarding wherever required
h. Removal of old conductor in coil form, removal of old steel structure, removal of old conductor fittings, removal of any other worn out/defective material and deposit them in Employer's store within a reasonable time as decided by Project Manager

Item-wise scope of works under renovation/augmentation of 11 kV line is detailed out under scope of new 11 kV line. It shall be utilized on item to item requirement under renovation/augmentation of 11 kV line also.

4. R & M and augmentation of Distribution Transformer Substations

1.00 Survey of Distribution Transformer Substations:

A detailed survey of overloaded Distribution Transformer substation shall be performed. Existing electrical connected loading and habitation shall be surveyed and a presentable document showing population residing in the un-electrified area/existing electrified area of habitation shall be performed. Based on survey, best option for augmentation of distribution

transformer substation and the capacity of new transformer shall be decided. The capacity of augmented DTR shall be governed by following technical aspects:

a) Optimistic lengths of LT lines needed to feed the existing consumers, existing un-connected consumers and future growth in electrical loading,
b) Space available for installation of support/transformers,
c) Probable load expected to come on the transformer due to existing BPL beneficiaries /others connected /un-connected probable beneficiaries in the locality taking care of their expected load growth in next 5 years.
d) Distribution Transformers of capacity 16 KVA to 315 KVA (single phase as well as three phase) shall be decided as per standard rating of distribution transformer as depicted in IS specifications. Nonstandard ratings of DTR shall not be installed.
e) Distribution Transformers of capacity 16 KVA to 315 KVA (single phase as well as three phase) shall be installed on existing structures/plinth.

Based on survey report, Project Manager shall decide type, capacity and location of Distribution Transformer sub-station for augmentation/R&M works.

2.00 Following types of works are envisaged for Distribution Transformer sub-station for augmentation/R&M works:

a. Replacement of defective materials of DTR substations
b. Re-erection/re-concreting of substation supports
c. Dismantling of defective/worn-out steel structure materials, 11 kV/LT equipment like Lightening Arrester, DO Fuse, Distribution box, LT cable, jumpering conductor, terminal clamps, insulators etc as required. Shifting of dismantled material to Employer's store within reasonable period of time.
d. Installation of stay set for strengthening of DTR substation structure.
e. Topping up of new and filtered transformer oil wherever required.
f. De-moisturizing of silica gel, filling of transformer oil in silica gel breather.
g. Providing new DTR substation equipment like steel structure materials, 11 kV/LT equipment like Lightening Arrester, DO Fuse, Distribution box, LT cable, jumpering conductor, terminal clamps, insulators etc
h. Renovation of DTR substation earthing by providing new earth pits, inter connection of earth pits and their connection to various equipment
i. Cleaning of metallic structure items by rubbing through emery paper and re-painting using two codes of red oxide paint and two coats of aluminium oxide paints of reputed type and make as approved by Project Manager using painting brush.

3.00 Fabricated steel items:

Fabricated steel items like DC cross arm (100x50x6 mm), back clamps (65x8 mm), pole clamp (65x8 mm), DO mounting channel (100x50x6 mm), transformer mounting channel (100x50x6 mm), transformer clamping set (50x50x6 mm), transformer belting set (50x50x6 mm), V cross arm, top clamp, DC cross arm, bracket, clamps, cross bracings, bracings, strain plate, back clamp, transformer mounting structure etc shall be made of MS Channels, MS angle, MS flats as per approved drawings.

While fabricating, good quality electric cutting tools and drill machine shall be used to ensure no sharp edges and perfect holes as per approved drawings. Gas cutting set should not be used for fabrication of MS steel items. Weld material shall be distributed equally between the two materials that were joined. The weld shall be free of waste materials such as slag. The weld surface should not have any irregularities or any porous holes (called porosity). The joint shall be tight. Most welds need to demonstrate the required strength. One way to ensure proper strength is to start with a filler metal and electrode rating that is higher than your strength requirement.

Fabricated steel structure items shall be hot dip galvanized and cleaned till good surface finish. The minimum coating of the zinc shall comply with IS: 2629 and IS: 2633 (with latest amendments). Galvanizing shall be checked and tested in accordance with IS: 2633. Items shall be offered for inspection and approval by Project Manager.

The fabricated steel structures materials shall be hot-dip galvanized thoroughly internally and externally according to IS: 2629 and IS: 2633 (with latest amendments). Galvanizing shall be checked and tested in accordance with IS: 2633.

Fabricated steel structure items shall be galvanized both inside and out. The zinc coating shall be smooth, continuous and uniform. It shall be free from acid spots and shall not scale, blister or be removable by handling or packing. There shall be no impurities in the zinc or additives to the smelter bath that could have a detrimental effect on the durability of the zinc coating. Before pickling, all welding, drilling, cutting and grinding shall be completed and all grease, paint, varnish, oil and welding slag shall be completely removed.

All protuberances which could affect the life of galvanizing shall also be removed. To avoid the formation of white rust all galvanized material shall be packaged in such a way to ensure adequate ventilation between parts during shipping and storage.

Testing of galvanizing shall be performed for Uniformity of thickness as per IS 2633/1986, Mass of coating as per IS 6745/1972 and quantity of zinc, water quenching & centriguging as per IS 2629/1985.

4.00 Hardware:

MS Nuts, bolts and washers (Galvanized) – 16 mm dia nuts, bolts & washers shall be used for tying of overhead structure items like cross arms, top clamps, brackets, clamps, bracing, strain plates etc.

While erecting, proper dimensions of nut-bolts and washers must be ensured. 2 to 3 threads only be visible of the bolt after full tightening of nut on requisite torque. The hardware shall be hot dip galvanized. The minimum coating of the zinc shall comply with IS: 2629 and IS: 2633. Galvanizing shall be checked and tested in accordance with IS: 2633. Before shifting them to site for erection, they shall be offered for inspection and approval by Project Manager.

5.00 Stay Set:

Galvanized Stay Set with 50x8 mm stay clamp, guy insulator (2Nos.), anchor plate (200x200x6mm) , nut-bolts, 2 Nos turn-buckles, 1.8 m long, 16 mm diameter solid GS stay rod & 7/3.15 mm dia GI stranded wire complete.

Stay set shall be used at all sub-station location to nullify the tension of conductor/cable/transformer on the supports. 0.2 cmt cement concreting in mixture 1 part cement, 3 part coarse sand and 6 part 40mm size aggregate stone chips (1:3:6) shall be provided in the foundation of the stay set. 2 Nos. guy insulator shall be provided in 7/3.15 mm dia stranded GI wire at middle locations between two turn buckles.

6.00 Distribution Transformer:

Following type and sizes of Energy efficiency Level 1 rated DT as per IS 1980 (Part-1) 2014 with Amendments 1, 2, 3, & 4. , distribution transformers are standardized in the project for augmentation

a) 5/6 KVA 1 phase Aluminium / Copper wound DTR
b) 10 KVA 1 phase / 3 phase Aluminium / Copper wound DTR
c) 16 KVA 1 phase / 3 phase Aluminium / Copper wound DTR
d) 25 KVA 1 phase / 3 phase Aluminium / Copper wound DTR
e) 63 KVA 3 phase Aluminium / Copper wound DTR
f) 100 KVA 3 phase Aluminium / Copper wound DTR
g) 200 KVA 3 phase Aluminium / Copper wound DTR
h) 250 KVA 3 phase Aluminium / Copper wound DTR
i) 315 KVA 3 phase Aluminium / copper wound DTR

Or any other rating as per latest Indian Standard Specification

The Distribution Transformers shall be 11/0.4 KV or 11KV/230 V or 22/.44 KV non-sealed typedouble wound, three phase, CRGO or amorphous core type having energy efficiency level 1 as specified in latest IS:1980 (Part-1) 2014 with Amendments 1,2 3 &4.

Distribution Transformers shall be subject to inspection during manufacturing (stage inspection), pre-delivery inspection, and inspection at site during pre-erection/post erection/post commissioning conditions. Project Manager shall select samples from the core laminations and get the same tested in CPRI/ NABL Accredited laboratory to prove the quality of the core material.

The new distribution transformers shall be supplied with transformer oil filled up-to maximum permissible level and breather with silica gel.

The distribution transformers must have been successfully type tested within five years from date of Letter of Intent and the designs should have been in satisfactory operation for a period not less than two years as on the date of bid opening. Compliance shall be demonstrated by submitting, (i) authenticated copies of the type test reports and (ii) performance certificates from the users, specifically from Central Govt./State Govt. or their undertakings.

The losses in Distribution Transformer should be as per **Energy Efficiency Level 1 as specified in IS 1180 (Part-1):2014 and amendment 1,2,3 &4** for all kVA ratings of distribution transformers

Bimetallic connectors of suitable capacities are to be provided on LT side and on HT side of the transformer.

T-Clamps should be provided on each jumper on bus bars. Line jumpers should be provided with adequate size of PG Clamps (Two numbers PG Clamps at each end of jumper). Clamp should be made of aluminum grade T-1F as per IS-8309 having good electrical quality aluminum material and should not be brittle in nature.
Transformers should be tested for pre-commissioning checks which includes Insulation Resistance Test, ratio test and oil breakdown voltage test. Before formal energisation, oil leakages from the parts of the transformer, oil level in conservator tank, condition of silica gel, earth connection (two separate) between neutral and earthing, proper jointing of earth wires/flats at the joints and earth resistance of the individual earthing pits are to be checked and recorded. On commissioning of the transformer, phase current and phase to phase voltage, phase to neutral voltage are to be recorded. The loading on the transformers should be balanced. The quantum of neutral current flowing through neutral shall be recorded. A record of pre-commissioning checks/tests are to be prepared and submitted to the Project Manager.

7.00 ACSR / AAAC Conductor:

ACSR raccoon conductor (or equivalent AAAC conductor) is to be used for connection between overhead lines to transformer studs/bushing.

8.00 Distribution box / SMC Distribution Box and Power Cabling:

Distribution Box/SMC Distribution Boxes are to be installed as per specifications enclosed. The boxes are to be erected, electrically connected with the existing system, properly earthed, and labeled. The test report of pre-commissioning checks should be prepared and submitted.

All CT terminals are to be ring type and other terminals are fork type. 2.5 sqmm copper multi stands wiring 1.1 KV grade, ISI marked, IS 694 shall be used for control wiring. A terminal block be provided between CT and Meter keeping 20% spare terminals.

The Distribution Box/SMC Distribution Boxes are to be earthed using 8 SWG GI wire direct connection to the earthing. 2 Nos Earthing bolts on the distribution boards should be provided of 10mm dia.

The single core power cables should be terminated with proper size lugs and gland. Necessary tagging, identification of cores and dressing of cables with nylon cable ties shall be in the scope of work. The unutilized holes in the DBs provided for cable entry needs to be plugged properly in a manner that it must stop access to reptiles, dust and water ingress.

The Low Tension bus bars are to be painted with two or more coats of brush-able epoxy compound suitable to insulate the bus bars for 415 volts exposure.

The Distribution Box/SMC Distribution Box 16 KVA should also house three phase tri-vector energy meter / single phase meter depending on capacity and type of distribution transformer as per specifications.

For higher capacity transformers where CT operated meters are to be installed, separate LTCT cum Meter Box at eye height shall be installed for housing of meter, CTs, terminal block and wiring.

The single core un-armored power cables shall be used for connection from Distribution Transformer to Distribution Box and Distribution Box to Outgoing LT lines. Cable should not be used in underground laying arrangement. Cables should be dressed & tied properly using clamps

/cable ties at 1 meter intervals and tied with substation structure/poles. At-least one meter cable is to be kept as spare at the individual ends.

Following arrangements shall be made for LT Distribution Transformers and LT Cables:

No	**Type of DTR**	**Incomer**		**Outgoing**	**Cable**	
		MCB/Isolator	***HRC fuse***	***MCCB***	***1***	***2***
1	5/6/10 KVA 1 Ph	45A SPN MCCB		2x32A SP MCCB	1Cx16 sqmm UA	
2	16 KVA 1 Ph	80A SPN MCCB		2x50A SP MCCB	1Cx16 sqmm UA	
3	16 KVA 3 Ph	25A TPN MCCB		6x16A SP MCCB	1Cx16 sqmm UA	
4	25 KVA 1 Ph	40A SPN MCCB		3x25A SP MCCB	1Cx35 sqmm UA	
5	25 KVA 3 Ph	40A TPN MCCB		6x25A SP MCCB	1Cx35 sqmm UA	
6	63 KVA 3 Ph	200A TPN Isolator	100 A	6x60A SP MCCB	1Cx50/70 sqmm UA	1Cx70 sqmm UA
7	100 KVA 3 Ph	200A TPN Isolator	160 A	6x90A SP MCCB	1Cx50/70 sqmm UA	1Cx150 sqmm UA
8	200 KVA 3 Ph	600A TPN Isolator	315 A	9x120A SP MCCB	1Cx150 sqmm UA	1Cx300 sqmm UA
9	315 KVA 3 Ph	600A TPN Isolator	500 A	12X120A SP MCCB	1CX150 sqmm UA	1CX300 sqmm UA

1.1 KV XLPE Aluminum Conductor, Stranded, un-armored cable be used for connection of transformer LV bushing to Distribution Box/SMC Distribution Box and Distribution Box/SMC Distribution Box to overhead line.

9.00 Earthing:

Distribution Transformer Earthing shall be provided with 3 Nos earthing and making earth mat /risers using 50X6mm GI Flat. Earthing should be provided with GI earth pipe or Chemical Earthing depending of strata of soil in the location. Project Manager shall decide the type of earthing.

25x3mm GI Flat and 8 SWG GI shall be used for making earthing connection to various sub-station equipment as per given details. GI Flat and GI wire shall be properly dressed, bunched

and clamped with the support at 2 feet intervals. An overlapping of 35mm shall be used at the place of flat to flat joint. Two sets of GI nuts, bolts and washers shall be used for flat-to-flat joints. GI nuts, bolts and washers must be used for GI Flat–to-GI wire & GI wire-to-GI wire joints.

Substation wise measurement of earth resistance of earth pits / mesh and corresponding drawing of existing earthing arrangement shall be recorded and submitted to Project Manager.

Description of equipment	Earth connection
Earthing pits	3 Nos. Earth Pipe 3 m long, 40 mm dia or Chemical Earthing
Earth mat and riser	50X6 mm GI Flat / 8 SWG GI wire
Laying of earth mat	Below ground 0.5 meter

Standard requirements of earthing shall be as under:

a) Earth Pit – 1 for Transformer Neutral,
b) Earth pit - 2 for Lightening Arrester,
c) Earth pit – 3 for Equipment body earthing.

Following arrangement is envisaged for various equipment of distribution transformer substation:

a) Transformer Neutral (Two distinct connections) : GS Flat 25X3mm
b) Transformer Body : GS Flat 25X3mm
c) Lightning Arrester : GS Flat 25X3mm
d) Fencing (Wherever required) : GI wire 8 SWG
e) LT Distribution Box (Two distinct connections) : GI wire 8 SWG
f) AB Switch handle : GI wire 8 SWG
g) Steel structure of substation : GI wire 8 SWG
h) Line meters : GS wire 8 SWG

The location of earth pits should be at-least 3m apart, so that they their earth conductive areas do not overlap. In rocky soil where getting required earth resistance is a challenge, chemical rod earthing shall be used in place of normal GI pipe type earthing. Project Manager shall decide type of earthing pits.

10.00 Insulator and hardware:

11 KV polymer/porcelain Disc/Pin insulator with suitable hardware fittings shall be used. Insulator should be tied properly using binding wire/helical form fitting. Bi-metallic clamps must be used at terminals.

The individual insulator shall be checked for insulation resistance before overhead line installation. Insulator should properly be cleaned before installation. No damage/crack insulator should be used.

11.00 Substation numbering:

Each Substation should be numbered properly labelled using yellow base and black indication marks (number or digits). 40/50 mm height digits/words should be used for this purpose. Base shall be made using 2 or more coats of yellow enamel paint till good surface finish. Base preparation shall be completed before shifting of poles to site for erection. Base painting and marking of digits should be performed by a skilled and trained painter using branded enamel paint, Project Manager shall approve type and brand of enamel paint.

12.00 Anti-climbing device:

3.5 kgs, 2.5mm dia (12 SWG) galvanized barbed wire shall be used on each sub-station support. Galvanized barbed wire should be properly dressed and crimped at termination. While wrapping the wire on support, proper tension should be maintained.

13.00 Danger board:

Each support should be provided with a danger board with pole clamps as per approved drawing. Danger board should be in bi-lingual languages (local language and English). Clamp for danger board, nut-bolts and washers shall be painted with two or more coats of red-oxide and aluminium paints respectively till smooth surface before installation.

14.00 Support foundation:

0.5 m^3 Cement concrete in mixture 1 part cement, 3 part coarse sand, 6 part 40 mm size aggregate stone chips (1:3:6) shall be used in PCC Pole, steel tubular poles, WPB Poles and H-Beam support foundation.

While erecting supports (poles), shuttering must be used for concreting so that proper quantity of cement concrete mixture be used and assessed during inspection. During concreting proper compaction by means of mobile vibrator be provided. While starting work of support erection, gang wise shuttering and mobile vibrator shall be offered for inspection to Project Manager. While erecting support, mercury level gauge must be used to ensure vertical erection of support.

250mm dia X 12" inch size muffing shall be provided on steel tubular, WPB poles and H-Beam poles to prevent direct entry of rain water along the poles. Cement Concrete of 1:2:4 (1 part

Cement, 2 parts coarse sand and 4 parts 20mm aggregate stones chips) shall be used for individual poles.

Steel plate shall be used in steel tubular poles and WPB poles and cement concrete reinforced plate shall be used as base plate for PCC poles.

15.00 11 KV AB Switch:

11 kV, 3-ph, 200 A, 3 Pin type, Horizontal/Vertical Mounting type, Gang Operated, AB Switch shall be installed on 100 KVA and more capacity distribution transformer substation only. B Class GI pipe shall be used (without any joints) for operation of switch. AB Switch structure and handle must be earthed using 8 SWG GI wire.

16.00 11 KV Drop Out Fuses:

11 kV, 3-ph, Drop Out fuse units (set of 3 units) along with Support Insulators, Base Channel, fuse barrel etc. shall be used for all capacity Distribution Transformer Substations. DO Fuse structure shall be earthed using 8 SWG GI wire.

17.00 Lighting Arrester:

Distribution Class LAs on each phase shall be provided in the sub-station with base steel structure, terminals bi – metallic connectors / PG clamps and earth connectors. LAs are to be connected with separate earth connection. 25x3 mm GI flat shall be used for earth connection.

5. Renovation/Augmentation of LT line

1.00 Conversion of LT line using additional supports with all fittings matching with length and type of existing support is envisaged on following type of supports:

a) 8 meter long /200 KG PSC Poles (PSC Pole as per state practice)
b) 10 meter long /270 KG PSC Poles (PSC Pole as per state practice)
c) 13 m long H-Beam 150x150 mm 34.6 kg/m
d) 9 m long H-Beam 116x100 mm 23 kg/m
e) 11 m long H-Beam 116x100 mm 23 kg/m

2.00 Conversion of existing LT line of bare conductor with following type of new ABC cable LT line as required are envisaged under this work-

2.01	1X16 (Ph) + 1X25 (bare messenger cum neutral) SQ. MM.
2.02	1X16 (Ph) + 1X25 (bare messenger cum neutral) + 1x16 (insulated Street lighting)SQ. MM.
2.03	3X16(Ph)+1X25 (bare messenger cum neutral) SQ. MM.
2.04	3 X 16(Ph) +1x25 (bare messenger cum neutral) + 1x16 (insulated Street lighting) SQ. MM.
2.05	1X25(Ph)+1x25 (bare messenger cum neutral) SQ. MM.
2.06	1X25(Ph) + 1X25 (bare messenger cum neutral) + 1x16 (insulated Street lighting) SQ. MM.
2.07	3X25(Ph)+1X25 (bare messenger cum neutral) SQ. MM.
2.08	3 X 25(Ph) +1x25 (bare messenger cum neutral) + 1x16 (insulated Street lighting) SQ. MM.
2.09	1X35(Ph)+1X25 (bare messenger cum neutral) SQ. MM.
2.10	1x35(Ph) + 1X25 (bare messenger cum neutral) + 1x16 (insulated Street lighting) SQ. MM.
2.11	3X35(Ph)+1X25 (bare messenger cum neutral) SQ. MM.
2.12	3X35 (Ph) + 1x25 (bare messenger cum neutral)+ 1x16 (insulated Street lighting) SQ. MM.
2.13	3X50(Ph)+1X35 (bare messenger cum neutral) SQ. MM.
2.14	3X50 (Ph)+1x35 (bare messenger cum neutral) +1x16 (insulated Street lighting) SQ. MM.
2.15	3X95(Ph)+1X70 (bare messenger cum neutral) SQ. MM.
2.16	3X95(Ph)+1X70 (bare messenger cum neutral) +1x16 (insulated Street lighting) SQ. MM.

3.00 While executing this work, mid span pole with all fittings may be provided matching with existing poles of the line or wherever the sag is high and need so arise.

4.00 Following works shall also be executed by contractor under this head –

a) Straightening of tilted supports by providing additional foundation or by providing boulders etc as required.
b) Revamping of pole earthings and replacement of GI earth wire.
c) Labelling, providing danger board, providing anti climbing device and painting of all the poles shall be in the scope of work
d) Providing of stay set wherever required
e) Removal of old bare conductor and depositing in Employer's store

Item-wise scope of works of LT line is detailed out under scope of new LT line. It shall be utilized on item to item requirement under renovation/augmentation of LT line also.

13.8. High voltage distribution system (HVDS)

1.00 HVDS system shall be used in following three situations:

a. To provide LT power supply to remote/farthest locations particularly in hilly areas or farthest location in newly developed plain areas. In this case entire work of erecting 11 kV lines, providing Distribution Transformers shall be executed. While executing HVDS scheme, extreme care to be taken to estimate loading on distribution transformer as capacity of distribution transformer shall be between 10 KVA to 25 KVA.

b. In areas where length of LT line is more than 300 meters causing line losses and in theft prone areas where unauthorized hooking is observed, HVDS is recommended. Existing LT line supports shall be used for erection of 11 kV lines.

c. To provide dedicated distribution transformer at location of agriculture pump (for maximum two pumps) connections by either extending 11kV new line or by converting existing LT lines to 11 kV line.

2.00 Survey of 11 kV line:

Mapping of route of proposed new HVDS system or conversion of LT line to 11 kV line by foot survey in rural/urban areas be performed mentioning various milestones. While surveying, existing electrical infrastructure in the locality should also be mapped. Line alignment (single line diagram) on political map with fair correctness, be prepared. SLD and foot survey report shall be approved by Project Manager and shall be used as basic document for assessment of works under the contract. On completion of line work, as built Single Line Diagram and pole wise line diagram showing pole wise materials used and pole-to-pole span should be submitted to Project Manager. This details shall be used as reference documents by Quality Inspecting officials to execute inspection works.

3.00 Survey of Distribution Transformer Substations:

A detailed survey of existing habitation shall be performed in presentable document showing population residing in the un-electrified area/existing electrified area of habitation, best location of installation of a new distribution transformer substation and the capacity of transformers to be selected for installation. The capacity of DTR shall be governed by following technical aspects:

a) Optimistic lengths of service lines needed to feed the beneficiaries,
b) Space available for installation of support/transformers,

c) Probable load expected to come on the transformer due to existing BPL beneficiaries /others connected /un-connected probable beneficiaries in the locality taking care of their expected load growth in next 5 years.
d) Distribution Transformers of capacity 16 KVA to 25 KVA (single phase as well as three phase as per detailed given) shall be installed on double pole structures. Hence, three phase 11 KV lines shall be laid for 16 KVA to 25 KVA (single phase as well as three phase) capacity sub-stations. Single phase 11 KV lines (2-wire) shall only be permitted for 10 KVA single phase transformers mounted on single pole structure. However, V-cross arms and top clamp shall be used on each line support so that whenever needed, this 2-wire line may be converted to 3-phase 11 kV line by erecting an additional conductor.
e) Double pole support steel structures for 16 KVA and 25 KVA distribution transformers shall be designed in such a way that they can be augmented to 63 KVA transformer structures without any addition in near future on technical requirements.
f) Single phase 10 KVA distribution transformer shall be installed on single pole structure.

Based on survey report, Project Manager shall decide type, capacity and location of Distribution Transformer sub-station.

4.00 Existing LT infrastructure:

Existing LT lines' conductor and fittings shall be dismantled. Tilted supports, if any, shall be straightened. Poles erected in water logging areas or loose soil areas shall be provided with cement concrete foundation.

5.00 Mid span support:

Requirement of mid span pole with all fittings, to suit 11 kV line conductor shall be examined during survey. Project Manager shall approve requirement of mid span poles and extra concreting on existing poles.

While deciding mid span poles, project manager shall decide type and length of poles matching with existing supports available in the field. Stay set wherever required in existing line to be converted may be provided.

6.00 Support for conversion of existing LT line into 11 KV overhead line and for new 11 kV line:

i. 8 meter long /200 KG PSC Poles (PSC Pole as per state practice)
ii. 10 meter long /270 KG PSC Poles (PSC Pole as per state practice)
iii. 13 m long H-Beam 150x150 mm 34.6 kg/m

i. 9 m long H-Beam 116x100 mm 23 kg/m
ii. 11 m long H-Beam 116x100 mm 23 kg/m of similar length as per existing support in LT line. This will improve mechanical strength of 11 KV line. And also facilitate line to line crossing clearance.

Steel plate shall be used in steel tubular poles and cement concrete reinforced plate shall be used as base plate for PCC poles.

7.00 Fabricated steel items:

Fabricated steel items like DC cross arm (100x50x6 mm), back clamps (65x8 mm), pole clamp (65x8 mm), DO mounting channel (100x50x6 mm), transformer mounting channel (100x50x6 mm), transformer clamping set (50x50x6 mm), transformer belting set (50x50x6 mm), V cross arm, top clamp, DC cross arm, bracket, clamps, cross bracings, bracings, strain plate, guarding channels, back clamp, transformer mounting structure etc shall be made of MS Channels, MS angle, MS flats as per approved drawings.

While fabricating, good quality electric cutting tools and drill machine shall be used to ensure no sharp edges and perfect holes as per approved drawings. Gas cutting set should not be used for fabrication of MS steel items. Weld material shall be distributed equally between the two materials that were joined. The weld shall be free of waste materials such as slag. The weld surface should not have any irregularities or any porous holes (called porosity). The joint shall be tight. Most welds need to demonstrate the required strength. One way to ensure proper strength is to start with a filler metal and electrode rating that is higher than your strength requirement.

The fabricated steel structures materials shall be hot-dip galvanized thoroughly internally and externally according to IS: 2629 and IS: 2633 (with latest amendments). Galvanizing shall be checked and tested in accordance with IS: 2633.

Fabricated steel structure items shall be galvanized both inside and out. The zinc coating shall be smooth, continuous and uniform. It shall be free from acid spots and shall not scale, blister or be removable by handling or packing. There shall be no impurities in the zinc or additives to the smelter bath that could have a detrimental effect on the durability of the zinc coating. Before pickling, all welding, drilling, cutting and grinding shall be completed and all grease, paint, varnish, oil and welding slag shall be completely removed.

All protuberances which could affect the life of galvanizing shall also be removed. To avoid the formation of white rust all galvanized material shall be packaged in such a way to ensure adequate ventilation between parts during shipping and storage.

Testing of galvanizing shall be performed for Uniformity of thickness as per IS 2633/1986, Mass of coating as per IS 6745/1972 and quantity of zinc, water quenching & centriguging as per IS 2629/1985.

8.00 Hardware:

MS Nuts, bolts and washers (Galvanized) – 16 mm dia nuts, bolts & washers shall be used for tying of overhead structure items like cross arms, top clamps, brackets, clamps, bracing, strain plates etc.

While erecting, proper dimensions of nut-bolts and washers must be ensured. 2 to 3 threads only be visible of the bolt after full tightening of nut on requisite torque. The hardware shall be hot dip galvanized. The minimum coating of the zinc shall comply with IS: 2629 and IS: 2633. Galvanizing shall be checked and tested in accordance with IS: 2633. Before shifting them to site for erection, they shall be offered for inspection and approval by Project Manager.

9.00 Stay Set:

Galvanized Stay Set with 50x8 mm stay clamp, guy insulator (1No.), anchor plate (200x200x6mm) , nut-bolts, 2 Nos turn-buckles, 1.8 m long, 16 mm diameter solid GS stay rod & 7/3.15 mm dia GI stranded wire complete.

Stay set shall be used at all sub-station location to nullify the tension of conductor/cable/transformer on the supports. 0.2 cmt cement concreting in mixture 1 part cement, 3 part coarse sand and 6 part 40mm size aggregate stone chips (1:3:6) shall be provided in the foundation of the stay set. 2 Nos. guy insulator shall be provided in 7/3.15 mm dia stranded GI wire at middle locations between two turn buckles. Erection of storm guys at suitable location in straight line may also be provided.

10.00 Distribution Transformer:

Following type and sizes of minimum level 1 {as per Bureau of Energy Efficiency (BEE)}, distribution transformers with all accessories are standardized in the project under HVDS:

a) 5/6 KVA 1 phase Aluminum / Copper wound DTR
b) 10 KVA 1 phase / 3 phase Aluminum / Copper wound DTR
c) 16 KVA 1 phase / 3 phase Aluminum / Copper wound DTR

d) 25 KVA 1 phase / 3 phase Aluminum / Copper wound DTR
e) 63 KVA 3 phase Aluminum / Copper wound DTR
f) 100 KVA 3 phase Aluminum / Copper wound DTR
g) 200 KVA 3 phase Aluminum / Copper wound DTR
h) 250 KVA 3 phase Aluminum / Copper wound DTR
i) 315 KVA 3 phase Aluminum / copper wound DTR
Or any other rating as per latest Indian Standard Specification

3ph/1ph Distribution Transformers shall be 11/0.4 KV or 11KV/230 V or 22/0.44 KV non-sealed type, double wound, three phase, CRGO or amorphous core type having energy efficiency level 1 as specified in latest IS:1980 (Part-1) 2014 with Amendments 1,2 3 &4.

Distribution Transformers shall be subject to inspection during manufacturing (stage inspection), pre-delivery inspection, and inspection at site during pre-erection/post erection/post commissioning conditions. Project Manager shall select samples from the core laminations and get the same tested in NABL Accredited laboratory to prove the quality of the core material at any time during pre-dispatch instruction/inspection at site etc.

The distribution transformers shall be supplied with transformer oil filled up-to maximum permissible level and all accessories viz. breather with silica gel etc.

The distribution transformers must have been successfully type tested within five years from date of Letter of Intent and the designs should have been in satisfactory operation for a period not less than two years as on the date of bid opening. Compliance shall be demonstrated by submitting, (i) authenticated copies of the type test reports and (ii) performance certificates from the users, specifically from Central Govt./State Govt. or their undertakings.

The losses in Distribution Transformer should be as per **Energy Efficiency Level 1 as specified in IS 1180 (Part-1):2014 and amendment 1,2,3 &4** for all kVA ratings of distribution transformers
Bimetallic clamps of suitable capacities and size are to be provided on LT side and on HT side of the transformer.

T-Clamps should be provided on each jumper on bus bars. Line jumpers should be provided with adequate size of PG Clamps (Two numbers PG Clamps at each end of jumper). Clamp should be made of aluminum grade T-1F as per IS-8309 having good electrical quality aluminum material and should not be brittle in nature.

Transformers should be tested for pre-commissioning checks which includes Insulation Resistance Test, ratio test and oil breakdown voltage test. Before formal energization, oil leakages from the parts of the transformer, oil level in conservator tank, condition of silica gel, earth connection (two separate) between neutral and earthing, proper jointing of earth wires/flats at the joints and earth resistance of the individual earthing pits are to be checked and recorded. On commissioning of the transformer, phase current and phase to phase voltage, phase to neutral voltage are to be recorded. The loading on the transformers should be balanced. The quantum of neutral current flowing through neutral shall be recorded. A record of pre-commissioning checks/tests are to be prepared and submitted to the Project Manager.

11.00 ACSR / AAAC Conductor:

ACSR raccoon is to be used for connection between overhead lines to transformer studs/bushing. All road crossings and line crossings shall be guarded as per specifications. Conductor joint should not be provided in mid span length. Instead, it should be nearer to the support. ACSR raccoon conductor (or equivalent AAAC Conductor) is to be used for connection between overhead lines to transformer studs/bushing upto 100 KVA ratings. For transformers having ratings more then 100KVA, higher size of conductors matching with its current carrying rating be used.

12.00 11 KV AB Switch:

11 kV, 3-ph, 600 A, 3 Pin type, Vertical/Horizontal Mounting type, Gang Operated, AB Switch shall be installed at cut points and at suitable locations as per instructions of Project Manager. B Class GI pipe shall be used (without any joints) for operation of switch. AB Switch structure and handle must be earthed using 8 SWG GI wire.

13.00 Distribution Box/SMC Distribution Box and Power Cabling:

Distribution Box/SMC Distribution Boxes are to be installed as per specifications enclosed. The boxes are to be erected, electrically connected with the existing system, properly earthed, and labeled. The test report of pre-commissioning checks should be prepared and submitted.

The Distribution Box/SMC Distribution Boxes are to be earthed using 8 SWG GI wire direct connection to the earthing. 2 Nos Earthing bolts on the Distribution Box/SMC Distribution Box should be provided of 10mm dia.

The single core power cables should be terminated with proper size lugs and gland. Necessary tagging, identification of cores and dressing of cables with nylon cable ties shall be in the scope of work. The unutilized holes in the DBs provided for cable entry needs to be plugged properly in a manner that it must stop access to reptiles, dust and water ingress.

The Low Tension bus bars are to be painted with two or more coats of brush-able epoxy compound suitable to insulate the bus bars for 415 volts exposure.

The Distribution Box/SMC Distribution Box should also house three phase tri-vector energy meter / single phase meter depending on capacity and type of distribution transformer as per specifications.

The single core un-armored power cables shall be used for connection from Distribution Transformer to Distribution Box/SMC Distribution Box and Distribution Box/SMC Distribution Box to Outgoing LT lines. Cable should not be used in underground laying arrangement. Cables should be dressed & tied properly using clamps /cable ties at 1 meter intervals and tied with substation structure/poles. At-least one meter cable is to be kept as spare at the individual ends.

Following arrangements shall be made for LT Distribution Transformers and LT Cables:

No	**Type of DTR**	**Incomer**		**Outgoing**	**Cable**	
		MCB/Isolator	***HRC fuse***	***MCCB***	***1***	***2***
1	5/6/10 KVA 1 Ph	45A SPN MCCB		2x32A SP MCCB	1Cx16 sqmm UA	
2	16 KVA 1 Ph	80A SPN MCCB		2x50A SP MCCB	1Cx16 sqmm UA	
3	16 KVA 3 Ph	25A TPN MCCB		6x16A SP MCCB	1Cx16 sqmm UA	
4	25 KVA 1 Ph	40A SPN MCCB		3x25A SP MCCB	1Cx35 sqmm UA	
5	25 KVA 3 Ph	40A TPN MCCB		6x25A SP MCCB	1Cx35 sqmm UA	
6	63 KVA 3 Ph	200A TPN Isolator	100 A	6x60A SP MCCB	1Cx50/70 sqmm UA	1Cx70 sqmm UA
7	100 KVA 3 Ph	200A TPN Isolator	160 A	6x90A SP MCCB	1Cx50/70 sqmm UA	1Cx150 sqmm UA
8	200 KVA 3 Ph	600A TPN Isolator	315 A	9x120A SP MCCB	1Cx150 sqmm UA	1Cx300 sqmm UA
9	315 KVA 3	600A TPN	500 A	12X120A SP	1CX150	1CX300

No	Type of DTR	Incomer		Outgoing	Cable	
		MCB/Isolator	***HRC fuse***	***MCCB***	***1***	***2***
	Ph	Isolator		MCCB	sqmm UA	sqmm UA

1.1 KV XLPE Aluminum Conductor, Stranded, un-armored cable be used for connection of transformer LV bushing to Distribution Box/SMC Distribution Box and Distribution Box/SMC Distribution Box to overhead line.

14.00 Earthing:

Distribution Transformer Earthing shall be provided with 3 Nos earthing and making earth mat /risers using 50X6mm GI Flat. Earthing should be provided with GI earth pipe or Chemical Earthing depending of strata of soil in the location. Project Manager shall decide the type of earthing.

25x3mm GI Flat and 8 SWG GI wire shall be used for making earthing connection to various sub-station equipment as per given details. GI Flat and GI wire shall be properly dressed, bunched and clamped with the support at 2 feet intervals. An overlapping of 35mm shall be used at the place of flat to flat joint. Two sets of GI nuts, bolts and washers shall be used for flat-to-flat joints. GI nuts, bolts and washers must be used for GI Flat–to-GI wire & GI wire-to-GI wire joints.

Substation wise measurement of earth resistance of earth pits / mesh and corresponding drawing of existing earthing arrangement shall be recorded and submitted to Project Manager.

Description of equipment	Earth connection
Earthing pits	3 Nos. Earth Pipe 3 m long, 40 mm dia or Chemical Earthing
Earth mat and riser	50X6 mm GI Flat / 8 SWG GI wire
Laying of earth mat	Below ground 0.5 meter

Standard requirements of earthing shall be as under:

a) Earth Pit – 1 for Transformer Neutral,
b) Earth pit - 2 for Lightening Arrester,
c) Earth pit – 3 for Equipment body earthing.

Following arrangement is envisaged for various equipment of distribution transformer substation:

a) Transformer Neutral (Two distinct connections) : GS Flat 25X3mm

b) Transformer Body : GS Flat 25X3mm
c) Lightning Arrester : GS Flat 25X3mm
d) Fencing (Wherever required) : GI wire 8 SWG
e) LT Distribution-cum-meter Box (Two distinct connections) : GI wire 8 SWG
f) Steel structure of substation : GI wire 8 SWG

The location of earth pits should be at-least 3m apart, so that they their earth conductive areas do not overlap. In rocky soil where getting required earth resistance is a challenge, chemical rod earthing shall be used in place of normal GI pipe type earthing. Project Manager shall decide type of earthing pits.

15.00 Insulator and hardware –

11 KV polymer/porcelain Disc/Pin insulator with suitable hardware fittings shall be used. Insulator should be tied properly using binding wire/helical form fitting. Bi-metallic clamps must be used at terminals.

The individual insulator shall be checked for insulation resistance before overhead line installation. Insulator should properly be cleaned before installation. No damage/crack insulator should be used.

16.00 Substation numbering:

Each Substation should be numbered properly labelled using yellow base and black indication marks (number or digits). 40/50 mm height digits/words should be used for this purpose. Base shall be made using 2 or more coats of yellow enamel paint till good surface finish. Base preparation shall be completed before shifting of poles to site for erection. Base painting and marking of digits should be performed by a skilled and trained painter using branded enamel paint, Project Manager shall approve type and brand of enamel paint.

17.00 Anti-climbing device:

3.5 kgs, 2.5mm dia (12 SWG) galvanized barbed wire shall be used on each sub-station support. Galvanized barbed wire should be properly dressed and crimped at termination. While wrapping the wire on support, proper tension should be maintained.

18.00 Danger board:

Each support should be provided with a danger board with pole clamps as per approved drawing. Danger board should be in bi-lingual languages (local language and English).

Clamp for danger board, nut-bolts and washers shall be painted with two or more coats of red-oxide and aluminum paints respectively till smooth surface before installation.

19.00 Support foundation:

0.5 m^3 Cement concrete in mixture 1 part cement, 3 part coarse sand, 6 part 40 mm size aggregate stone chips (1:3:6) shall be used in PCC Pole, steel tubular poles and H-Beam support foundation.

While erecting supports (poles), shuttering must be used for concreting so that proper quantity of cement concrete mixture be used and assessed during inspection. During concreting proper compaction by means of mobile vibrator be provided. While starting work of support erection, gang wise shutting and mobile vibrator shall be offered for inspection to Project Manager. While erecting support, mercury level gauge must be used to ensure vertical erection of support.

250mm dia X 12" inch size muffing shall be provided on steel tubular and H-Beam poles to prevent direct entry of rain water along the poles. Cement Concrete of 1:2:4 (1 part Cement, 2 parts coarse sand and 4 parts 20mm aggregate stones chips) shall be used for individual poles.

Steel plate shall be used in steel tubular poles and cement concrete reinforced plate shall be used as base plate for PCC poles.

20.00 11 KV Drop Out Fuses:

11 kV, 3-ph, Drop Out fuse units (set of 3 units) along with Support Insulators, Base Channel, fuse barrel etc. shall be used for all capacity Distribution Transformer Substations. DO Fuse structure shall be earthed using 8 SWG GI wire.

21.00 Lighting Arrester:

Distribution Class LAs shall be provided in the sub-station with base steel structure, terminals bi – metallic connectors / PG clamps and earth connectors. LAs are to be connected with separate earth connection. 25x3 mm GI flat shall be used for earth connection.

13.9. Civil Works And Soil Investigation

1.00 General

The provisions of this section of specification shall only be applicable to the extent of scope of works indicated in Bid Proposal Sheet (BPS). The intent of specification covers the following:

Design, engineering, and construction of all civil works at power sub-station, 66 kV line, 33 kV line, 11 kV line, DTR substation, LT line, HVDS, augmentation/renovation of system etc. All civil works shall also satisfy the general technical requirements specified in other Sections of this Specification and as detailed below. They shall be designed to the required service conditions/loads as specified elsewhere in this Specification or implied as per National/ International Standards.

All civil works shall be carried out as per applicable Indian Laws, Standards and Codes. All materials shall be of best quality conforming to relevant Indian Standards and Codes.

The Contractor shall furnish all design, drawings, labor, tools, equipment, materials, temporary works, constructional plant and machinery, fuel supply, transportation and all other incidental items not shown or specified but as may be required for complete performance of the Works in accordance with approved drawings, specifications and direction of Employer.

The work shall be carried out according to the design/drawings to be developed by the Contractor and approved by the Project Manager based on Tender Drawings Supplied to the Contractor by the Project Manager and Original Equipment Manufacturer recommendation. For all buildings, structures, foundations etc. necessary layout and details shall be developed by the Contractor keeping in view the functional requirement of the substation facilities and providing enough space and access for operation, use and maintenance based on the input provided by the Project Manager. Certain minimum requirements are indicated in this specification for guidance purposes only.

In case of R&M of existing substations, Contactor shall visit site to ascertain the amount of repair and strengthening of structures and foundations, dismantling and new construction of structures and foundations works are to be done before quoting. Contractor must furnish the design and drawings in support of the activities mentioned above that are to be carried out in the R&M of existing substation site.

The rate quoted by the bidder for all type of civil work shall be firm irrespective of the type of terrain and depth of filling.

This specification covers all the work required for detailed soil investigation and preparation of a detailed report. The work shall include mobilization of necessary equipment, providing necessary engineering supervision and technical personnel, skilled and unskilled labor etc. as required to carry out field investigation as well as, laboratory investigation, analysis and interpretation of data and results, preparation of detailed Geo-technical report including specific recommendations for the type of foundations and the allowable safe bearing capacity for different sizes of foundations at different founding strata for the various structures of the substation. The Contractor shall make his own arrangement for locating the co-ordinates and various test positions in field as per the information supplied to him and also for determining the reduced level of these locations with respect to the benchmark indicated by the Project Manager.

All the work shall be carried out as per latest edition of the corresponding Indian Standard Codes.

a. Geotechnical Investigation

The Contractor shall perform a detailed soil investigation to arrive at sufficiently accurate, general as well as specific information about the soil profile and the necessary soil parameters of the site. So that the foundation of the various structures can be designed and constructed safely and rationally.

A report to the effect will be submitted by the Contractor for Project Manager's specific approval giving details regarding data proposed to be utilized for civil structures design.

The Contractor should visit the site to ascertain the soil parameters before submitting the bid. The topography is uneven steeply sloping at few places requiring cutting and filling operations including slope stability and protection measures (if slopes encountered). Any variation in soil data shall not constitute a valid reason for any additional cost & shall not affect the terms & condition of the Contract. Tests must be conducted under all the critical locations i.e. Control Room Building. Tower locations, transformer etc.

b. Bore Holes

Drilling of bore holes of 150 mm dia. in accordance with the provisions of IS: upto 10 m depth or to refusal which ever occur earlier. (By refusal it shall mean that a standard penetration blow count (N) of 100 is recorded for 30 cm penetration). For a new substation, minimum three (3) bore holes shall be done to find out the geological profile of the area. If any unconformity encountered then more bore holes shall be drilled with the approval of Project Manager for the new projects. However in case deep pile foundations are envisaged the depths have to be regulated as per codal provisions. In

cases where rock is encountered, coring in one borehole per bay shall be carried out to 1.5 M in bedrock and continuous core recovery is achieved.

Performing Standard Penetration Tests at approximately 1.5 m interval in the borehole starting from 1.5 m below ground level onwards and at every change of stratum. The disturbed samples from the standard penetrometer shall also be collected for necessary tests.

Collecting undisturbed samples of 100/75 mm diameter 450 mm long from the boreholes at intervals of 2.5 m and every change of stratum starting from 1.0 m below ground level onwards in clayey strata.

The depth of Water table shall be recorded in each borehole.

All samples, both disturbed and undisturbed, shall be identified properly with the borehole number and depth from which they have been taken.

The sample shall be sealed at both ends of the sampling tubes with wax immediately after the sampling and shall be packed properly and transported to the Contractor's laboratory without any damage or loss.

The logging of the boreholes shall be compiled immediately after the boring is completed and a copy of the bore log shall be handed over to the Project Manager.

c. Electrical Resistivity Test

This test shall be conducted to determine the Electrical resistivity of soil required for designing safe grounding system for the entire station area. The specifications for the equipments and other accessories required for performing electrical resistivity test, the test procedure, and reporting of field observations shall confirm to IS: 3043. The test shall be conducted using Wagner's four electrode method as specified in IS: 1892, Appendix-B2. Unless otherwise specified at each test location, the test shall be conducted along two perpendicular lines parallel to the coordinate axis. On each line a minimum of 8 to 10 readings shall be taken by changing the spacing of the electrodes from an initial small value of 0.5 m upto a distance of 10.0 m.

d. Water Sample

Representative samples of ground water shall be taken when ground water is first encountered before the addition of water to aid drilling of boreholes. The samples shall be of sufficient quantity for chemical analysis to be carried out and shall be stored in airtight containers.

e. Back Filling of Bore Holes

On completion of each hole, the Contractor shall backfill all bore holes as directed by the Project Manager. The backfill material can be the excavated material and shall be compacted properly.

f. Laboratory Test

1. The laboratory tests shall be carried out progressively during the field work after sufficient number of samples have reached the laboratory in order that the test results of the initial bore holes can be made use of in planning the later stages of the field investigation and quantum of laboratory tests.

2. All samples brought from field, whether disturbed or undisturbed shall be extracted/prepared and examined by competent technical personnel, and the test shall be carried out as per the procedures laid out in the relevant I.S. Codes.

The following laboratory tests shall be carried out

a) Visual and Engineering Classification
b) Liquid limit, plastic limit and shrinkage limit for C-□ soils.
c) Natural moisture content, bulk density and specific gravity.
d) Grain size distribution.
e) Swell pressure and free swell index determination for expensive soil only.
f) Consolidated un-drained test with pore pressure measurement.
g) Chemical tests on soil and water to determine the carbonates, sulphates, nitrates, chlorides, Ph value, and organic matter and any other chemical harmful to the concrete foundation.
h) C.B.R value
    i) Rock quality designation (RQD), RMR in case of rock is encountered

2.00Test Results and Reports

1. The Contractor shall submit the detailed report in two (2) copies wherein information regarding the geological detail of the site, summarized observations and test data, bore logs, and conclusions and recommendations on the type of foundations with supporting calculations for the recommendations. Initially the report shall be submitted by the Contractor in draft form and after the draft report is approved, the final report in two (3) copies shall be submitted. The test data shall bear the signatures of the Investigation Agency, Vendor and also site representative of Employer.

2. The report shall include but not limited to the following:

i. A plan showing the locations of the exploration work i.e. bore holes, dynamic cone penetration tests etc.

ii. Bore Logs: Bore logs of each bore holes clearly identifying the stratification and the type of soil stratum with depth. The values of Standard Penetration Test (SPT) at the depths where the tests were conducted on the samples collected at various depths shall be clearly shown against that particular stratum.

Test results of field and laboratory tests shall be summarized strata wise as well in combined tabular form. All relevant graphs, charts tables, diagrams and photographs, if any, shall be submitted along with report. Sample illustrative reference calculations for settlement, bearing capacity, pile capacity shall be enclosed.

a. Recommendations: The report should contain specific recommendations for the type of foundation for the various structures envisaged at site. The Contractor shall acquaint himself about the type of structures and their functions from the Project Manager. The observations and recommendations shall include but not limited to the following:

i. Geological formation of the area, past observations or historical data, if available, for the area and for the structures in the nearby area, fluctuations of water table etc. Slope stability characteristics and landslide history of the area shall be specifically highlighted. Remedial measures to be adopted shall also be given.

ii. Recommended type of foundations for various structures. If piles are recommended the type, size and capacity of pile and groups of piles shall be given after comparing different types and sizes of piles and pile groups.

iii. Allowable bearing pressure on the soil at various depths for different sizes of the foundations based on shear strength and settlement characteristics of soil with supporting calculations. Minimum factor of safety for calculating net safe bearing capacity shall be taken as 3.0 (three). Recommendation of liquefaction characteristics of soil shall be provided.

iv. Recommendations regarding slope of excavations and dewatering schemes, if required. Required protection measures for slope stability for cut & fill slopes of switchyard and approach road with stone pitching/retaining walls shall be clearly spelt out. Calculation shall also be provided for stability adequacy.

v. Comments on the Chemical nature of soil and ground water with due regard to deleterious effects of the same on concrete and steel and recommendations for protective measures.

vi. If expansive soil is met with, recommendations on removal or retaining the same under the structure, road, drains, etc. shall be given. In the latter case detailed specification of any special treatment required including specification or materials to be used, construction method, equipment to be deployed etc. shall be furnished. Illustrative diagram of a symbolic foundation showing details shall be furnished.

vii. Recommendations for additional investigations beyond the scope of the present work, if considered such investigation as necessary.

3.00 Site Preparation

The Employer shall be responsible for proper leveling of switchyard site as per layout and levels of switchyard finalized during detailed engineering stage. The Employer at his own cost shall make the layout and levels of all structure etc from the general grids of the plot and benchmarks set and approved by the Project Manager. The Contractor shall give all help in instruments, materials and personnel to the Project Manager for checking the detailed layout and shall be solely responsible for the correctness of the layout and levels. Site leveling shall be in the scope of the Employer. Bidder may decide the level of the sites. However, the level shall be such that it is 300 mm higher than the highest flood level (HFL) of the site. If HFL is not available, then nearby road level shall be assumed as HFL.

Whenever for bay extension works the existing substation are to be modified or strengthen, Contractor should keep same as EGL of existing sub-station so that FFL shall be same for both and all the necessary arrangements are to be carried out in this regard by the Contractor.

This clause covers the design and execution of the work for site preparation, such as clearing of the site, the supply and compaction of fill material, slope protection by stone pitching/retaining walls depending on the site location & condition, excavation and compaction of backfill for foundation, road construction, drainage, trenches and final topping by brick soling/stone filling.

1) The Employer shall develop the site area to meet the requirement of the intended purpose. The site preparation shall conform to the requirements of relevant sections of this specification or as per stipulations of standard specifications. Employer shall also carry out necessary protection of slope of switchyard area and approach road.

2) The fill material if required shall be suitable for the above requirement. The fill shall be such material and the site so designed as to prevent the erosion by wind and water of material from its final compacted position or the in-site position of undisturbed soil.

3) Material unsuitable for founding of foundations shall be removed and replaced by suitable fill material and to be approved by the Project Manager.

4) Backfill material around foundations or other works shall be suitable for the purpose for which it is used and compacted to the density described under Compaction. Excavated material not suitable or not required for backfill shall be disposed off in areas as directed by Project Manager upto a maximum lead of 1 km.

a. Excavation and backfill

1. Excavation and backfill for foundations shall be in accordance with the relevant code.

2. Whenever water table is met during the excavation, it shall be dewatered and water table shall be maintained below the bottom of the excavation level during excavation, concreting and backfilling.

3. When embankments are to be constructed on slopes of 15% or greater, benches or steps with horizontal and vertical faces shall be cut in the original slope prior to placement of embankment material. Vertical faces shall measure not more than 1 m in height.

4. Embankments adjacent to abutments, culverts, retaining walls and similar structures shall be constructed by compacting the material in successive uniform horizontal layers not exceeding 20 cm in thickness (of loose material before compaction). Each layer shall be compacted as required by means of mechanical tampers approved by the Project Manager. Rocks larger than 10 cm in any direction shall not be placed in embankment adjacent to structures.

5. Earth embankments of roadways and site areas adjacent to buildings shall be placed in successive uniform horizontal layers not exceeding 20 cm in thickness in loose stage measurement and compacted to the full width specified. The upper surface of the embankment shall be shaped so as to provide complete drainage of surface water at all times.

6. The land required for borrowing earth shall be arranged & selected by Contractor. The identified land shall be got approved by Project Manager. The quoted rates shall include cost of earth, taxes, duties, royalty, compensation for the land identified for borrow earth. The rate shall also be inclusive of all leads, lifts, ascent, descent and testing required for completion of work in all respect.

7. The ground levels for all measurements shall be taken at every 5 meter distance in uniformly sloping ground and at closer distance where pits/undulations are met with. In fairly leveled area,

levels shall be taken at 15 mt. apart at the discretion of Project Manager. The ground levels shall be recorded and plotted on plans. The same shall be recorded by Project Manager before the earth work is started. All labor, material, tool, equipment etc required for the above work shall be arranged by the Employer at his own cost.

b. Compaction

1. The density to which fill materials shall be compacted shall be as per relevant IS and as per direction of Project Manager. All compacted sand filling shall be confined as far as practicable. Backfilled earth shall be compacted to minimum 95% of the Standard Proctor's density at OMC. The sub-grade for the roads and embankment filling shall be compacted to minimum 95% of the Standard Proctor's density at OMC. Cohesion less material sub grade shall be compacted to 70% relative density (minimum).

2. At all times unfinished construction shall have adequate drainage. Upon completion of the road's surface course, adjacent shoulders shall be given a final shaping, true alignment and grade.

3. Each layer of earth embankment when compacted shall be as close to optimum moisture content as practicable. Embankment material, which does not contain sufficient moisture to obtain proper compaction, shall be wetted. If the material contains any excess moisture, then it shall be allowed to dry before rolling. The rolling shall begin at the edges overlapping half the width of the roller each time and progress to the center of the road or towards the building as applicable. Rolling will also be required on rock fills. No compaction shall be carried out in rainy weather.

c. Requirement for fill material under foundation

All foundations shall rest below virgin ground level and the minimum depth of foundation below the virgin ground level shall be at least 500 mm. For small equipment and minor foundations like marshalling kiosk, Switch board stand, earth switch and main box support etc. may be reduced to 300 mm with specific approval of the Project Manager.

4.00 Stone Filling & Antiweed Treatment

The Contractor shall furnish all labor, equipment and materials required for complete performance of the work in accordance with the drawings, specification, and direction of the Project Manager.

Stone filling shall be done in the areas of the switchyard wherever equipment and or structures are to be provided under present scope of work covering entire fencing area.

Prevailing practice of stone filling is to be adopted for the bay extension works of existing substations. Contractor shall verify the existing practice prevailing at site before quoting.

Before taking up stone rolling, antiweed treatment shall be applied in the switchyard area where stone filling is to be done and the area shall be thoroughly de-weeded including removal of the roots. The recommendation of local agriculture/horticulture department shall be sought where ever feasible while choosing the type of chemical to be used. Nevertheless, the effectiveness of chemical shall be demonstrated by the Contractor in a test area of size 10-meter X 10 meter (approx..). The final approval based on the result shall be given by Project Manager. Antiweed treatment shall be procured from reputed manufacturer. The dosage and application of chemical shall be strictly as per the manufacturer's recommendation. The Contractor shall be requested to maintain the area free of weed for a period of one year from the date of application of the first dose of the chemical.

5.00 General Requirement

a. The material required for site surfacing shall be free from all types of organic materials and shall be of standard quality, and as approved by the Project Manager.

The material to be used for stone filling/ site surfacing shall be uncrushed/ crushed/ broken stone of 20 mm nominal size (single sized) conforming to table 2 of IS: 383- 1970. Hardness, flakiness shall be as required for wearing courses are given below.

(a) Sieve analysis limits/Gradation

Sieve size	% passing by weight
40mm	100
20mm	85-100
10mm	0-20
4.75mm	0-5

(b) Hardness
Abrasion value (IS: 2386 part-IV) not more than 40%
Impact value (IS: 2386 part-IV) not more than 30%

(c) Flakiness Index
As per (IS: 2386 part-IV) and maximum value is 25.

b. After all the structures/equipment are erected, the surface of the switchyard area shall be maintained, rolled/compacted to the lines and grades as decided by Project Manager. De-weeding including removal of roots shall be done before rolling is commenced. Project Manager shall decide

final formation level so as to ensure that the site appears uniform. The final formation level shall however be very close to the formation level indicated in the drawing using half-ton roller with suitable water sprinkling arrangement to form a smooth and compact surface.

c. A base layer of uncrushed/crushed/broken stone of 20 mm nominal size (single sized) shall be spread and rolled/compacted by using half ton roller with 4 to 5 passes and water sprinkling to form a minimum 50 mm layer on the finished ground level of the specified switchyard area excluding roads, drains, cable trench and tower and equipment foundations as indicated in the drawing.

d. Over the base layer of site surfacing material, a final surface course of minimum 50 mm thickness of 20 mm nominal size (single sized) broken stone as specified above shall be spread and compacted by light roller using half tones steel roller (width 30" and 24" dia meter) with water sprinkling as directed by the Project Manager. The water shall be sprinkled in such a way that bulking does not take place.

e. In areas that are considered by the Project Manager to be too congested with foundations and structures for proper rolling of the site surfacing material by normal rolling equipment, the material shall be compacted by hand, if necessary. Due care shall be exercised so as not to damage any foundation structures or equipment during rolling compaction.

6.00 Site Drainage

a. Adequate site drainage system shall be provided by the Contractor in new and existing substation. In case of bay extension of existing substation, drainage layout shall be prepared by the Contractor in such a way that it should satisfy the technical parameters stated below while designing the drainage system so that flow of water of the existing part of substation remain uninterrupted and the same should be approved by the Project Manager. The technical parameters stated below also to be taken into account while designing the drainage system for new substation as well.

The Contractor shall obtain rainfall data and design the storm water drainage system, (culverts, ditches, drains etc.) to accommodate run off due to the most intense rainfall that is likely to occur over the catchments area in one hour period on an average of once in ten years. The surface of the site shall be sloped to prevent the ponding of water.

b. The maximum velocity for pipe drains and open drains shall be limited to 2.4m/sec and 1.8m/sec respectively. However, minimum non-silting velocity of 0.6m/sec shall be ensured. Longitudinal bed slope shall not be milder than 1 in 1000.

c. The drains shall be constructed using Brick masonry except at road crossings etc. where RCC pipe shall be used. The RCC pipe for drains and culverts shall be as per IS:456 and IS:783.

d. The Contractor shall ensure that water drains are away from the site area and shall prevent damage to adjacent property by this water. Adequate protection shall be given to site surfaces, roads, ditches, culverts, etc. to prevent erosion of material by water.

e. The drainage system shall be adequate without the use of cable/pipe trenches. (Pipe drains shall be provided in areas of switchyard where movement of crane will be necessary in operating phase of the substation).

f. For pipe drains, concrete pipe of class NP2 shall be used. However, for road crossings etc. higher strength pipe of class NP3 shall be provided. For rail crossings, pipes conforming to railway loading standards or at least NP4 class shall be provided. Manholes shall be provided at every 30m interval, at connection points and at every change of alignment.

g. Open surface drains for new s/s shall be provided with brick masonry in 1:6 (1 cement: 6 coarse sand) cement mortar with 12 mm thick, 1:4 (1 cement: 4 sand) cement plaster inside and exposed surface of drains as per approved drawing. For bay extension at existing substations, prevailing practice of the respective substation shall be adopted.

h. Pipe drains shall be connected through manholes at an interval of max. 30m. Effluents shall be suitably treated by the Contractor to meet all the prevalent statutory requirements and local pollution control norms and treated effluents shall be conveyed to the storm water drainage system at a suitable location for its final disposal.

i. Invert of the drainage system shall be decided in such a way that the water can easily be discharged above the High Flood Level (HFL) outside substation boundary at suitable location upto a maximum 50M beyond boundary wall of substation or actual whichever occurs earlier and approved by Project Manager.

j. All internal site drainage system, including the final connection/disposal to Project Manager acceptance points shall be part of Supplier's scope including all required civil works. The Contractor shall connect his drain(s) at one or more points to outfall points as feasible at site.

k. The drainage scheme and associated drawings shall be got approved and constructed as per enclosed tender drawing.

7.00 Roads and Culverts inside substation premises

a. The main approach road including modification of existing road to meet the site conditions, roads for access to equipment and buildings with in substations (including bay extension in existing substations) are in the scope of the Contractor. Layout of the roads shall be based on General detail

& Arrangement drawing for the substation. If extra road is required for functional point of view, which has not been mentioned in the layout drawing, Contractor should provide the same without extra cost to the Project Manager.

b. All substation roads shall be constructed so as to permit transportation of all heavy equipment. The roads shall have min. 3.0 m wide RCC road as per enclosed tender drawing.

c. Road construction shall be as per IRC standards.

d. Adequate provision shall be made for road drainage. Protection of cut and embankment slopes of roads as per slope stability requirement shall be made.

e. All the culverts and its allied structure (required for road/rail, drain trench crossings etc.) shall be designed for class A loading as per IRC standard / IS code and should be checked for loading.

f. All roads shall be designed for class 'D' of traffic as per IRC-37 Guide-lines for the design of rigid pavements.

8.00 Transformer Foundation

The Contractor shall provide a road system integrated with the transformer foundation to enable installation and the replacement of any failed unit by the spare unit located at the site. This system shall enable the removal of any failed unit from its foundation to the nearest road.

If existing/failed transformer is required to be replaced by new one in augmentation/bay extension works of existing substations then the foundation supporting that equipment shall be strengthen by modifying the foundation itself or the foundation shall be dismantle and recast new foundation as per site conditions. However, Contractor must furnish the design calculation incorporating all those changes so that safety of the structure and foundation remain adequate.

Similarly all types of equipment foundations with /without supporting structures shall be treated in similar manner as stated for transformer foundations.

Contractor must access the amount of work involve for augmentation/bay extension of existing substations while quoting.

9.00 Cable & Pipe Trenches

a. The cable trenches and precast removable RCC cover (with lifting arrangement) shall be constructed using RCC of M20 grade for new substation whereas for bay extension of existing

substation size and material of cable trenches shall be same as the existing one and pre-cast removable RCC cover (with lifting arrangement) shall be constructed using RCC of M20 grade. Cable trenches must be designed for the design criteria stated below, whether it is of concrete or brick for both new substations and bay extension works in existing substations.

b. The cable trench walls shall be designed for the following loads.

(i) Dead load of 100 kg/m length of cable support + 75 Kg on one tier at the end.
(ii) Triangular earth pressure + uniform surcharge pressure of 1T/m2.

c. Cable trench covers shall be designed for self-weight of top slab + concentrated load of 200 kg at center of span on each panel.

d. Cable trench crossing the road/rails shall be designed for class A. Loading of IRC/relevant IS Code and should be checked for transformer loading.

e. Trenches shall be drained. Necessary sumps be constructed and sump pumps if necessary shall be supplied. Cable trenches shall not be used as storm water drains.

f. The top of trenches shall be kept at least 100 mm above the finished ground level for the new substation. The top of cable trench shall be such that the surface rainwater does not enter the trench.
g. The top of trench shall be kept same as existing one to maintain uniformity of the cable trenches structure in case of bay extension works of existing substations.

h. All metal parts inside the trench shall be connected to the earthing system.

i. Cables from trench to equipment shall run in hard conduit pipes.

j. Trench wall shall not foul with the foundation. Suitable clear gap shall be provided.

k. The trench bed shall have a slope of 1/500 along the run & 1/250 perpendicular to the run.

l. Cable trenches shall be blocked at the ends if required with brick masonry in cement sand mortar 1:6 and plaster with 12mm thick 1:6 cement sand mortar.
m. Cable trench contains cable trey that shall be supported on ISA. The size and spacing of angle section shall be as per design criteria mentioned above.

n. Cable trench shall be constructed as per enclosed tender drawing.

10.00 Foundation /RCC Construction

1. Work covered under this Clause of the Specification comprises the design and construction of foundations and other RCC constructions for switchyard structures, equipment supports, trenches, drains, control cubicles, bus supports, transformer, marshalling kiosks, auxiliary equipment & systems, buildings, tanks, boundary wall or for any other equipment or service and any other foundation required to complete the work. This clause is as well applicable to the other RCC constructions.

However, for the augmentation/bay extension works of existing substation, type of RCC structures and foundations etc. shall be similar to one already existing at the existing substation and for which design shall be furnished in support of safety of those RCC structures and foundations etc. Contractor must access the amount of work involved for the construction of switchyard structures, equipment supports, trenches, drains, control cubicles, bus supports, transformer, marshalling kiosks, auxiliary equipment & systems, buildings, tanks, boundary wall or for any other equipment or service and any other foundation required to complete the work for the existing substations.

2. Concrete shall conform to the requirements mentioned in IS: 456 and all the tests shall be conducted as per relevant Indian Standard Codes as mentioned in Standard field quality plan appended with the specification

A minimum grade for PCC and RCC shall be used for all structural/load-bearing members as per latest IS 456.

3. If the site is sloppy, the foundation height will be adjusted to maintain the exact level of the top of structures to compensate such slopes.

4. The switchyard foundation's plinths and building plinths shall be minimum 300mm and 500 mm above finished ground level respectively.

5. Minimum 75mm thick lean concrete shall be provided below all underground structures, foundations, trenches etc. to provide a base for construction.

6. Concrete made with Portland slag cement shall be carefully cured and special importance shall be given during the placing of concrete and removal of shuttering.

7. The design and detailing of foundations shall be done based on the approved soil data and sub-soil conditions as well as for all possible critical loads and the combinations thereof. The Spread footings foundation or pile foundation as may be required based on soil/sub-soil conditions and superimposed loads shall be provided.

8. If pile foundations are adopted, the same shall be cast-in-situ driven/bored or precast or under reamed type as per relevant parts of IS Code 2911. Only RCC piles shall be provided. Suitability of the adopted pile foundations shall be justified by way of full design calculations. Detailed design calculations shall be submitted by the bidder showing complete details of piles/pile groups proposed to be used. Necessary initial load test shall also be carried out by the bidder at their cost to establish the piles design capacity. Only after the design capacity of piles has been established, the Contractor shall take up the job of piling. Routine tests for the piles shall also be conducted. All the work (design & testing) shall be planned in such a way that these shall not cause any delay in project completion.

a. Design

1. Foundations shall be of reinforced cement concrete for new substation but for the augmentation / bay extension works of existing substation it could be of RCC/ PCC depending on type of structures and materials used for the similar type of structures in those bay extension works of existing substation. Design requirement shall be fulfilled by the Contractor and furnished for approval for both new substation and existing substation (for bay extension works) as specified in the scope of work. The design and construction of RCC/ PCC / Masonry structures shall be carried out as per IS: 456 and relevant IS code/CBIP manual/NBC etc and minimum grade of concrete shall be as per relevant IS code. Higher grade of concrete than specified above may be used at the discretion of Contractor without any additional financial implication to the Project Manager.

2. Limit state method of design shall be adopted unless specified otherwise in the specification.

3. For detailing of reinforcement IS: 2502 and SP: 34 shall be followed. Cold twisted deformed bars (Fe=415 N/mm2) conforming to IS: 1786 shall be used as reinforcement. However, in specific areas, mild steel (Grade I) conforming to IS: 432 can also be used. Two layers of reinforcement (on inner and outer face) shall be provided for wall & slab sections having thickness more than 150 mm. Clear cover to reinforcement towards the earth face shall be minimum 40 mm.

4. RCC water retaining structures like storage tanks, etc. shall be designed as un-cracked section in accordance with IS: 3370 (Part I to IV) by working stress method. However, water channels shall be designed as cracked section with limited steel stresses as per IS: 3370 (Part I to IV) by working stress method.

5. The procedure used for the design of the foundations shall be the most critical loading combination of the steel structure and or equipment and/or superstructure and other conditions, which produces the maximum stresses in the foundation or the foundation component and as per the

relevant IS Codes of foundation design. Detailed design calculations shall be submitted by the bidder showing complete details of piles/pile groups or isolated /combined footings proposed to be used.

6. Design shall consider any sub-soil water pressure that may be encountered following relevant standard strictly.

7. Necessary protection to the foundation work, if required shall be provided to take care of any special requirements for aggressive alkaline soil, black cotton soil or any other type of soil which is detrimental/harmful to the concrete/masonry foundations.

8. RCC columns /pedestals shall be provided with rigid connection at the base.

9. All sub-structures shall be checked for sliding and overturning stability during both construction and operating conditions for various combinations of loads. Factors of safety for these cases shall be taken as mentioned in relevant IS Codes or as stipulated elsewhere in the Specifications. For checking against overturning, weight of soil vertically above footing shall be taken and inverted frustum of pyramid of earth on the foundation should not be considered.

10. Earth pressure for all underground structures shall be calculated using co-efficient of earth pressure at rest, co-efficient of active or passive earth pressure (whichever is applicable).

11. In addition to earth pressure and ground water pressure etc., a surcharge load of 1T/Sq.m shall also be considered for the design of all underground structures including channels, sumps, tanks, trenches, substructure of any underground hollow enclosure etc., for the vehicular traffic in the vicinity of the structure.

12. Following conditions shall be considered for the design of water tank in pumps house, channels, sumps, trenches and other underground structures:

i. Full water pressure from inside and no earth pressure & ground water pressure & surcharge pressure from outside (application only to structures, which are liable to be filled up with water or any other liquid).

ii. Full earth pressure, surcharge pressure and ground water pressure from outside and no water pressure from inside.

iii. Design shall also be checked against buoyancy due to the ground water during construction and maintenance stages. Minimum factor of safety of 1.5 against buoyancy shall be ensured ignoring the superimposed loadings.

13. The foundations shall be proportioned so that the estimated total and differential movements of the foundations are not greater than the movements that the structure or equipment is designed to accommodate.

14. The foundations of transformer and circuit breaker shall be of block type foundation. Minimum reinforcement shall be governed by IS: 2974 and IS: 456.

15. The tower and equipment foundations shall be checked for a factor of safety of 2.0 for normal condition and 1.5 for short circuit condition against sliding, overturning and pullout.

b. Admixtures & additives

1. Only approved admixtures shall be used in the concrete for the Works. When more than one admixture is to be used, each admixture shall be batched in its own batch and added to the mixing water separately before discharging into the mixer. Admixtures shall be delivered in suitably labeled containers to enable identification.

2. Admixtures in concrete shall conform to IS: 9103. The water proofing cement additives shall conform to IS: 2645. Project Manager shall approve concrete Admixtures/ Additives.

3. The Contractor may propose and the Project Manager may approve the use of a water-reducing set-retarding admixture in some of the concrete. The use of such an admixture will not be approved to overcome problems associated with inadequate concrete plant capacity or improperly planned placing operations and shall only be approved as an aid to overcoming unusual circumstances and placing conditions.

4. The water-reducing set-retarding admixture shall be an approved brand of Ligno-sulphonate type admixture.

5. The waterproofing cement additives shall be used as required / advised by the Project Manager.

c. Gates and Boundary Wall

1. The Gate frame shall be made of medium duty MS pipe conforming to relevant IS with welded joints.

2. The gates shall be fabricated with welded joints to achieve rigid connections. The gate frames shall be painted with one coat of approved steel primmer and two coats of synthetic enamel paint.

3. Gates shall be fitted with approved quality iron hinges, latch and latch catch. Latch and latch catch shall be suitable for attachment and operation of pad lock from either side of gates. Hinges shall permit gates to swing through 180 degree back against fence. Gates shall be earthed by G I wire.

4. Gates shall be fitted with galvanized chain hook or gate hold back to hold gates open. Double gates shall be fitted with center rest and drop bolt to secure gates in closed position.

5. Gates shall be installed in locations shown on drawings. Next to the main gate, a men gate (1.25 m wide, single leaf) shall also be provided.

6. Bottom of gates shall be set approximately 40mm above ground surface and necessary guiding mechanism shall be fitted.

7. The Contractor shall design and construct boundary wall around substation area as per requirements. The boundary wall shall be of height 2.0M and shall be made of RCC frame construction with RCC column and plinth beam arrangement and panels filled with one brick thick wall in cement sand mortar 1:6. The boundary wall shall be plastered on both external and internal faces with cement and sand plaster 1:6 of thickness 18 mm and 12 mm respectively. An additional barbed Y-shaped arm of MS angle 50x50x6 with 3-rows (6 nos) barbed wire A-4 IS: 278. Expansion joints shall be provided as per codal requirements. MS grating shall be provided at required locations for drainage purposes. The boundary wall shall be painted with minimum two coats of color wash over a base coat of white wash with lime. The front portion of boundary wall shall however be with a RC jail and 12 mm square MS bar top above brick work and pebble dash plaster finish with color pigment. The steel work shall be given two coats of synthetic enamel paint of approved make over one coat of primer. Boundary wall and gate shall be constructed as per enclosed *tender drawing*.

11.00 Buildings - General Requirements

The scope for new control room building includes the design, engineering and construction including anti-termite treatment, plinth protection, DPC of Building including sanitary, water supply, electrification, false ceiling etc. of control room building. The buildings shall be of RCC framed structure of concrete of M20 grade (Min.). Following design criteria shall be adopted for design purposes for new substation.

If any extension of the Control Room building is required in augmentation / bay extension works of existing substation then extension part shall be compatible to existing one structurally and architecturally but following design criteria shall be adopted for design purposes for R&M of existing substation.

a. Control room Building

Minimum floor area requirements shall be 10000×12000 mm excluding space for wash room which may be increased at the time of detailed engineering to suit project requirements. The layout of the control room shall be finalized as per detailed engineering to suit project requirements. The minimum dimension of different rooms required for C.R.building shall be as per drawing. The CR building shall consist of the following:

a. Control room
b. S/s In-charge room
c. Battery room
d. Store room
e. Toilet

An open space of 1 m minimum shall be provided on the periphery of the rows of panel and equipment generally in order to allow easy operator movement and access as well as maintenance.

Any future possibility of annexe building shall be taken care of while finalizing the layout of the control room building.

Minimum headroom of 3 M below soffit of beams/false ceiling shall be considered for rooms. The roof shall have four side sloping roof or flat roof as finalized during detailed engineering.

i. Design

a) The buildings shall be designed:

1. To the requirements of the National Building Code of India, and the standards quoted therein.

2. For the specified climatic & loading conditions.

3. To adequately suit the requirements of the equipment and apparatus contained in the buildings and in all respects to be compatible with the intended use and occupancy.

4. With a functional and economical space arrangement.

5. For a life expectancy of structure, systems and components not less than that of the equipment, which is contained in the building, provided regular maintenance is carried out.

6. Be aesthetically pleasing. Different buildings shall show a uniformity and consistency in architectural design.

7. To allow for easy access to equipment and maintenance of the equipment.

8. With, wherever required, fire retarding materials for walls, ceilings and doors, which would prevent supporting or spreading of fire.

9. Suitable expansion joints shall be provided in the longitudinal direction wherever necessary with provision of twin columns.

10. Individual members of the buildings frame shall be designed for the worst combination of forces such as bending moment, axial force, shear force, torsion etc.

11. Permissible stresses for different load combinations shall be taken as per relevant IS Codes.

12. The building lighting shall be designed in accordance with the requirements of relevant section.

13. Seismic considerations as applicable.

ii. Design loads

Building structures shall be designed for the most critical combinations of dead loads, super-imposed loads, equipment loads, wind loads, seismic loads, and temperature loads.

Dead loads shall include the weight of structures complete with finishes, fixtures and partitions and should be taken as per IS: 1911.

Super-imposed loads in different areas shall include live loads, minor equipment loads, cable trays, small pipe racks/hangers and erection, operation and maintenance loads. Equipment loads shall constitute, if applicable, all load of equipments to be supported on the building frame.

The wind loads shall be computed as per IS 875, Seismic Coefficient method shall be used for the seismic analysis as per IS 1893 with importance factor 1.5.

Wind and Seismic forces shall not be considered to act simultaneously.

Floors/slabs shall be designed to carry loads imposed by equipment, cables piping, equipment and other loads associated with building. Floors shall be designed for live loads as per relevant IS. Cable and piping loads shall also be considered additionally for floors where these loads are expected.

For consideration of loads on structures, IS: 875 shall strictly adhere to. Any other load coming in the structure, not mentioned in IS 875 shall be calculated as per relevant IS code and NBC.

iii. Submission

The following information shall be submitted for review and approval to the Project Manager:

1. Design criteria shall comprise the codes and standards used, applicable climatic data including wind loads, earthquake factors maximum and minimum temperatures applicable to the building locations, assumptions of dead and live loads, including equipment loads, impact factors, safety factors and other relevant information.

2. Structural design calculations and drawing (including construction/fabrication) for all reinforced concrete and structural steel structures.

3. Fully, dimensioned concept plan including floor plans, cross sections, longitudinal sections, elevations and perspective view of each building. These drawings shall be drawn at a scale not smaller than 1:75 and shall identify the major building components.

4. Fully dimensioned drawings showing details and sections drawn to scales of sufficient size to clearly show sizes and configuration of the building components and the relationship between them.

5. Product information of building components and materials, including walls partitions flooring ceiling, roofing, door and windows and building finishes.

6. A detailed schedule of building finishes including color schemes.

7. A door & window schedule showing door types and locations, door lock sets and latch sets and other door hardware.

Approval of the above information shall be obtained before ordering materials or starting fabrication or construction as applicable.

iv. Finish Schedule

1. The finishing schedule is given in subsequent clauses.

2. M.S. Ladder should be provided to access the control room roof from outside. Ladder shall be made up of ISMC 75x40 which will run as beam one meter apart and intermediate steps will be

made up of 45x45x5 angle with rise of 300 mm. Red oxide premier shall be applied initially, then two coats of rich zinc paint shall be applied to avoid corrosion.

v. Flooring

Flooring in various rooms of control room building shall be as for detailed schedules given in Table -1

vi. Walls

Control room buildings shall be of framed superstructure. All walls shall be non-load bearing walls. Min. thickness of external walls shall be 230 mm (one brick) with 1:6 cement sand mortar.

vii. Plastering

All internal walls shall have minimum 12mm and 15 mm thick 1:6 cement sand plaster on either side of wall. The ceiling shall have 6mm thick 1:4 cement sand plaster.

viii. Finishing

All external surfaces shall have 18 mm cement plaster in two coats, under layer 12 mm thick cement plaster 1:5 and finished with a top layer 6 mm thick cement plaster 1:6 (DSR 13.19) with water proofing compound. The paint shall be antifungal quality of reputed brand suitable for masonry surfaces for high rainfall zone. White cement primer shall be used as per manufacturer's recommendation.

Internal finish Schedule is given Table - 1 below:

TABLE-1

S.No.	Location	Flooring & Skirting 150mm high	Wall Internal	Ceiling	Doors, Windows, Ventilators
1.	Control Room, Relay Room	Precast Terrazo tiles (DSR'02, item no. 11.29A.2 & 11.31.2	Oil bound washable distemper on smooth surface applied with 2mm thick Plaster of Paris putty.	White Wash (DSR'02 – 13.70.1)	1) Standard steel rolled section frames with 5 mm glass. DSR'02 – 10.12, 10.13 & 10.14 2) Flush door shutters -

			(DSR'02 – 13.40 A & 13.77.2)		DSR'02 – 9.25.2
2.	Sub-station Incharge, Office, corridor, staff room.	Precast Terrazo tiles (DSR'02, item no. 11.29A.2 & 11.31.2	Oil bound washable distemper on smooth surface applied with POP putty. (DSR'02 – 13.40 A & 13.77.2)	White Wash (DSR'02 – 13.70.1)	1) Standard steel rolled section frames with 5 mm glass. DSR'02 – 10.12, 10.13 & 10.14 2) Flush door shutters - DSR'02 – 9.25.2
3.	Battery room	Acid and Alkali Resistant tiles. DSR'02 – 11.36 C. 1 & 11.36 C.1.1	Dado of acid resistant tile 1.2 M high & Paint above 1.2 M to ceiling. DSR'02 – 11.36 C. 2.1, 11.36C.2 & 13.96.1	Acid resistant Paint. DSR'02 – 13.96.1	1) Standard steel rolled section frames with 5 mm glass. DSR'02 – 10.12, 10.13 & 10.14 2) Flush door shutters - DSR'02 – 9.25.2 Painted with acid resistant Paint. DSR'02 –13.96.1
4.	Toilet	Ceramic glazed tiles in flooring DSR'02 – 11.74	DADO glazed tile 2.1M high for toilet (DSR 02 - 11.73)	White Wash (DSR'02 – 13.70.1)	1) Standard steel rolled section frames with 5 mm glass. DSR'02 – 10.12, 10.13 & 10.14 2) Flush door shutters - DSR'02 – 9.25.2
5.	Other areas not specified	Terrazo tiles (DSR'02 - 11.29A.2 & 11.31.20	Oil bound distemper, DSR'02 - 13.40A & 13.77	White Wash (DSR'02 – 13.70.1)	

Note: DSR item references (DSR-2002) to be read with CPWD specifications are only for material and workmanship guidance of the Contractors.

ix. Roof

Roof of the C.R. Building shall consist of Cast-in-situ RCC slab treated with a water proofing system which shall be an integral cement based treatment conforming to CPWD specification (item no. 25.8 of DSR 2002). The water proofing treatment shall be of following operations:

i. Applying and grouting a slurry coat of neat cement using 2.75 kg/m^2 of cement admixed with proprietary water proofing compounds conforming to IS: 2645 over the RCC slab including cleaning the surface before treatment.

ii. Laying cement concrete using broken bricks/brick bats 25mm to 100mm size with 50% of cement mortar 1:5 (1 cement: 5 coarse sand) admixed with proprietary water proofing compound conforming to IS: 2645 over 20mm thick layer of cement mortar of min 1:5 (Cement: 5 coarse sand) admixed with proprietary water proofing compound conforming to IS: 2645 to required slope and treating similarly the adjoining walls upto 300mm height including rounding of junctions of walls and slabs.

iii. After two days of proper curing applying a second coat of cement slurry admixed with proprietary water proofing compound conforming to IS: 2645.

iv. Finishing the surface with 20mm thick joint less cement mortar of mix 1:4 (1 cement: 4 course sand) admixed with proprietary water proofing compound conforming to IS: 2645 and finally finishing the surface with trowel with neat cement slurry and making of 300 x 300 mm square.

v. The whole terrace so finished shall be flooded with water for a minimum period of two weeks for curing and for final test. All above operations to be done in order and as directed and specified by the Project Manager.

With average thickness of 120 mm and minimum thickness at khurra at 65 mm.

x. Glazing

Minimum thickness of glazing shall be 5.0 mm. as per IS: 2835.

xi. Doors and Windows

The details of doors and windows of the control room building shall be as per finish schedule Table-1 and tender drawing with the relevant IS code. Rolling steel shutters and rolling steel grills shall be provided as per layout and requirement of buildings. Paints used in the work shall be of best quality specified in CPWD specification.

xii. Plumbing & Sanitation

1. All plumbing and sanitation shall be executed to comply with the requirements of the appropriate byelaws, rules and regulations of the Local Authority having jurisdiction over such matters. The Contractor shall arrange for all necessary formalities to be met in regard to inspection, testing, obtaining approval and giving notices etc.

2. PVC syntax or equivalent make Roof water tank of adequate capacity depending on the number of users for 24 hours storage shall be provided. Minimum 1 Nos. 500 liters capacity shall be provided.

3. Galvanized MS pipe of medium class conforming to IS: 1239 shall be used for internal & external piping work for potable water supply.

4. Sand CI pipes with lead joints conforming to IS: 1729 shall be used for sanitary works above ground level.

5. Each toilet shall have the following minimum fittings.

(a) WC (Western type) 390 mm high with toilet paper roll holder and all fittings

Or

WC (Indian Type) Orissa Pattern (580 x 440 mm) with all fittings (both types of WCs shall be provided at alternate locations).

(b) Urinal (430 x 260 x 350 mm size) with all fittings.

(c) Wash basin (550 x 400 mm) with all fittings.

(d) Bathroom mirror (600 x 450 x 6 mm thick) hard board backing

(e) CP brass towel rail (600 x 20 mm) with C.P. brass brackets

(f) Soap holder and liquid soap dispenser.

6. All fittings, fastener, grating shall be chromium plated.

7. All sanitary fixtures and fittings shall be of approved quality and type manufactured by well-known manufacturers. All items brought to site must bear identification marks of the type of the Manufacturer.

8. Soil, waste and drain pipes, for underground works shall be stoneware for areas not subject to traffic load. Heavy-duty cast iron pipes shall be used otherwise.

9. In case of Augmentation/R&M of existing substation, amount of work shall be envisaged by contract for lump sum quotation.

12.00 Miscellaneous General Requirements

1. Dense concrete with controlled water cement ratio as per IS-code shall be used for all underground concrete structures such as pump-house, tanks, water retaining structures, cable and pipe trenches etc. for achieving water-tightness.

2. All joints including construction and expansion joints for the water retaining structures shall be made water tight by using PVC ribbed water stops with central bulb. However, kicker type (externally placed) PVC water stops shall be used for the base slab and in other areas where it is required to facilitate concreting. The minimum thickness of PVC water stops shall be 5 mm and minimum width shall be 230 mm.

3. All steel sections and fabricated structures that are required to be transported on sea shall be provided with anti-corrosive paint to take care of sea worthiness.

4. All mild steel parts used in the water retaining structures shall be hot-double dip galvanized. The minimum coating of the zinc shall be 750 gm/sq. m. for galvanized structures and shall comply with IS: 2629 and IS: 2633. Galvanizing shall be checked and tested in accordance with IS: 2633.The galvanizing shall be followed by the application of an etching primer and dipping in black bitumen in accordance with BS: 3416.

5. A screed concrete layer not less than 100 mm thick and of grade not weaker than M10 conforming to IS: 456-1978 shall be provided below all water retaining structures. A sliding layer of bitumen paper or craft paper shall be provided over the screed layer to destroy the bond between the screed and the base slab concrete of the water retaining structures.

6. Bricks having minimum 75kg/cm2 compressive strength can only be used for masonry work. Contractor shall ascertain himself at site regarding the availability of bricks of minimum 75kg/cm2 compressive strength before submitting his offer.

7. Doors and windows on external walls of the buildings (other than areas provided, with insulated metal claddings) shall be provided with RCC sunshade over the openings with 300 mm projection on

either side of the openings. Projection of sunshade from the wall shall be minimum 450 mm over window openings and 750 mm over door openings.

8. Service ladder shall be provided for access to all roofs.

9. Angles 45x45x5 mm (minimum) with lugs shall be provided for edge protection all round cut outs/openings in floor slab, edges of drains supporting grating covers, edges of RCC cable/pipe trenches supporting covers, edges of manholes supporting covers, supporting edges of manhole precast cover and any other place where breakage of corners of concrete is expected.

10. Anti-termite chemical treatment shall be given to column pits, wall trenches, foundations of buildings, filling below the floors etc. as per IS: 6313 and other relevant Indian Standards.

11. All rungs for ladder shall also be galvanized as per IS: 277 medium classes.

12. For all civil works covered under this specification, nominal mix by volume batching as per CPWD specification is intended. The relationship of grade of concrete and ratio of ingredients shall be as below:

Sl.No.	Mix	Cement	Sand	Coarse aggregate of 20 mm down grade as per IS 383
1.	M 10	1	3	6
2.	M 15	1	2	4
3.	M 20	1	1.5	3

The material specification, workmanship and acceptance criteria shall be as per relevant clauses of CPWD specification and approved standard Field Quality Plan.

13. The details given in tender drawings shall be considered along with details available in this section of the specification while deciding various components of the building.

14. Items/components of buildings not explicitly covered in the specification but required for completion of the project shall be deemed to be included in the scope.

13.00 Interfacing

The proper coordination & execution of all interfacing civil works activities like fixing of conduits in roofs/walls/floors, fixing of foundation bolts, fixing of lighting fixtures, fixing of supports/embedment, provision of cutouts etc. shall be the sole responsibility of the Contractor. He shall plan all such activities in advance and execute in such a manner that interfacing activities do not become bottlenecks and dismantling, breakage etc. is reduced to minimum.

14.00 Water Supply

(i) Contractor shall make its own arrangement for construction water.

(ii) The Contractor shall carry out all the plumbing/erection works required for supply of water in control room building.

(iii) The details of tanks, pipes, fittings, fixtures etc for water supply are given elsewhere in the specification under respective sections.

(iv) A scheme shall be prepared by the Contractor indicating the layout and details of water supply which shall be got approved by the Project Manager before actual start of work including all other incidental items not shown or specified but as may be required for complete performance of the works.

(v) Bore wells and pumps for water supply are in the scope of Contractor meeting the day-to-day requirement of the water supply.

(vi) If the water is supplied by Municipal Corporation then bore well for water supply purposes is not required to be carried out by Contractor. Contractor shall also make necessary arrangement /formalities to receive water connection from corporation.

15.00 Sewerage System

(i) Sewerage system shall be provided for control room building.

(ii) The Contractor shall construct septic tank and soak pit suitable for 5 users if outside of Municipal Corporation zone. Otherwise, all necessary arrangement for the disposal of sewerage to the Municipal Corporation's end shall be arranged by the Contractor at his own cost for regularizing the disposal activity.

(iii) The septic tank and soak pit shall be constructed as per enclosed tender drawing.

16.00 Statutory Rules

a. Contractor shall comply with all the applicable statutory rules pertaining to factories act (as applicable for the State). Fire Safety Rules of Tariff Advisory Committee, Water Act for pollution control etc.

b. Provisions for fire proof doors, no. of staircases, fire separation wall, plastering on structural members (in fire prone areas) etc. shall be made according to the recommendations of Tariff Advisory Committee.

c. Statutory clearance and norms of State Pollution Control Board shall be followed as per Water Act for effluent quality from plant.

d. Requirement of sulphate resistant cement (SRC) for sub structural works shall be decided in accordance with the Indian Standards based on the findings of the detailed soil investigation to be carried out by the Bidder.

e. Foundation system adopted by Bidder shall ensure that relative settlement and other criteria shall be as per provision in IS: 1904 and other Indian Standards

f. All water retaining structures designed as un-cracked section shall also be tested for water tightness at full water level in accordance with clause no. 10 of IS: 3370 (Part-I).

g. Construction joints shall be as per IS: 456.

h. All underground concrete structures like water retaining structures etc. shall have plasticizer cum water proofing cement additive conforming to IS: 9103. In addition, limit on permeability as given in IS: 2645 shall also be met with. The concrete surface of these structures in contact with earth shall also be provided with two coat of bituminous painting for water/damp proofing. In case of water leakage in the above structures, Injection Method shall be applied for repairing the leakage.

i. All building/construction materials shall conform to the best quality specified in CPWD specifications if not otherwise mentioned in this specification.

j. All tests as required in the standard field quality plans have to be carried out.

17.00 Fencing

a. Product materials for fencing

The minimum requirements are as follows:

i. Chain Link fence fabric in accordance to IS-2721

1. Size of mesh : 75 mm
2. Nominal wire size : 4.0 mm dia
3. Width of chain link : 2000 mm
4. Class of zinc coating : medium
5. Zinc coated after weaving.

ii. Posts

Angle Section

Intermediate : L 65 x 65 x 6

Straining posts : L 65 x 65 x 6

Stay post : L 65 x 65 x 6

1. All structural steel shall conform to IS: 2062 and shall be painted with a coat of approved steel primer and two coats of synthetic enamel paint.

2. The Chain Link fabric shall be fixed to the post at the top and bottom of the fence by welding/fixing 50 mm MS flat all through its length.

3. Fencing top shall be either of galvanized barbed wire or tape. Barbed wire shall conform to IS: 278.

4. The barbed wire may consist of not more than two splices per reel. The barbed wire shall be formed by twisting two line wires, one containing the barbs. The barbed wire shall be designated as A-4 IS: 278 and shall be galvanized.

5. Above chain link, 3-rows (6 nos) of barbed tape/wire shall be provided in each arm of the Y shaped barbed arm at top.

6. With barbed tape/wire above the chain link fence, the total fence height shall be minimum 2500 mm above finished gravel level.

7. Barbed tape/wire arms shall be same as intermediate and straining post.

8. Tension wire: single strand, high tensile, galvanized steel wire, 4 mm diameter.

9. Fittings and hardware: cast aluminum alloy or galvanized steel, malleable or ductile cast iron turnbuckles to be drop forged.

10. GI chain link mesh shall be as per IS: 2721. Mesh size 75 mm and nominal wire size shall be 4.0 mm diameter.

On the results of these additional tests, the whole or portion of the barbed wire/tape shall be accepted or discarded by the Purchaser, as the case may be.

b. Installation

1. Contractor shall submit the fencing drawing Fence shall be installed along lines shown on approved drawings.

2. Post holes shall be excavated by approved methods.

3. Intermediate posts shall be spaced 2.5 m apart measured parallel to ground surface.

4. Straining posts shall be installed at equal intervals not exceeding 25.0 m.

5. Straining posts shall be installed at sharp changes in grade, at corners, at change of direction and where directed.

6. All corner post will have two-stay post and every tenth post will have a transverse stay post.

7. Posts shall be set in 1:2:4 plain cement concrete Blocks of minimum dimension 400 mm x 400 mm x 1000 mm deep Concrete work shall conform to relevant clause. Post shall be braced and held in plumb position and true alignment and elevation until concrete has set.

8. Fence fabric shall not be installed until concrete has cured a minimum of 7 days.

9. Bottom and top of the fence fabric shall be fixed with MS flats of 50 mm x 6mm (min).

10. Fence fabric shall be laid out with barbed edge on top, stretched tightly and shall be fastened to intermediate, post gate and straining post with 50 x 6 flats.

11. Fabric shall be secured to tension wires with tie wires at 400 mm intervals. Tie wires shall be given not less than two twists.

12. Barbed tape shall be spliced with standard wire splices.

13. Barbed tape shall be stretched to have uniform tension.

14. Barbed tape shall be attached to barbed wire arms with approved metal clips.

15. Toe wall of one Brick/Random Rubble masonry, with notches over 75 mm thick PCC (1:4:8) shall be provided below all fencing and shall be minimum 200 mm above and 200 mm below finished ground level. All exposed surfaces of brick toe wall shall be provided with 1:6 cement sand plaster and coated with two coats of color wash with a base coat of whitewash with lime. Rubble masonry toe wall shall be with raised & cut pointing and 50 mm PCC (1:2:4) band coping.

16. Proper earthing shall be done for fencing also.

13.10. LT AB Cable Reconductoring Work

1. Survey

1.1. Survey

The Contractor shall carry out a GPS based survey of existing bare conductor LT distribution lines in the habitation. The Survey should cover Pole by pole survey of all the bare conductor lines to identify the location of poles and phase configuration, pole condition, Existing stays / struts, Existing street lamp connections, Location and capacity of the connected distribution transformer (DTR) to each LT line, Connection points of any existing ABC lines connected to the bare conductor lines should be identified. The length of such ABC lines and total service connections provided through this line should be indicated on the map at this point, Load readings for each LT feeder. Upon completion of the survey the contractor is required to develop the Single Line Diagram (SLD-A) indicating the survey Information and Schedule of network survey information (Schedule – A).

1.2. Load Readings

Load readings of each LT feeder shall be taken before and after proposed ABC conversions. This is required to monitor actual demand reductions achieved following ABC conversions.

Load currents on each phase and the neutral in respective LT feeder shall be taken on four different occasions per day before and after completion of ABC conversion work. The load current measurements shall be decided by Engineer in Charge. Load reading before ABC conversions shall be taken when carrying out the survey and recorded in Schedule-A. Load readings after ABC conversions shall be provided to the Project Manager/Engineer in charge within one week from completion of works.

1.3. **Network Design for ABC Conversions**

Contractor should prepare details of proposed ABC conversions for respective habitation in accordance with these guidelines and prepare Single line diagram indicating proposed ABC conversions (SLD-B) and Schedule of proposed ABC conversions (Schedule -B). while preparing SLD, loading in distribution transformer must be examined. On completion of work, average dayloading in distribution transformer should limit 80-85% only.

1.4. **Load Balancing**

When preparing ABC conversion schedule (Schedule-B), phase connections for single phase distribution boxes shall be determined so that total number of single phase consumers are balanced across the three phases of a given feeder.

2. **Conversion of bare conductor lines to ABC**

2.1. AB Cable types and Sizes

1,1 kV voltage grade XLPE insulated aluminum conductor and aluminum alloy bare neutral messenger type cables shall be used for proposed ABC conversions. The AB cables provided shall fully comply with technical specifications provided in this tender document.

The following **standard sizes** of AB cables shall be used:

- ABC16-SP : 1X16 mm2 (ph)+1X25 mm2 (bare messenger cum neutral) +1x16 mm2 (insulated street lighting cable)
- ABC50 : 3X50 mm2 (ph)+1x35 mm2 (bare messenger cum neutral) +1x16 mm2 (insulated street lighting)
- ABC95 : 3X95 mm2 (ph)+1x70 mm2 (bare messenger cum neutral) +1x16 mm2 (insulated street lighting)

2.2. **Vertical and Horizontal Clearances**

all statutory clearances shall be ensured for ground clearance, line-to-line clearance, road crossing clearance, horizontal and vertical clearances from buildings/objects etc. All road crossings and line crossings shall be guarded as per specifications. Conductor joint should not be provided in mid span length. Instead, it should be nearer to the support.

As per ISS 162-1961 minimum electrical clearance from live part to earth and safety clearance in case of different voltage must be kept as follows:			
Voltage	Electrical Clearance (mm)		Safety Clearance in SIS (mm)
	Phase - Earth	Phase - Phase	
33kV	381	432	2740
66kV	658	786	3050

Minimum Clearance Between Power Lines (mtr.) :			
kV	11	33	66
11	2.44	2.44	2.44
33		2.44	2.44
66			2.44

2.3. **Installation of AB Cables**

Prior to installation of AB cables, all pole works including **stay/struts works** stay / struts works should be completed as per scope of works provided in proceeding sections. (i.e installation of new poles, pole replacements, pole re-alignment, installation of pole supports).

All ABC accessories used for installation works shall conform to technical specification provided in this document.

2.4. **Installation of clamp assemblies**

AB cable should be installed on poles using anchoring and suspension clamps according to the approved drawings by the Project Manager. Samples of complete clamp assemblies shall be approved by the Project Manger prior to use.

Anchoring clamps shall be used at the beginning and end of each cable run, at a major change in direction, terminal poles and at T-off points. Suspension clams shall be used at other intermediate points.

It should be noted that different clamps are specified for cable ranges 25-50 sqmm and 70-95 sqmm. These have different dimensional and maximum load specifications. If ABC manufacturer recommends any alternate clamps it should be approved by the Project Manger prior to use.

Stainless steel straps and buckles shall be used for fixing pole brackets to the pole as shown in drawings. Strap binding tool shall be used for tensioning and cutting the straps.

Separation of neutral messenger for tensioning and fixing to the clamp should be done using plastic phase separators. Weather resistant black nylon ties should be used for typing insulated conductors to the neutral messenger at either side of suspension clamps, to prevent the phase conductors from chatting against suspension clamp.

2.5. **Stringing of AB cable**

Stringing of AB cables shall be done in a proper manner ensuring insulated conductors do not get damaged during installation. Dragging the ABC on the ground is not permitted. Pulleys installed on poles shall be used to pull AB cables.

Minimum clearance above ground to line shall be maintained. Sag tension charts for installing AB cables shall be developed by the Contractor taking into consideration of cable characteristics, maximum / minimum temperatures and maximum wind pressure as per service conditions provided by Employer. Based on this clear guidelines shall be provided to linesmen to ensure bare neutral messenger is pulled at appropriate tension so that;

(a) Required ground clearances are maintained, and

(b) Messenger conductor tension is maintained well below its breaking load at all temperatures.

Dynamometer method or sag method may be used to ensure appropriate tension of neutral messenger during installation. Over tensioning of neutral messenger should be avoided to ensure its tension does not exceed permissible loading limits at low temperatures. Loose spans of AB cable should be avoided to maintain permissible maximum sag at high temperatures. Loose spans may only be allowed for short spans in special cases. This applies when there are practical difficulties to install necessary stays or struts as required at a t-off point. A short loose span of AB cable may be used in this case to transfer the stay / strut support point upstream or downstream of the line.

Stringing of AB cable shall be done using proper equipment such as stringing blocks with plastic coated pulleys, pulling (come along) clamp, cable hoist and pulling tool, dynamometer etc. Proper equipment recommended by the ABC manufacturer shall be used to avoid any damage to the cable during installation. Temporary stays or strut poles shall be employed as necessary during stringing operation to ensure safety of personnel and equipment.
Phasing of insulated conductors shall be identified by one, two and three ridges on the XLPE insulation. Same phasing shall be maintained accordingly through the line. Interchanging of phasing at any connection point is not permitted.

In order to ensure durability of AB cables and to prevent possibility of failures due to effects of water treeing, any exposed parts of phase conductors or open cuts of insulation are strictly not permitted. Hence all connectors to be used in ABC line shall be pre-insulated type or bare connectors covered by heat shrinkable tubing or GelWrap sleeves. For installing connectors proper equipment such as insulation stripping tool, ratchet cable cutter, hydraulic compression tool with compression dies shall be used.

All cable ends shall be properly sealed by pre-moulded or heat-shrinkable type end caps.
Samples of all ABC accessories including connectors shall be approved by the Project Manager prior to use.

Mid-span joints shall be generally avoided by properly planning stringing work. In exceptional cases where mid span joint is required, pre-insulated compression connectors shall be used. The joints for each phase shall be staggered along the cable. No mid-span joints are allowed for AB cable sections running across a street.

Insulated piercing connectors or non-tension mechanical connectors with heat shrinkable tubing shall be used for non-tension inline connections at anchoring points where necessary.

2.6. **AB cable connections to Distribution Transformers**

AB cables shall be connected to busbars or protection equipment terminals of the LT feeder Distribution Boards by means of pre-insulated compression lugs and aluminum / bi-metallic strips.

Where no Distribution Board is available AB cable shall be directly connected to the distribution transformer bushing terminals using insulated compression lugs. In this case additional length of AB cable shall be provided by means of a loop to facilitate future connection to the Distribution Board or fuses.

2.7. **Earthing of Poles / ABC neutral messenger conductor**

Earthing shall generally be carried out in accordance with the requirements of latest CEA regulations (as amended from time to time) and the relevant regulations of the Electricity Supply Authority

The Contractor shall ensure every 6th pole of ABC line including neutral messenger and any metallic hardware is earthed with spike earth (20x2500 mm) as per existing practice of Employer. (for normal soil).

Poles shall be earthed using 8 SWG (7/4.0 mm) GI wire with 1 No. Coil/Spike/Pipe earth.

2.8. **Pole Numbering**

Each pole of the existing line shall be uniquely numbered as per pole numbering scheme followed by the Employer. Pole number and other information as required by the Employer should be pained on the pole.

2.9. **Dismantling existing bare conductors and line hardware**

Dismantling existing bare conductors and line hardware. Conductors and other line hardware including insulators, brackets, cross arms and bolts and nuts shall be carefully removed without causing damage to the existing poles. Bare conductors shall be removed in the longest length practicable for future re-use with a metal tag of description/ tag # of conductor, the said conductor shall be wound on empty conductor reels or made up in rolls.

Following dismantling works affected areas shall be cleaned and reinstated. All dismantled items shall remain the property of Employer and Contractor shall deliver all salvaged materials to the designated Employer warehouse as directed by the Project Manager.

2.10. **Parallel AB Cable lines**

Parallel AB cable lines refers to installation of second ABC cable line on the existing poles as per design requirements approved by Employer.

The scope of work for this item shall exclude (a) existing bare conductor line dismantling and (b) pole numbering requirements applicable for the scope of works specified above for 'conversion of bare conductor lines to ABC'.

2.11. **Rates for Conversion of bare conductor lines to ABC**

It should be noted that scope of work for this item relates to AB cable installation on existing poles. It excludes any additional works required on the existing poles or installation of new poles, installation of Distribution Box/SMC Distribution Boxes, stays etc. Separate BOQ items are provided for work associated with installation of new poles and replacement, re-alignment or relocation of existing poles, installation of stays and struts and installation of Distribution Box/SMC Distribution Boxes for AB cables.

3. **Installation of LT Distribution Box/SMC Distribution Boxes for ABC**

3.1. **Types of LT Distribution Box/SMC Distribution Boxes**

The following types of LT Distribution Box/SMC Distribution Boxes (according to number of consumers to be connected) shall be selected:

- Type A : Single Phase, 1 Incoming (25 mm2)/ 6 outgoing (upto 10 mm2)
- Type B : Three Phase,1 Incoming (35 mm2)/ 4 outgoing (upto 16 mm2)

3.2. **Mounting Arrangement**

Distribution Box/SMC Distribution Box (DB) shall be mounted on LT pole with galvanized MS clamp of 40x3 mm size.

3.3. **Connection to AB Cable**

2Cx25 sqmm or 4Cx35 sqmm Stranded cables shall be used to connect AB cable with single phase and three phase Distribution Box/SMC Distribution Box respectively. For connection to ABC, insulation piercing connectors (IPC) and PG clamps of appropriate size shall be used.

Single phase Distribution Box/SMC Distribution Boxes shall be connected to specified phase as per Schedule-B in order to ensure load balancing in ABC line.

3.4. **Connection of Consumer Service Cables**

All existing consumer service cables shall be re-connected to the Distribution Box/SMC Distribution Box by the Contractor. In case existing consumer service connections are to be replaced with armored service cables in each habitation as determined by the Project Manager, new armored cable shall be connected to the Distribution Box/SMC Distribution Box.

4. **Replacement of Existing Consumer Service Connections**

4.1. **Service Connection Types**

The applicable service connection types are as follows;

SC Type	Connected Load No of Phases / Contract Dmd	Service Cable Size (cores / sqmm)
SP-1	Single Phase / upto 4 kW	2 x 4 mm2
TP-1	Three Phase / upto 4 kW	4 x 4 mm2
TP-2	Three Phase / above 4 kW	4 x 4 mm2

4.2. **Service Cable Types**

The service cable shall be 1.1 KV grade PVC insulated, PVC sheathed, armored multicore **stranded** aluminum cable as per sizes indicated in above table

4.3. **Service Cable Span**

Permissible maximum span for service cable shall be 30 m. In isolated cases this limit may be extended with the approval of Project Manager provided that required ground clearance is maintained with additional supports where necessary.

Existing service cables shall be replaced with armored service cables only in certain specified areas which are high theft prone areas. This will be specified by the Project Manger during execution. No service cable replacements shall be carried out without the approval of Project Manager.
In this case existing service cables shall be replaced with new armored cables. Existing un-armored service cables shall be removed and returned to Employer warehouse. Any non-standard supports used as supports for existing service cables shall also be removed.

New armored service cables shall be drawn from the LT Distribution Box/SMC Distribution Box upto the meter board as shown in drawings. The service wire is to be hanged on supportive GI wire between pole support and the house. 7/3.15 mm (10 SWG) & 7/4.00 mm (8 SWG) GI wires shall be used for single phase and three phase services respectively.

Before installing service wires and GI wire, GI pipe / MS Angle on the consumer premises is to be erected using clamps/ nails/proper binding etc. In case of hut or poor structure at consumer premises, GI pipe is to clamp on wooden planks/wooden structure existing in the house. The GI pipe should be supported for neutralizing tension by means of GI tie wire support. In pukka/brickwork/cement concrete foundations, house, GI support pipe is to be clamped by means of MS clips.

New service cable shall be connected to existing consumer meter terminals or incoming fuse / MCB / MCCB terminals. Care should be taken not to damage the existing meters in the process. 20mm dia PVC conduit pipes shall be used to take down service cable from the roof to the meter box along the walls. The service cable shall be drawn inside PVC pipes from roof upto the meter board.

Terminal cover of the meter or fuses shall be sealed upon connection of new service cable as arranged with the Employer.

Earth terminal point shall be provided at meter board via bearer GI wire. This point shall be connected with the proper earthing system through GI wire. 10mm diameter earth knob in form of bolt and nut is to be installed on energy meter board.

All work required to install service cable from LT Distribution Box/SMC Distribution Box upto the meter board shall be carried out as per drawings. This includes GI wire for supporting service cables from LT Distribution Box/SMC Distribution Box upto the consumer premises, MS angle fixed at roof, clamp with bolts nuts and flat iron for fixing GI wire on pole, clamps for fixing cable to GI wire, PVC conduit pipes and accessories to draw the service cable from roof upto the meter board.

Contractor

5. **Installation of Poles**

5.1. Types of pole installation works for ABC conversions

The following types of pole installation works applicable for ABC conversions as per site requirements specified in the table below;

#	**Type**	**Site Requirements**
1	Installation of new poles	• New pole to be used as an intermediate pole in the existing line to address excessive spans or other requirements. • When there is a need to do minor extensions to the existing line in order to minimize excessive service cable lengths to existing consumers. • To shift existing lines due to safety/ clearance issues.
2	Replacement of existing (unusable) poles	• To replace existing poles which are damaged / corroded and cannot be re-used. • To replace of existing non-standard line supports such as temporary structures including supports embedded in buildings.
3	Re-location of existing poles	• To shift existing poles • To shift existing lines due to safety/ clearance issues
4	Re-alignment of existing poles	• To straighten the poles that are inclined in a particular direction but in re-usable condition

5.2. **Types of poles**

For works relating to new poles and replacement of poles, poles according to Employer specification shall be used.

For works relating to re-location or realignment of existing poles the available existing pole (any type) may be re-used provided that it is in re-usable condition.

6. **Erection of Poles**

6.1. **Removal of existing poles for re-use or disposal**

All unusable poles or non-standard line supports in the existing LT lines shall be removed and disposed. If the existing pole is removed for re-use adequate measures should be taken not to damage the pole during removal.

Existing poles shall be removed by pulling the complete pole from the ground; poles shall not be cut off at the ground line. Pole shall be cleaned and any material attached with the pole (including concrete) shall be removed. The RCC base plate may be removed and re-used if it is in re-usable condition.

Pits shall be backfilled and compacted completely with sufficient added backfill piled above grade to prevent depressions being created by natural compaction.

Contractor shall be responsible for disposal of unusable poles or non-standard line support structures after taking approval of the Project Manager/ Engineer In- Charge of the Employer.

6.2. **Erection of new or existing poles**

For 8/8.5 m PCC poles pole pit shall be excavated as per details provided in drawing # <REC/DDUGJY/GEN/02. Pole shall be placed on the RCC base pad made as per drawing # REC/DDUGJY/GEN/05A. PCC pole pit shall be refilled with 200 mm average size of boulder mixed with excavated earth. Proper ramming shall be performed for better compaction. Pole shall be erected fully vertical and firmly fixed to ground and shall not wobble.

6.3. **Erection of poles with concrete foundation**

Concrete foundations shall be used to erect terminal / tension poles and poles in water logged areas or for all locations as instructed by the Project Manager. Details of concrete foundation for PCC poles are provided in drawing # REC/DDUGJY/GEN/01.

6.4. **Re-alignment of existing pole**

Existing poles that are inclined in a particular direction shall be re-aligned / straightened by pulling, providing additional bouldering, concreting and re-compacting as necessary. Upon re-alignment pole shall be erected fully vertical and firmly fixed to ground and shall not wobble. If necessary pole may be completely removed and re-installed.

6.5. **Earthing of poles**

Earthing of poles shall be carried out as per CEA regulations and existing practice of Employer.

6.6. **Pole Numbering**

Requirements specified in section 3.9 with respect pole numbering shall also be applicable for new poles or pole replacements indicated in this section.

7. **Installation of Stays and Struts**

7.1. **Installation of Stays (Guys)**

Stays shall be installed to nullify tension on poles due to tension of AB cable at terminal, angle, cut-point and T-off positions. Stays may also be installed at steep gradient locations as required. Along the straight run stays shall be installed at minimum two locations in 1 km.

If there are no existing stays installed at such locations in the existing line, such poles shall be identified and included in Schedule-B for installation of new stays. In addition required stays for proposed new and relocated poles shall also be included.

10 SWG stay wire (7/ 3.15 mm) with 16 mm stay rod shall be used for 11 kV / LT lines. Stay shall be installed in the opposite direction of resultant force due to AB cable tension in order to nullify the same.

If the stay wire proves to be hazardous, it should be protected with suitable asbestos pipe filled with concrete of about 2 m length above the ground level, painted with white and black strips so that, it may be visible at night.

7.2. **Installation of Struts**

The struts may be used only in case where stays cannot be installed due to physical obstacles or limitations. Strut shall be applied in the same direction of resultant force due to AB cable tension in order to nullify the same.

7.3. **Installation of Stays**

Stay assembly comprising of turn buckle assembly, anchor rod and plate, stay insulator, thimble and GI stay wire shall be supplied and installed as indicated in drawing # EC/DDUGJY/GEN/09B.

In general, the stay should be applied on the pole as close as possible to the load center. The angle between stay wire and pole shall be between 45^{o} – 60^{o}. Where there are issues obtaining specified angle due to physical obstacles, bow (outrigger) stay arrangement may be considered with the approval of the Project Manager. In case of critical space issues, fly stays may also be considered subject to approval of the Project Manager. (Reference : REC Drawing # G4).

Concreting of stay pit shall be done as shown in drawings except for firm soil where compacting with necessary aggregates shall be done.

Stay wire shall be properly tightened after installation and allowing sufficient time for setting concrete. Contractor shall ensure all stays in the existing line are properly tightened including new and existing stays.

7.4. **Installation of Strut pole**

Installation of strut pole shall be carried out using 8 m PCC pole and pole brackets as shown in drawing # REC/DDUGJY/GEN/10. Strut pole shall be installed with the RCC base plate. Angle between the line and strut pole shall be 450.

8. **Re-Connecting Existing Street Lamps to ABC**

If there are existing street lamps connected to the bare conductor line, these street lamps shall be re-connected to ABC line through the street lighting conductor using IPC (for insulated conductor) and PG clamps (for bare neutral messenger). This work scope is limited to providing connection to existing street lamps only.

9. **Shutdown during execution of works :**

The Contractor is required to take shutdown to execute reconductoring and all other works wherever needed. During shut down, safety of system and operating manpower shall be ensured by Contractor.

Shut down shall be planned with concerned substation incharge well in advance. This may subject to exigencies leading to cancellation of requisition if situation so desire. Contractor shall be responsible to take advance action on resource mobilization (men, materials and machine) well in advance to perform shut down works. Adequate manpower shall be mobilized to take-up the works in parallel at ll supports on given shut-down area. Contractor shall deploy well educated and experience engineer to take care of shut down, end earthing of lines, check clearances on completion of works, return shut down and ensure re-energization of section/part of line. He shall be available at site for taking shut-down, during execution of works, return of shut down and re-energization of line. Safety of working crew shall be looked after by him. He must be a trained person having requisite experience of shut-down works. He must be well aware of LT/HT networks and their supply sources.

On completion of work, Contractor shall provide as built GA drawings GPS making of connected consumers and their type of connection (single/three phase), domestic/commercial/agriculture etc. and connected loads.

13.11. Construction of New 11 kV Feeders and Associated Works for Separation of Agricultural Consumers

1. Construction of new 11 kV lines

1.1. Survey

Mapping of routes of proposed 11 KV lines shall be done by GPS survey. While surveying, existing electrical infrastructure, existing agriculture private tube well (PTW) locations, capacity and load details shall be mapped during survey.

Upon completion of the survey the Contractor shall provide a survey report with the following information;

- Single line diagram of the route survey and proposed line alignment details mapped and provided in a standard mapping software. This should also include information such as existing electrical infrastructure and PTW information.
- Road and railway crossing points of the proposed 11 kV line shall be marked on the single line diagram.
- Line sections proposed for 11 kV AB (Ariel Bunched) cables due to vegetation, safety and forest clearance issues (if applicable) shall be marked on the single line diagram. Lengths of proposed AB cable line sections shall be indicated.
- Schedule of location wise pumps to be fed through new feeder or alternatively general consumer distribution transformers to be transferred to new feeder for making dedicated feeder for agricultural consumers. This schedule should include location / capacity of the existing distribution transformers to be transferred and location /capacity and load of agriculture PTWs with reference to the locations of the single line diagram.
- Estimated peak demand on each feeder/s upon implementation and percentage voltage regulation at farthest point on various spur sections.
- Single line diagram of the 33/11 kV substation indicating of 11 kV outgoing feeder to connect the new feeder. If existing spare feeder is unavailable list of works to be performed at the substation to install additional new feeder.
- Cost estimate for construction of proposed 11 kV line and associated works based on contract rates.

  The survey report shall be submitted in a suitable format for uploading to the web portal and for printing.

  The survey report will be used as the basic document for execution of work upon approval by the Project Manager. Upon completion of work, as built single line diagram shall be provided with relevant information of the works carried out.
- On the survey drawings Line to line crossing (HT/LT, LT/LT, HT/HT/Railways Crossing) details to be marked with available clearances.
- Efforts shall be taken to avoid long zig-zag lines and too many line-to-line crossing while surveying and finalizing route maps/SLD.

1.2. Statutory Clearances

For execution of new 11 KV line construction work, all statutory clearances shall be obtained by the Contractor coordinating through the Project Manager. These include road crossing clearances, railway crossing approvals, way leave clearance and any approvals needed from local authorities, road authorities and other regulatory authorities. All statutory clearances shall be ensured for ground clearance, line-to-line clearance, road crossing clearance, horizontal and vertical clearances from buildings/objects etc. All road crossings and line crossings shall be guarded as per specifications. Conductor joint should not be provided in mid span length. Instead, it should be nearer to the support.

1.3. Construction of new 11 kV lines

Upon approval from the Project Manger the Contractor shall carry out construction work in full compliance with the technical instructions, specifications and drawings provided in this Volume.

1.4. Stringing of conductors / AB cables

Minimum safety clearances shall be maintained in the 11 kV line. Sag tension charts for installing ACSR conductors or AB cables shall be developed by the contractor taking into consideration of conductor / cable characteristics, maximum / minimum temperatures and design wind pressure as per service conditions.

Based on this, clear guidelines shall be provided to linesmen to ensure ACSR conductors or bare neutral messenger (for AB cables) are pulled at appropriate tension so that;

(a) Required ground clearances are maintained and

(b) Conductor tension is maintained well below its breaking load at all temperatures.

Dynamometer method or sag method may be used to ensure appropriate tensioning of conductors / cables during installation. Over tensioning of conductors should be avoided to ensure its tension does not exceed permissible loading limits at low temperatures. Loose spans of conductors should be avoided to maintain permissible maximum sag at high temperatures. Loose spans may only be allowed for short spans in special cases. This applies when there are practical difficulties to install necessary stays or struts as required at a t-off point. A short loose span may be used in this case to transfer the stay / strut support point upstream or downstream of the line.

Stringing of conductors / AB cable shall be done using proper equipment as recommended by the manufacturer to avoid any damage to the conductor / cable during installation. Temporary stays or strut poles shall be employed as necessary during stringing operation to ensure safety of personnel and equipment.

1.5. 11 kV line for underground railway crossing

Detail survey of location of railway crossing shall be carried out by the contractor to avoid multi-crossing at nearby location. Prior approval from railway authorities for execution of this work shall be obtained by the Contractor through the Project Manager. Contractor should

ensure timely completion of work during block period allocated by the railway authority by mobilizing adequate resources.

2 Nos. separate cables shall be laid in separate HDPE pipe enclosures per crossing. One cable to be kept as a spare. Horizontal Direct Drilling (HDD) shall be used for installation of cables below the railway tracks.

1.6. Tree Cutting and Trimming

The Contractor shall count, mark with suitable quality of paint all the trees that are required to be cut/trimmed to obtain required wayleave clearance. Contractor shall pay compensation for any loss or damage for tree cutting due to Contractor's work. If forest clearance is envisaged for execution of work, clearance of forest department shall be arranged by the Contractor through the Project Manager. The contractor shall pay tree cutting / trimming compensation to affected parties based on Employer standard rates as incorporated in price schedules.

1.7. Installation of Distribution Box/SMC Distribution Boxes for LT lines

3 phase and single-phase Distribution Box/SMC Distribution Boxes shall be supplied as per specifications and installed on poles according to number service connections for LT AB cable lines. When installing single phase Distribution Box/SMC Distribution Boxes they shall be connected to alternate phases of the AB cable in order to obtain adequate level of load balancing.

2. Extension of Substation Control Room Building

Extension of substation control room building shall be carried out as per instructions of the Project Manger to provide additional space for new outgoing feeder panels if required.

This work shall be carried out as instructed by the Project Manager under the supervision of civil engineer / technical officer appointed by him. The contractor shall be responsible to ensure building is extended in the same manner as existing building. The contractor shall be responsible to provide necessary measures to ensure substation control operations are carried out without disruption during the construction period.

13.12. Underground Cabling

1. Survey

The detailed survey shall be carried out for the approved feeders/spur lines by the contractor and submitted for owner approval. The Successful Tenderer shall carry out radar survey of the route using Ground penetrating Radar and determine route profile of any other utility cables, pipes etc along the route. The route survey and drilling profile shall be got approved and finalized by the Engineer-in-Charge prior to commencement of the drilling, HDPE pipe insertion and cable insertion.

2. The scope includes :

- Laying of underground 33 KV, XLPE HT Cable (3Cx300 sqmm)
- Laying of underground 11KV, XLPE HT Cable (3Cx185/240 sqmm)
- Laying of underground 1.1 KV, XLPE, LT Power Cable (3.5Cx240-204.79KM, 3.5Cx 150-227.39KM, 3.5Cx25 sqmm-44.74KM, 1Cx630 Sqmm -1.8KM and 1Cx400 sqmm-2.4KM)
- Laying of underground 1.1 KV, PVC, LT armoured Power Cable for Street Light (4Cx25 sqmm)
- Laying of underground 1.1 KV,PVC, LT armoured Service Power Cable (4Cx10 sqmm - 56KM, 2Cx10 sqmm - 247KM)

3. Horizontal Direction Drilling

3.1. HDD or Horizontal Directional Drilling is a trenchless boring method for installing underground cables, pipes and conduits in a shallow curve along a prescribed bore path with the use of a surface-launched rig / machine, which minimises the disruption of th surrounding area, for example, roads and driveways. The laying of U/G cables shall normally be done direct in ground through trenchless boring by using HDPE pipes. However in exceptional circumstances the cables may have to be laid in covered trenches or in racks fixed to the walls or supported from the ceilings. The scope shall cover supply of all the material as per the BOQ, erection equipments, labour and all the other items required for the laying of the power cables. The cable route markers, at a maximum distance of 200 mtrs, and danger boards shall be provided for the information of all concerned and for their safety. Any additional requirement in terms of safety perspective shall be provided by the contractor without any extra cost. It is the responsibility of the contractor to maintain the required statutory clearances from other utility services. Any damage caused to any utility services/ human life / public property etc shall be the sole responsibility of the contractor. The contractor will lay the underground power cable in such a fashion that no straight through joints are required and only end terminations joints are required, however wherever the joints are required in HT cable then the same shall be carried out overhead on PCC poles structure. In exceptional circumstances such as where length of line is more than the standard cable length in drum and overhead jointing is not possible then straight through joints will be allowed. The contractor shall have ISO 9001-2008/18001-2007

3.2. The Horizontal drilling shall be for a distance of not less than 90 mts at each stretch and subsequently thereafter. The reinstatement of road dug up for drilling at every 90 mts shall be incorporated in the price for Horizontal Directional Drilling.

3.3. Disposal of extra excavated material such as mud, slurry, stones etc shall be also included in the rate per meter of horizontal drilling and shall not be charged extra.

3.4. The trenchless technology shall be used with HDPE casing for the portion of the cable route such as road, railway, nullah crossing and without HDPE casing for major portion of the cable route. The outer diameter of the HDPE pipe shall be suitable for insertion in an 8" diameter horizontally drilled bore. The HDPE pipe shall be of PE 80 grade with pressure rating PN4 conforming to IS 4984/1995 and shall have wall thickness of 6.20 to 7.10 mm. The HDPE pipes shall be joined by using Butt welding and a 7/20 G.I wire shall be provided along the entire length of each pipe duct.

3.5. The directional drilling equipment shall consist of a directional drilling rig of sufficient capacity to perform the bore and pull back the pipe/cable, a drilling fluid mixing, delivery, and recovery system of sufficient capacity to successfully complete the installation, a drilling fluid recycling system to remove solids from the drilling fluid so that the fluid can be reused (if required), a magnetic guidance system or walk over system to accurately guide boring operations, a vacuum truck of sufficient capacity to handle the drilling fluid volume, and trained and competent personnel to operate the system. All equipment shall be in good, safe condition with sufficient supplies, materials and spare parts on hand to maintain the system in good working order for the duration of this project.

3.6. The directional drilling machine shall consist of a hydraulically powered system to rotate and push hollow drilling pipe into the ground at a variable angle while delivering a pressurized fluid mixture to a guidable drill (bore) head. The machine shall be anchored to the ground to withstand the bulling, pushing and rotating pressure required to complete the installation. The hydraulic power system shall be self-contained with sufficient pressure and volume to power drilling operations. Hydraulic system shall be free of leaks. Rig shall have a system to monitor and record maximum pullback pressure during pullback operations.

3.7. There shall be a system to detect electrical current from the drill string and an audible alarm which automatically sounds when an electrical current is detected.

3.8. The drill head shall be steerable by changing its rotation and shall provide necessary cutting surfaces and drilling fluid jets.

3.9. Mud motors shall be of adequate power to turn the required drilling tools.

3.10. Drill Pipe shall be constructed of high quality 4130 seamless tubing, grade D or better, with threaded box and pins. Tool joints should be hardened to 32-36 RC.

4. Accessories

4.1. This being a Turnkey contract, successful installation, commissioning & integration with existing system, of those equipment/accessories/material not specifically mentioned in the specifications, shall be the responsibility of contractor. No extra payment shall be made for these inherent works.

4.2. He shall also supply all other associated equipment/ material/accessories not specifically mentioned in this tender specification but are required for successful and trouble free operation of the executed work as a whole. For that no extra payment shall be made to the contractor.

5. Technical Standards

5.1. The electrical equipments and materials required during erection should be of high standard. Technical features of these equipments and materials must conform to the technical specification given in this bidding document. Wherever the same is not specified, it must conform to the relevant I.S for that material.

5.2. Materials conforming to other international standards, which ensure equal or higher quality than the standards mentioned above, shall also be acceptable. In case the bidders who wish to offer materials conforming to other standards, salient points of difference between standards adopted and specific standards shall be clearly brought out in the respective schedule. Four copies of such standards with authentic English version shall be furnished along with the offer.

5.3. Whenever a material or an article is specified or described by the name of a particular brand, manufacturer or trade mark, the specific item shall be understood as establishing type, function and quality desired. Products of other manufacturers may also be considered, provided sufficient information is furnished, so as to enable the owner to determine that the products are equivalent to those mentioned.

5.4. Materials supplied/used shall conform in all respects to the relevant Indian Standard Specification with latest amendments there to.

	Title	IS No.
1.	Cement	IS 269
2.	Steel	IS 6003/1970
3.	Fasteners	IS 6639/1972
4.	Concrete mix	IS 1343
5.	RCC	IS 456
6.	Cable laying and jointing	IS 1255

Installation work pertaining to equipment, cable laying etc should be in accordance with the applicable standards, safety codes etc.

6. Site Storage/ Transportation

6.1. It shall be the responsibility of the contractor to store, move/transport from stores/storage yard etc., relevant items and accessories to the place of installation wherever necessary he will assemble all parts of equipment. In accordance with the specific installation instructions as directed by Site Engineer.

6.2. The stores should be dismantled and site cleared after the work is completed

7. Erection, Testing and Commissioning

7.1. All the works covered under the scope of the tender shall be done in accordance with the norms defined by the Employer, unless the same is not specifically defined in the specification or with the provisions of Indian Electricity Rules/Acts/Other Government Rules/Regulations as prevalent at the time of execution of the job/work.

7.2. Installation shall be carried out strictly in accordance with the approved drawings Modifications, if any, required to suit site conditions, shall be carried out only with the prior approval of the Site Engineer. All such changes shall be incorporated in "As built" drawings to be furnished by the contractor.

7.3. Responsibility for successful installation of other equipment accessories, purchased but not mentioned specifically above, and their commissioning shall be on contractor. For all such items the contractor shall be supplying all material and equipment required to accomplish the job complete in all respect.

7.4. Installation work pertaining to equipment, cable laying etc should be in accordance with the applicable standards, safety codes etc.

7.5. The contractors shall themselves be responsible for timely arrangement/ procurement of all the raw materials required for the manufacture of all tendered items by them/ their and / or by their vendors.

7.6. While Repairing & Replacing the equipment, if any other equipment gets damaged due to negligent handling of the contractor the same shall be replaced by the contractor at his cost to the owner satisfaction.

7.7. He shall be responsible for dismantling of defective equipments, there proper handling and shifting.

7.8. Also he shall hand over the old & dismantled equipments/ material to the purchaser's local stores or other sites as per instructions of the purchaser for which no extra payment shall be made.

7.9. All charges on account of damages/losses/claims/thefts etc. involved under the conditions laid down above shall be borne by the contractor. It's cost shall be recovered from his bills /security deposits /other assets.

7.10. In order to avoid hazards to personnel moving around, the equipment such as Transformer, Capacitor Banks, Switchgears etc. if required to be kept charged after installation till their commissioning, shall be cordoned off by suitable barriers to prevent accidental injury to personnel moving around.

7.11. Where the equipments/ assemblies are supplied in more than one part, the contractor shall make all necessary mechanical and electrical connections between the sections. The contractor shall also do necessary adjustment in the alignments required for its proper operation.

7.12. Care shall be taken in handling instruments relays and other delicate devices where instruments and relays are supplied separately they shall be mounted only after the associated switch gear/control panels are erected and aligned.

7.13. Precaution: The contractor shall exercise all possible care to avoid damage to public utilities e.g. water/ sewage pipes telephone and power lines/cable already existing. In case of any

accidental damage during the work, the contractor shall be responsible to repair/replace the same at his own cost, and shall ensure that the purchaser is not put to any loss.

7.14. The contractor shall have to provide proper lighting, barricading, signboards etc. at the work site as a necessary precautionary arrangement to avoid accident/ damage/ losses to the public /utilities/properties.

7.15. Site Solution: It may be possible due to some reasons or others that it would not be possible to work as per the procedure. In such case/cases, the solution to the problem shall be achieved by the purchaser with the consultation of contractor, and the contractor shall work as per procedure proposed by the purchaser. Such cases shall in variably be informed to the engineer of the contract for which no extra payments shall be made.

7.16. Space Constraints: While executing the job it is quite possible that some of the specified work may not be carried out due to space/land/ other technical constraints etc. In such case the concerned Employer, if required, may divert this work at some other site or cancel the left over portions of work.

7.17. The contractor shall ensure that the equipment under erection as well as the work area and the site are kept clean to the satisfaction of the Engineer. In case, the Engineer is not satisfied about the cleanliness he will have the right to carry out the cleaning operations and expenditure incurred in this regard will be to contractor's account. Packing cases and packing materials shall be promptly cleared from sites.

13.13. Specification for erection of 66 kV M/C, D/C tower / H-frame line :

1.1. GENERAL TECHNICAL PARTICULARS FOR ERECTION OF 66 KV LINES.

1.1.1. SCOPE :

The erection work covered under these sections consists mainly of

- Distribution of all materials to erection site.
- Stub setting.
- Tower Erection.
- Cold line Stringing.
- Testing and commissioning and Guarantee of Line.

1.1.2. The Contractor shall be fully responsible for completing all the above works and till them are taken over by the Employer.

1.1.3. The methods of erection are dealt within details, but are left to the Contractor who shall exercise his own judgment with regards to actual handling of materials and in deciding upon the best methods to be adopted in the erection of the towers, conductors and other materials.

1.2. WAY LEAVE/TREE CUTTING AND OTHER CONSTRUCTION :

1.2.1. The Employer will arrange for write off way and for tree cutting clearance, the Contractor will instruct his laborers & staff to use minimum area while doing the work where there are standing crops. No person of the Contractor should pick in items from standing crops of fruits. The Contractor should take all possible steps to avoid or minimize damage to standing crops etc.

1.2.2. The Contractor should immediately notify and obstruction or hindrance from local community or the local authorities in the prosecution of the work to the concerned Engineer-in-charge, but should not deal directly in the matter. The Engineer-in-charge will arrange to remove the obstacles as soon as possible.

1.3. ACCESS TO LOCATIONS :

1.3.1. It will be the Contractor's sole responsibility to take the materials up to the locations required. Any path way, temporary road or temporary bridge required will have to be provided by the Contractor at his cost. If for any reasons the above is not feasible the Contractor at his own cost shall have to arrange transportation by Head roads.

1.4. DISTRIBUTION OF MATERIALS :

1.4.1. The Contractor has to take delivery of tower materials/lines materials from the Employer's stores and transport it to the respective tower erection sites and will be responsible for any damages to or loss of all materials at any stage during the Transportation or erection. The materials that will be issued by the Employer will be in 'AS IS WHERE IS' conditions at the store center of the Employer in the area during working hours days. All the materials received by the Contractor shall

be got insured for storages and erection risk by the Contractor at his own cost. An indemnity Bond/Bonds have to be issued by the Contractor for the materials take over by him for erection.

1.4.2. On completion of the work all surplus tower and line materials including the excess Bolts & Nuts and stub materials shall be returned by the Contractor to the nearest respective stores of the Employer as per the instructions of the Engineer-in-charge of the works at no extra cost to the Employer.

1.4.3. The Contractor shall submit the complete material account immediately after the works is completed and in case not late than one month of completion and Handing over of the line.

1.5. STUB SETTING AND FOUNDATIONS :-

1.5.1. The Contractor shall be fully responsible for correct setting of stubs in accordance with approved methods at the exact locations and alignments and in precisely correct level; stub setting templates to the supplied by the Employer should be used for proper setting of stubs. The Contractor will be responsible for constructing the foundations in accordance with the design of each type of foundations supplied to him by the Employer and as per approved final schedules.

1.5.2. The foundation work includes stone revetment, concrete or earth filling above ground level where necessary and stacking and tamping on the site of all surplus excavated soil. Surplus stone should be stacked within the tower base.

1.5.3. Classification of Soil :

1. Normal soil : Which can be readily removed ordinary spades, shovels viz Normal Soil, Black cotton soil, Hard & Soft Morrum and Yellow clay.
2. Soft Rock : Literate, line stone or rock which break away chips or slabs.
3. Hard-Rock : Rock which may need chiseling or blasting.
4. wet Soil : Soil encounters in wet location.

1.5.4. **EXCAVATION FOR FOUNDATION :**

1.5.4.1. The tenderer should quote different rates for different types of soil. The Contractor will be intimated the alternative that will be operated, the payment for excavation will be limited to guaranteed volume as per approved excavation drawings that will be furnished by the Employer to the Contractor even though the Contractor may excavate more the sake of his own convenience. If the excavated depth is more than the depth shown in approved drawings, the additional depth should be filled in with lean concrete (1:4:8) at Contractor's cost.

1.5.5. **CONCRETE :**

1.5.5.1. The cement required shall be supplied by the Contractor approved by the Employer

1.5.5.2. All cement is used shall be accountable. If the quantity of cement utilized in the work is observed to be more than the permissible quantities worked out bases on the finally approved foundation drawings and subject to the maximum as per the guaranteed volumes, irrespective of the fact that the cost of cement is recovered from the Contractor's Bills.

The cement consumption for difference types of concrete shall be considered as follows:-

1. M-20 Mix (1:1.5:3) 8.2 bags.
2. M-15 Mix (1:2:4) 6.5 bags.

1.5.5.3. The sand shall be of best quality containing hard siliceous materials, clean and of snap angular grit type and free from earth or organics matter of salts and to the satisfaction of the Engineer-in-charge. The sand shall be washed before use. No. salty or Darkish water shall be used for concreting.

1.5.5.4. The aggregate shall be of the best quality to the satisfaction of the Engineer-in-charge and brakes to maximum size of 40mm for thick concrete and 20mm thin concrete section. It should also be free from grit and dirt.

1.5.5.5. The mixture of concrete to be used shall be such as to produce a sound : compact and water proof concrete and shall not be weaker than 1:2:4 ratio with 20mm stone metal for chimney portion and 40mm stone metal for mass concreting pyramid portion or slab portion, unit rates may be quoted for concrete of M-15 Mix ratio. The concrete shall be mixed as stiff as the requirements of placing the concrete in the form of molds with case and degree to which concrete resists segregations will permit. Hence the quantity of water used should not be too much.

1.5.5.6. Proper forms or molds adequately braced to retain proper shape while concreting should be used for chimney or pyramid and slab portions. Form boxes should be water tight so as not to allow cement cream to come out leaving only sand and jelly to form money coml. in concrete. Form excess boxes should be cleaned and oiled before using for concreting.

1.5.5.7. All wet locations must be kept completely dewatered both during the placing of concrete and for 24 hours after completion. There should be no disturbance of concrete by water during this period.

1.5.5.8. Form boxes should not be removed before 24 hours after concreting. Concrete surface where required should be set right with tick cement and mortar immediately after removal of the forms.

1.5.5.9. After 24 hours of pouring, the concrete should be cured by keeping it continuously wet for 14 days. The pit may be back filled with selected earth sprinkled with necessary amount of water and well consolidated layers not exceeding 150mm after 48 hours and thereafter both the exposed top and the fill shall be kept wet for the remainder of the prescribed time.

1.5.5.10. Payment for the quantity of excavation and concreting for each type of tower shall be made on prorate basis of actual work done subject to the maximum of guaranteed volumes as per the approved drawings to be furnished by the purchaser.

1.5.5.11. The supply of steel for reinforcement, if required is to be supplied by the Contractor

1.5.6. EXCAVATION IN ROCK :

1.5.6.1. Where towers are to be planted in rock, suitable holes should be drilled, but if drilling is difficult, blasting may be resorted to, but sufficient care should be taken to eliminate the possibility of serious cracking of the rock.

1.5.6.2. Care should also be taken to minimize the concreting for filling blasted areas. Stubs may be shortened suitably in case of drilled holes as per design drawings.

1.6. ERECTION OF TOWERS :

1.6.1. The superstructure of towers should be erected on foundations after 14 days of concreting. However, the method adopted for erection of towers is left to the decision of the Contractor subject to the condition that be takes responsibility for any damages to materials. No. tower member should get strained or bent during erection. The tower must be truly vertical after exaction and no straining would be allowed to bring it in alignment. Maximum tolerance in verticality that will be permitted is one mm per 360mm of tower height. All bolts and nuts shall be made fully tight and finally the bolt threads shall be centre purchased to avoid nuts becoming loose, punching of bolts shall be made by chamfering the threads with centre punch at least at three places equally spaced on contact surface of bolts and nuts.

1.6.2. Tower erection shall include erection of all accessories and fittings including attachment for step bolts, ladders, platform, 'U' Bolts shackles, Hangers, strain plates etc. and punching of bolts and nuts so that towers are completed in all respect.

1.6.3. Suitable tower extension shall be erected to get desired ground clearance whenever required. Which have been determined at the time of final survey.

1.7. GROUNDING :

1.7.1. It is necessary that in no case tower footing resistance should be more than 10 ohms. During dry weather.

1.7.2. PIPE TYPE EARTHING :

1.7.2.1. At location where footing resistance does not exceeds 10 ohms the pipe type earthing as per method specified by Employer would be followed. The Contractor will have to supply all materials required for grounding including salt, finely broken coke/charcoal, G.I. Pipe G.I. Wire clamp & Nuts-Bolts etc.

1.7.3. COUNTERPOISE EARTHING :

1.7.3.1. In place of high receptivity soil conditions, counterpoise earthing shall be adopted as per Employer specifications to bring down the tower footing resistance below 10 ohms. The counterpoise earthing shall be buried 600mm below ground level and for this purpose some space should be left out in chimney coping portion at the time of stub setting. Coping should be complete after installation of counterpoise earthing. All materials are to be supplied by the Contractor.

1.8. INSULATOR HOISTINGS:

1.8.1. Suspension Insulator strings shall be used on all tangent type towers with deviation up to 2 and tension insulator string on all shall medium, large angle and dead end type towers on all lines.

1.8.2. Insulators string shall be assembled on ground. These shall be cleaned and examined for their cracks ships or defective glazing (not exceeding half centimeter square) and then hoisted by careful handling, the work will include fitting of all hard wares and fitting in their proper places and order.

1.9. STRINGING OF CONDUCTOR AND GROUND WORK:

1.9.1. Before commencing of stringing work, tower healthiness certificate of each & every tower location must be submitted to Engineer in charge in writing.

1.9.2. Before commencing of stringing work, Contractor must obtain approval of sag tension charts showing initial and final sags and tensions for various temperature and spans.

1.9.3. The Contractor shall be responsible and will take care of proper handling of drums from stores to site, sufficient numbers of aluminum sketch blocks shall be used for laying out the A.C.S.R. Conductors. Necessary precautions shall be taken to avoid conductor rubbing on the ground by providing adequate ground rollers on supports. Additional rollers shall also be provided to cross thorny hedges, forcing and other obstructions to avoid scratching of conductors. The conductor and ground wire shall be made to sag correctly as per stringing charts before they are finally transferred to the hard wares for conductors and to clamps for ground wire, No joints should be made at less than 30 meters from the tower and that no joint shall be permitted in Railway., River & Road crossing spans. There shall not be more than one joint in a span of each conductor. All conductors shall be stressed to their maximum working load at the time of stringing.

1.9.4. The minimum clearance between the lowest point of conductor and ground shall not be less than required those. All compression joints should be carefully made and a record of initial and final length of the joints, jointly signed by Contractor's and Employer's representatives should be maintained. Dynamometer shall be used in tensioning the conductors, check for sag should also be made at intervals when conductors are drawn up. Over stressing, causing damage to towers, should be avoided care should be exercised not to over tension the conductor. An extra sag if 150mm should be allowed at all important tension points like Railway and River crossing. After being pulled the conductor/ground wire shall not be allowed to hang in the stringing sheaves for more than 72 hours before being pulled to the specified sag. During the time the conductor/ground wire is on the stringing sheaves before sagging in, it shall be ensured that the conductors/ground wire is not damaged to wind, vibration vehicles or other causes.

1.9.5. The conductor shall be pulled up to desired sag, and left in Arial stringing sheaves for at least one hours after which the sag shall be rechecked and adjusted, if necessary, before clipping in an transferring the conductors from the Arial stringing sheaves to the suspension clamps.

1.9.6. Conductor shall be clamped within 24 hours of sagging in. The sag will be checked the first and last span of the section in case of sections up to eight spans and in one intermediate open also for section with more than eight spans.

1.9.7. The stinging sheaves, when suspended on the transmission structure for sagging, shall be so adjusted that the conductor will be on the sheaves at the same height as the suspension clamp to which it is secured.

1.9.8. All the line conductors shall be terminated at sub-station structures whose details shall be furnished by the Employer, at the appropriate times, The Contractor shall fix strain insulators on the sub-station structures.

1.9.9. P.A Rods and Vibration Dampers shall be fitted at each suspension towers before final clamping of conductor with insulator string. Vibration damper are to be fixed using aluminum tape

with each clamping bolt and in correct vertical position in relation to conductor. Compression type joints are to be used for jointing of conductors. Each part connected with joints shall be perfectly cleaned by wire brush and properly greased before final compression. All the joints of conductors and earth wire shall be made in the best workmanship manner and shall be perfectly straight and having maximum possible strength.

1.9.10. Stringing work includes the hoisting insulators, fixing hardware, lifting amour rods, and vibration dampers, making joints, repair sleeve etc. All stringing tools and hydraulic compressor machine should be arranged by the Contractor.

1.10. SUPPLY OF MATERIALS BY EMPLOYER :-

1. G.I. Tower Material & Nut-Bolts & ACD excluding barbed wire.
2. Conductors, Earth Wire, Disc Insulators, Hardware for conductor and Earth Wire as the case may be.
3. All jointing materials and accessories for ACSR conductor.
4. Any other items required to complete the work.

1.11. MATERIALS TO BE SUPPLIED BY THE CONTRACTOR:-

1. Cement, Sand, Stone, and Crusher, metal, gravels and morrum.
2. DP/NP/PP/CIP Including supply of G.I. Nut Bolts and Barbered wire for fixing of anti-climbing devices complete.
3. Coke, Salt and G.I. wire and all earthing requirements.
4. Heavy duty G.I. Earthing pipe 32 mm dia, 3 mtr. Long and 50x6 mm. G.I. Flat with nut-bolt for pipe type earthing and G.S.S. Wire, Lugs, Bolts, Nuts etc for CP type earthing as per specification.
5. Any other materials which shall be required to complete the work satisfactorily in all respects and not specified in above for supply of materials by the Employer.
6. Steel bars required for reinforcement.

13.14. Plinth Mounted Distribution Substations

1.0 SCOPE

The specification covers the design, engineering, manufacture, stage inspection, testing, pre-delivery inspection, supply, delivery, loading, unloading and performance requirements of 11/0.433 KV non-sealed type aluminum and copper wound distribution transformers for outdoor use. The transformers shall be double wound, three phase, oil immersed with ONAN cooling. The rating required under this specification is 500 KVA with copper windings.

The equipment offered should have been successfully type tested within five years from date of tender and the designs should have been in satisfactory operation for a period not less than three years as on the date of bid opening. Compliance shall be demonstrated by submitting with the bid, (i) authenticated copies of the type test reports and (ii) performance certificates from the users, specifically from Central Govt./ State Govt. or their undertakings.

The scope of supply should also include the provision of type tests on random samples if desired by the purchaser. In this case the bidder has to bear the charges for conducting such type tests at CPRI or National Govt. approved Laboratory.

The transformer shall conform in all respects to highest standards of engineering, design, workmanship, this specification and the latest revisions of relevant standards at the time of offer and the Purchaser shall have the power to reject any work or material, which, in his judgment, is not in full accordance therewith.

2.0 CODES & STANDARDS

Except where modified by this specification, the transformers shall be designed, manufactured and tested in accordance with the latest editions of the following standards. The Bidder may propose alternative standards, provided it is demonstrated that they give a degree of quality and performance equivalent to or better than the referenced standards. Whether to accept or reject any alternative standard shall be adjudged by the Purchaser. The Bidder shall furnish a copy of the alternative standard proposed along with the bid. If the alternative standard is in a language other than English, an English translation shall be submitted with the standard. In the case of conflict the order of precedence shall be 1) IEC or ISO Standards, 2) Indian Standards, 3) other alternative standards.

IEC/ISO	Indian Standard	Subject
IEC 71		Insulation Coordination
IEC 76	IS 2026	Power Transformers
	IS 1180	Outdoor Three Phase Distribution Transformers up to 500 KVA, 11/ 0.433 KV, Non- Sealed Type
IEC 137	IS 2099	Bushing for Alternating Voltages above 1000V
IEC 156		Method of determining Electric Strength of Insulating Oils.
IEC 296	IS 335	Specification for Unused Mineral Insulating Oils for Transformers and Switchgear
	IS 6792	Method of determination of electric strength of insulating oils.
IEC 354	IS 6600	Loading Guide for oil immersed Transformers
IEC 437		Radio Influence Voltage Measurement
IEC 551		Determination of Transformer and Reactor Sound Levels.
IEC 616		Terminal and Tapping markings for power transformers.
IEC 722		Guide to the Lightning and Switching impulse testing of Power Transformers and Reactors
ISO 1460/BS 729		Galvanizing

This list is not to be considered exhaustive and reference to a particular standard or recommendation in this specification does not relieve the Supplier of the necessity of providing the goods complying with other relevant standards or recommendations.

3.0 SERVICE CONDITIONS

The service conditions shall be as follows:

- maximum altitude above sea level - 1,000m
- maximum ambient air temperature - 50° C
- maximum daily average ambient air temperature - 35° C
- minimum ambient air temperature - 5° C
- maximum temperature attainable by an object exposed to the sun - 60 ° C
- maximum yearly weighted average ambient temperature - 32° C
- maximum relative humidity - 100%
- average number of thunderstorm days per annum (isokeraunic level) - 70
- average number of rainy days per annum - 120
- average annual rainfall - 1500 mm
- maximum wind pressure - 260Kg / m2

Environmentally, the region where the equipment will be installed includes coastal areas, subject to high relative humidity, which can give rise to condensation. Onshore winds will frequently be salt laden. On occasions, the combination of salt and condensation may create pollution conditions for outdoor insulators.

Therefore, outdoor material and equipment shall be designed and protected for use in exposed, heavily polluted, salty, corrosive, tropical and humid coastal atmosphere.

4.0 SYSTEM CONDITIONS:

The equipment shall be suitable for installation in supply systems of the following characteristics.

Frequency		- 50 Hz ± 5%
Nominal system voltages	11 KV System	- 11 KV
	LV System	- 433/250 V
Maximum system voltages	11 KV System	- 12 KV
	LV System	- 476 V
Minimum LV voltage	(NEC)	- 392 V
Nominal short circuit apparent power of	11 KV System	- 500 MVA (IS: 2026)
Insulation levels		
1.2/50 μ sec impulse withstand	11 KV System	- 75KV peak (IS:2026)
Power frequency one minute withstand	11 KV System	- 28 KV (rms)
(wet and dry)	LV System	- 3 KV (rms)
Neutral earthing arrangements:	LV System	- Solidly earthed

PART 2: TECHNICAL

		SPECIFIC TECHNICAL REQUIREMENTS		
1		Rated KVA (ONAN rating)		500 KVA, 11/ 0.433 KV
2		No. of phases		3
3		Type of installation		Outdoor
4		Frequency		50 Hz (± 5%)
5		Cooling medium		Insulating Oil (ONAN)
6		Type of mounting		for 500 KVA on Wheels, Mounted on rails.
7		Rated voltage		
	a)	High voltage winding		11 KV

	b)	Low voltage winding		0.433 KV
8		Highest continuous system voltage		
	a)	Maximum system voltage ratio (HV/ LV)		12 KV / 0.476 KV
	b)	Rated voltage ratio (HV / LV)		11 KV / 0.433 KV
9		No. of windings		Two winding Transformers
10		Type of cooling		ONAN (Oil natural / Air natural)
11		KVA Rating corresponding to ONAN cooling system		100%
12		Method of connection:		
		HV:		Delta
		LV:		Star
13		Connection symbol		DYN 11
14		System earthing		Neutral of LV side to be solidly earthed.
15		Percentage impedance voltage on normal tap and KVA base at 750 C corresponding to HV/ LV rating and applicable tolerances (Negative tolerance will not be allowed):		% Impedance + Tolerance %
				5.0 + 10% (No Negative Tolerance)
16		Intended regular cyclic overloading of windings		As per IEC –76-1, Clause 4.2
17	a)	Anticipated unbalanced loading		Around 10%
	b)	Anticipated continuous loading of windings (HV / LV)		110 % of rated current
18	a)	Type of tap changer		Off-load tap changer
	b)	Range of taping		+ 2.5% to – 7.5% in 5 equal steps of 2.5% each on HV winding
1		Neutral terminal to be brought out		On LV side only

9				
20		Over Voltage operating capability and duration		112.5 % of rated voltage (continuous)
21		Maximum Flux Density in any part of the core and yoke at rated KVA, rated voltage i.e. 11 KV / 0.433 KV and system frequency of 50 HZ		1.5 Tesla
22		Insulation levels for windings :-		
	a)	1.2 / 50 microsecond wave shape Impulse withstand (KVP)		HV: 28 LV: N.A.
	b)	Power frequency voltage withstand (KV- rms)		HV: 28 LV: 03
23		Type of winding insulation		
	a)	HV winding		Uniform
	b)	LV winding		Uniform
24		Withstand time for three phase short circuit		2 Seconds
25		Noise level at rated voltage and frequency		As per NEMA Publication No. TR-1
26		Permissible Temperature Rise over ambient temperature of 50^0C		
	a)	Of top oil measured by thermometer.		35^0C
	b)	Of winding measured by resistance.		40^0C
27		Minimum HV clearances in air (mm) :-		
	a)	Phase to Phase		280
	b)	Phase to ground		140
28		Terminals		
	a)	HV winding line end		12 KV oil filled porcelain communicating type of bushings (Antifog type)
	b)	LV winding		0.433 KV porcelain type of

				bushings (Antifog type)
29		Insulation level of bushing		HV LV
	a)	Lightning Impulse withstand (KVP)		75 Not applicable
	b)	1 Minute Power Frequency withstand voltage (KV –rms)		28 3
	c)	Creepage distance (mm) (minimum)		25 mm/ KV
30		Material of HV & LV Conductor		Electrolytic Copper for 500 KVA
31		Maximum current density for HV and LV winding for rated current		1.4 Amp/ mm2 for Aluminum windings and 2.4 Amp/ mm2 for Copper windings.
32		Polarisation index i.e ratio of megger values at 600 sec. to 60 sec for HV to earth, L.V to earth and HV to LV.		Shall be greater than or equal to 1.5, but less than or equal to '5'.
33		Core Assembly		Boltless type
34		Maximum permissible No Load and Load Losses (Watts)		500 KVA
	a)	No Load Losses at rated voltage and rated frequency	-	950
	b)	Load Losses at rated current and at 750 C	-	6500

5.0 TYPE OF TRANSFORMER

The transformers shall be of core type construction, double wound, three phase, oil immersed, 11/0.433KV, 50 Hz with natural oil and air cooling (ONAN) to be used as step down transformers for outdoor use. The design of the tank, fittings, bushings, etc shall be such that it will not be necessary to keep the transformer energized to prevent deterioration as the transformers may be held in reserve, outdoors, for many years.

6.0 PERFORMANCE , CAPACITY AND SHORT CIRCUIT RATINGS

The following ratings are covered under this specification

• 500 KVA, 11/0.433 KV, Copper wound

The transformer shall be capable of supplying a continuous load equal to its KVA rating, under the following conditions:

- continuous steady load;
- design at maximum ambient air temperature of 50^0C;
- 40^0 C average winding temperature rise and 35^0C top oil temperature rise for conventional breathing transformers.

The transformer may be overloaded during emergency up to 150% of its continuous rating in accordance with IEC Publication 354 or IS: 6600. Bushings and other current-carrying parts shall also be designed for this condition.

The transformer shall be capable of withstanding for two seconds without damage to any external short circuit, with the short circuit MVA available at the terminals of either winding with rated voltage on the other winding. If short circuit tests have been carried out on the particular design of transformer offered, the test results shall be supplied with the bid.

The thermal ability to withstand short circuit shall be demonstrated by calculation.

The transformer shall be capable of withstanding the thermal and dynamic effects of short circuits, as specified in IEC 76-5 or IS: 2026: Ability to withstand short circuits.

The maximum flux density in any part of the core and yoke at rated KVA, Voltage and frequency shall not exceed 1.5 Tesla.

7.0 VOLTAGE RATIO & TAPPING RANGE

The transformers shall have the following ratio:-

- the nominal voltage ratio shall be 11,000/ 433 V for 500 KVA transformers;
- Tolerance on the voltage ratio shall be ± 0.5%.
- For transformers of ratings 500 KVA, 11/0.433 KV, Taps shall be provided on the H.V. Windings for voltage variation from tap-1 (+2.5%) to tap-5 (- 7.5%) in equal steps of 2.5 %. Tap No-2 shall be the principal (normal) tap.

The bidder shall state in the technical schedule, the percentage regulation at full load, power factor 1.0 and at full load, power factor 0.8 lagging.

Transformers shall be suitable for parallel operation with each other.

8.0 PERCENTAGE IMPEDANCE

The Percentage of Impedance at 75ºC shall be 5% for 500 KVA transformer with positive tolerance of 10%. No negative tolerance on percentage Impedance is allowed.

9.0 LOSSES

The No Load and Load Losses shall not exceed the values given below:-

KVA Rating	Maximum No Load loss in Watts	Maximum Full Load loss in Watts at 75ºC.
500 KVA	950	6500

The above losses are maximum allowable and there should not be any positive tolerance.

The offered transformer(s) should have been type-tested at CPRI/ National Govt. approved laboratory. The bid shall be accompanied with type-test reports (short circuit test and Impulse test) conducted at Central Power Research Institute / National Govt. approved laboratory for the offered transformers within five years from date of tender. The short circuit test report(s) must contain the measured no load loss and load loss, determined by CPRI/ National Govt. approved laboratory.

In case of any doubts, <EMPLOYER> reserves the right to verify the original type test reports of CPRI/ National Govt. approved Laboratory or ask the supplier to conduct the type tests at CPRI/ National Govt. approved Laboratory at his (supplier's) cost for re-confirmation of the test results particularly no load losses, load losses and percentage impedance. Bids without type test reports shall not be considered for evaluation.

If the bidder quotes lower values of losses than the CPRI's measured losses, he has to prove the same by conducting the Impulse & short Circuit tests at CPRI/ National Govt. approved laboratory along with measurement of no load losses and load losses at his own cost in presence of EMPLOYER' s authorized representative without any financial liability to EMPLOYER.

However, if the loss figures will exceed the stipulated values as per specification, the transformer(s) shall be out rightly rejected.

10.0 VECTOR GROUP

The transformers shall be connected delta-star, in accordance with vector group reference Dyn11 of IEC - 76/ IS - 2026.

The LV neutral shall be brought out to a terminal bushing, which shall be identical to the phase bushings in all respects.

11.0 LOSSES AND CAPITALISATION

Transformers would be out rightly rejected if losses exceed the values indicated at clause-10 above.

12.0 FLUX DENSITY

The flux density at rated voltage & rated frequency shall not exceed. 1.50 Tesla. The transformer must be capable of operating at 10% over voltage and at frequency of 48.5 Hz without saturation.

13.0 INSULATION LEVELS

The insulation levels as defined in IEC 76-C/ IS: 2026 Insulation levels and dielectric test shall apply as per Table.

	HV Winding	LV Winding
Basic Impulse voltage Level (KVp) (1.2/50 micro. sec. Wave)	75	Not Applicable
Power Frequency voltage withstand level, Wet and Dry (KV)	28	3

14.0 NOISE LEVEL

The average noise level of the transformers shall not exceed 51db. The measurement shall be carried out in accordance with IEC 551 at a distance of 300mm from the envelope of the transformer.

15.0 RADIO INFLUENCE VOLTAGE

The maximum radio influence voltage shall be 250μ V, measured as specified in IEC 437.

16.0 CORE AND WINDINGS

Core

- Stage level inspection for core construction shall be carried out by the owner.
- Each lamination shall be insulated such that it will not deteriorate due to mechanical pressure and the action of hot transformer oil.
- The core shall be constructed from high grade, non-ageing, Cold Rolled Grain Oriented silicon steel laminations (CRGO or M3 or better) only. No other core materials shall be entertained. Bidders are requested to note that only PRIME CORE materials are to be used. In no case, second grade core material is to be used. The bids should contain copies of invoices towards purchase of core laminations along with test certificates and curves of specific core loss of the laminations proposed to be used.

The purchaser at his discretion, may select samples from the core laminations and get the same tested in CPRI/ Approved National Govt. Laboratory to prove the quality of the core material.

- For the above purpose, the supplier shall have to offer every batch of core laminations received from his Sub-Vendor along with Invoice of the sub-vendor, Mills test certificate, packing list, Bill of lading, Bill of entry certificate to customs etc. towards proof of prime core materials for verification by the Purchaser's representative without any cost to the Purchaser. Besides, the contractor must mention in his bid about the type of CRGO lamination to be utilized for the offered transformers along with a copy of the specific core loss curve at different flux densities.
- Core materials should be directly procured either from the manufacturer or through their accredited marketing organization of repute, but not through any agent. The core and winding shall be capable of withstanding shocks during transport, installation and service. Provision shall be made to prevent movement of the core and windings relative to the tank during these conditions and also during short circuits.
- The design shall avoid the presence of pockets which would prevent the complete emptying of the tank through the drain valve. The core material offered in the tender to be checked for its correctness before core coil assembly. For this, the tenderer must ask for core and coil inspection before its tanking.
- The laminations shall be free of all burrs and sharp projections. Each sheet shall have an insulting coating resistant to the action of hot oil.
- The insulation structure for the core to bolts and core to clamp plates, shall be such as to withstand 2000 V DC voltage for one minute.
- The completed core and coil shall be so assembled that the axis and the plane of the outer surface of the core assemble shall not deviate from the vertical plane by more than 25mm.
- All steel sections used for supporting the core shall be thoroughly shot or sand blasted, after cutting, drilling and welding.
- The finally assembled core with all the clamping structures shall be free from deformation and shall not vibrate during operation.
- The core clamping structure shall be designed to minimize eddy current loss.
- The framework and clamping arrangements shall be securely earthed.

- The core shall be carefully assembled and rigidly clamped to ensure adequate mechanical strength.
- Oil ducts shall be provided, where necessary, to ensure adequate cooling inside the core. The welding structure and major insulation shall not obstruct the free flow of oil through such ducts.
- The design of magnetic circuit shall be such as to avoid static discharges, development of short circuit paths within itself or to the earth clamping structure and production of flux component at right angle to the plane of the lamination, which may cause local heating. The supporting framework of the cores shall be so designed as to avoid the presence of pockets, which would prevent complete emptying of the tank through the drain valve or cause trapping of air during filling.
- The construction is to be of boltless core type. The core shall be provided with lugs suitable for lifting the complete core and coil assembly. The core and coil assembly shall be so fixed in the tank that shifting will not occur during transport or short circuits.

INTERNAL EARTHING

- All internal metal parts of the transformer, with the exception of individual laminations and their individual clamping plates shall be earthed.
- The top clamping structure shall be connected to the tank by a copper strap. The bottom clamping structure shall be earthed by one or more the following methods:

a) By connection through vertical tie-rods to the top structure.
b) By direct metal to metal contact with the tank base.
c) By a connection to the structure on the same side of the core as the main earth connection to the tank.

- The magnetic circuit shall be connected to the clamping structure at one point only and this shall be brought out of the top cover of the transformer tank through a suitably rated insulator. A disconnecting link shall be provided on transformer tank to facilitate disconnections from ground for IR measurement purpose.
- Coil clamping rings of metal at earth potential shall be connected to the adjacent core clamping structure on the same side as the main earth connections.

Windings

- Winding shall be subjected to a shrinking and seasoning process, so that no further shrinkage occurs during service. Adjustable devices shall be provided for taking up possible shrinkage in service.
- All low voltage windings for use in the circular coil concentric winding shall be wound on a performed insulating cylinder for mechanical protection of the winding in handling and placing around the core.

- Winding shall not contain sharp bends which might damage the insulation or produce high dielectric stresses. No strip conductor wound on edge shall have width exceeding six times the thickness.
- The winding insulation shall be free from insulating compounds which are liable to soften, ooze out, shrink or collapse. It shall be non catalytic and chemically inert in hot transformer oil during normal service.
- The stacks of windings are to receive adequate shrinkage treatment.
- The windings and connections are to be braced to withstand shocks during transport, switching, short circuit or other transient conditions.
- Permanent current carrying joints in the windings and leads shall be welded or brazed. Clamping bolts for current carrying parts inside oil shall be made of oil resistant material which shall not be affected by acidity in the oil steel bolts, if used, shall be suitably treated.
- Terminals of all windings shall be brought out of the tank through bushings for external connections.
- The windings shall be uniformly insulated and the L.V neutral points shall be insulated for full voltage.
- The completed core and coil assemble shall be dried in vacuum at not more than 0.5mm of mercury absolute pressure and shall be immediately impregnated with oil after the drying process to ensure the elimination of air and moisture within the insulation. Vacuum may be applied in either vacuum over or in the transformer tank.
- The winding shall be so designed that all coil assembles of identical voltage ratings shall be interchangeable and field repairs to the winding can be made readily without special equipment. The coils shall have high dielectric strength.
- Coils shall be made of continuous smooth high grade electrolytic copper or aluminium conductor shaped and braced to provide for expansion and contraction due to temperature changes.
- Adequate barriers shall be provided between coils and core and between high and low voltage coil. End turn shall have additional protection against abnormal line disturbances
- The insulation of winding shall be designed to withstand voltage stress arising from surge in transmission lines due to atmospheric or transient conditions caused by switching etc
- Tapping shall not be brought out from inside the coil or from intermediate turns and shall be so arranged as to preserve as far as possible magnetic balance of transformer at all voltage ratios.
- Magnitude of impulse surges transferred from HV to LV windings by electromagnetic induction and capacitance coupling shall be limited to BIL of LV winding.
- The winding conductor shall be of Al. up to 250 KVA transformers and copper for 500 KVA Transformers. The current density shall not exceed 1.4 Amp/ mm2 for aluminium and 2.4 Amp/ mm2 for copper at normal full load current.

17.0 BUSHINGS AND TERMINATIONS

Bushings

- Bushings shall be of the outdoor type and easily replaceable. Cemented in types will not be accepted. They shall be sufficiently robust to withstand normal transport and erection hazards and shall confirm to IEC 137 /IS 3347 and 2099.
- All bushings shall have a minimum creepage distance of 25 mm /KV and shall have a continuous rating of 200% of the transformer rating. The protected creepage distance shall not be less than 50% of the total.

The following minimum 11 KV clearance shall be provided:

	External (Air) for 11 KV
Phase to phase	280 mm
Phase to earth	140 mm

- The 11 KV bushings of transformers shall be provided with a bi-metallic terminal connector or suitable device to receive 55 –100 mm^2 AAAC or ACSR conductor directly without any bimetallic action.
- The secondary bushings of transformers shall be fitted with non ferrous threaded terminals. With the exception of brass the terminals shall be protected from atmospheric deterioration by suitable tinning or by some other approved coating.
- The terminals are to be supplied with one 16mm bolt, one conic spring washer, one matching flat washer, one nut and one lock nut for each hole in the terminal plate.
- HV Bushing stud shall be not less than 12 mm dia for 250KVA & 500KVA with HV side terminal connectors & LV Bushing stud shall be not less than 32 mm dia for 500KVA & 20 mm dia for 250KVA with Palm terminal connectors (For LV studs)

Bushing Labels

- The HV bushings shall be labeled U, V and W and the LV bushing u, v, w and n. Marking letters shall be at least 12 mm high. The means of marking shall be either,

❖ engraved metal plate; or
❖ etched anodized aluminum.

Phase identification by adhesive stickers shall not be acceptable.

- If labeling is to be carried out on the tank, it is preferred that one plate be used rather than individual markings for each phase, in order to prevent incorrect phase markings. Labels shall conform to the requirements of the section on labels in this specification.

Earthing Terminals

All transformers shall be provided with two earthing terminals conforming to relevant Standards and M12 ISO metric bolt and nut which shall be non ferrous. It shall include a spring washer and lock washer.

18.0 LIGHTNING ARRESTORS

9 KV, 5KA metal oxide lightning arresters of reputed make conforming to IS-3070 Part- III, one number per phase shall be provided.(Under the HV bushing with GI earth strip 25x4 mm connected to the body of the transformer with robust clamping arrangement). Lightening arrestors with polymer insulators in conformance with relevant IEC can also be used.

19.0 TANK FABRICATION

All transformer sizes, the tank shall be of bolted type construction in accordance with IS 1180 (Part 2).

- The tank shall be at atmospheric pressure at an internal temperature of 100 C;
- The tank shall be designed for an internal pressure of 100 Kg/ m^2 at 50^0 C ambient conditions. It shall be capable of withstanding an unlimited number of 24 hours cyclic variations of internal pressure from atmospheric to this value.
- The tenderer shall state the top oil temperature at which the tank internal pressure shall reach the value of 100 kN/ m^2 and the value of steady load which will result in this top oil temperature with an ambient temperature of 45^0 C.
- Adequate space shall be provided at the bottom of the tank for collection of sediments.

Transformer tanks of all types shall be designed so that the completed transformer can be lifted and transported without permanent deformation or oil leakage. Stiffeners provided on all the four side walls for rigidity should be so designed that there is no accumulation of water.

The Tank shall be of rectangular shape with round edges fabricated from tested quality mild steel plates with minimum thickness of 3.15 mm. for the side walls while top cover and the bottom plate of the tank shall have a minimum thickness of 5 mm. The transformer tank and the top cover shall be designed in such a manner as to leave no external pockets in which water can log, or any internal pocket where air/ gas can accumulate.

All sealing washers / gaskets shall be made of oil and heat resistant neoprene rubber or neoprene bonded cork seals suitable for temperature as stipulated in this specification. Surfaces at gasketted joints shall be such that an even face is presented to gasket, thereby eliminating the necessity for the gasket to take up surface irregularities.

All pipes, radiators, stiffeners or corrugations which are welded to the tank wall shall be welded externally and shall be double welded wherever possible. All welds shall be stress relieved.

The transformer tank shall be complete with all accessories, lifting lugs etc. and shall be designed to allow the complete transformer filled with oil to be lifted by crane or jacks without risk of any damage and can be transported by Rail/ Road without straining any joints and without causing any leakage of oil.

20.0 PRESSURE RELIEF DEVICE

Transformers shall be fitted with a pressure relief device in the form of explosion vent. The tenderer shall state the pressure at which it is designed to operate.

21.0 OIL LEVEL GAUGE

A suitable oil level gauge (Magnetic type) shall be fitted on the transformers and so located that it can be easily read from ground level. The gauge fitted with the conservator shall be graduated for temperatures of 5^0 C, 30^0 C and $+98^0$ C.

22.0 CONSERVATORS AND BREATHERS

All the transformers shall be provided with a conservator tank.

The conservator tank shall be so designed and located as to eliminate any trapping of air in the transformer or pipe work. It shall be inclined at an angle of about 5 degrees to the horizontal towards the drain plug and the pipe connecting the main tank to the conservator should project about 20 mm above the bottom of the conservator so as to create a sump for the collection of impurities. Minimum oil level corresponding to 50 C shall be well above the sump level.

All transformers shall be fitted with a silica gel breather of weatherproof design at a convenient height with oil seal at the bottom, draw in plug and filling holes with covers to isolate the silica gel from the atmosphere. The breather pipe should be connected at top of the conservator tank with two bends at right angles. The cover of the main tank and bushings turrets shall be provided with air release plug to enable the trapped air to be released.

23.0 FITTINGS AND ACCESSORIES

The following standard fittings and accessories shall be provided:

- rating, diagram and terminal marking plate.
- two earthing terminals .
- lifting lugs/ platform lugs.
- pressure relief device in form of explosion vent.
- silica gel breather. (1 Kg for 500KVA)

- filling and drain / sampling plugs (A single drain / filling plug shall consist of a 20 mm pipe inside the transformer tank, starting from the bottom and projecting to the top cover with a hermetically sealed / welded plug).
- a magnetic or prismatic oil level gauge for all transformers indicating three position of oil i.e. minimum. 5 ^{0}C, 30 ^{0}C and 98 ^{0}C.
- A thermometer pocket with thermometer with screwed top to prevent ingress of water or leakage oil.
- Inlet valve having p-30 mm thread (with cover) on the transformers body/ conservator.
- Drain valve 12 mm size for draining the conservator oil with locking arrangement.
- Top filter valve (25 mm with adopter for 16 mm hole) with plug.
- Bottom filter valve with drain Plug.
- Air release plugs at transformer top cover, bushing turrets etc.
- Lightning Arresters (LA) for HT bushing.
- Set of Radiators.
- Conservator Tank.

Bi-metallic terminals on the bushings for connection with over head ACSR/ AAAC conductor (For HV & LV).
The Specification and brief details of the salient features of these terminals should be stated.

The fittings, tap-changer for 250 KVA and 500 KVA Transformers, accessories and sizes listed are indicative only and any other fittings and accessories which are generally required for satisfactory operation of the transformer are to be provided without any extra cost.

24.0 TAP CHANGING ARRANGEMENTS

Off - load tap changing mechanism for 250 KVA & 500 KVA, 11/0.433 KV Transformers shall have the following characteristics:-

- Tap changing shall be carried out with the transformers in off circuit.
- Tap positions shall be numbered as follows:

Tap No. - 1	Tap No. - 2	Tap No. - 3	Tap No. - 4	Tap No. - 5
+ 2.5 %	Principal/ Normal tap	- 2.5 %	- 5 %	- 7.5 %

- Provision shall be made for locking of the tap switch handled by using a pad-lock with 6 mm diameter hasp.
- Tap-changing handles shall be fitted with gasketed covers, so that sealing of the transformers under normal condition is independent of the switch shaft gland.

25.0 TRANSFORMER OIL

The transformers shall be supplied complete with first filling of transformer oil and 10% extra. The quantity of oil required for the first filling of the transformer and its full specification shall be stated

in the bid. The complete first filling shall be of new oil free from inhibitors and additives. The bidder shall quote the price of transformer complete with first filling of oil plus 10% extra. However, the rate of transformer oil in Rupees per litre shall be quoted separately also. The transformer oil shall be supplied in non-returnable drums.

The insulating oil for the transformer shall be of EHV grade, generally conforming to IEC: 296/ BS: 148/ REC: 39/ 1993 or latest version of IS: 335/ 1983 whichever is more stringent. No inhibitors shall be used in the oil. The dielectric strength of the oil shall not be less than 60 KV at 2.5 mm. gap when tested in accordance with IS: 6792/ 1972. If an anti-oxidant inhibitor is recommended, its use shall be subject to the purchaser's approval.

The design and materials used in the construction of the transformer shall be such as to reduce the risk of the development of acidity in the oil.

The contractor shall warrant that oil furnished is in accordance with the following specifications.

S. No	Characteristic	Requirement	Method of Test
1	Appearance	The oil shall be clear & transparent & free from suspended matter or sediment	A representative sample of oil shall be examined in a 100 mm thick layer at ambient temp.
2	Density at 200C	0.89 g/cm3 Max.	IS:1448
3	Kinematic Viscosity at 27 deg. C Max	27 CST	IS:1448
4	Interfacial tension at 27deg.C Min.	0.03 N/m	IS:6104
5	Flash Point	136 0C	IS:1448
6	Pour Point Max.	-6 0C	IS:1448
7	Nautralisation Value (Total Acidity) Max.	0.03 mg KOH/gm	IS:335
8	Electric strength Breakdown (voltage) Min.	72.5 KV	IS:6792
9	Dielectric dissipation factor tan delta at 900 C	0.03 Max	IS:6262
10	Min specific resistance(resistively) at 90 deg.C	35X1012 ohm cm (min.)	IS:6103
11	Oxidation stability		
12	Neutralization value after oxidation	0.40mg KOH/g	

13	Total sludge after oxidation	0.10% by weight max.	
14	Presence of oxidation Inhibitor	The oil shall not contain anti-oxidant Additives.	IS:335
15	Water content Max:	Less than 25ppm	IS:2362

26.0 RATING AND CONNECTION PLATE

Each transformer shall be provided with a rating plate of weatherproof material showing the following items indelibly marked:

- type of transformer
- standard to which it is manufactured (preferably IEC 76)
- manufacturer's name
- transformer serial number
- year of manufacture
- rated frequency in Hz (50)
- rated voltages in KV (11/0.433)
- number of phases (3)
- rated power in KVA
- type of cooling (ONAN)
- rated currents in A
- vector group symbol (Dyn11)
- 1.2/50μs wave impulse voltage withstand level in KVp
- power frequency withstand voltage in KV
- impedance voltage at rated current and frequency in percentage at 75ºC at normal tap
- Measured load loss in KW at rated current and at 75ºC at normal tap
- Measured no-load loss in KW at rated voltage and rated frequency
- continuous ambient temperature at which ratings apply in 0C
- top oil and winding temperature rise at rated load in 0C
- winding connection diagram
- total weight in kg with complete oil filled.
- total weight of the transformer without oil
- volume of oil in litres.
- weight of core and windings in kg; and
- name of the purchaser (<EMPLOYER>)

The rating plate shall conform to the requirements of the section of Labels in this specification.

27.0 BASE MOUNTING ARRANGEMENT

The under base of all transformers of 460 mm long with holes of 14 mm dia at a centre to centre distance of 415 mm to make them suitable for fixing on a platform or plinth. 500 KVA transformers shall be provided with bi-directional flat rollers, suitable for use on a 1000 mm gauge track.

28.0 PAINTING

All paints shall be applied in accordance with the paint manufacturer's recommendations.

Particular attention shall be paid to the following:
a) Proper storage to avoid exposure as well as extremes of temperature.
b) Surface preparation prior to painting.
c) Mixing and thinning
d) Application of paints and the recommended limit on time intervals between coats.
e) Shelf life for storage.

All paints, when applied in normal full coat, shall be free from runs, sags, wrinkles, patchiness, brush marks or other defects.
All primers shall be well marked into the surface, particularly in areas where painting is evident, and the first priming coat shall be applied as soon as possible after cleaning. The paint shall be applied by airless spray according to the manufacturer's recommendations. However, wherever airless spray is not possible, conventional spray be used with prior approval of purchaser.
The supplier shall, prior to painting protect nameplates, lettering gauges, sight glasses, light fittings and similar such items.
Cleaning and Surface Preparation

- After all machining, forming and welding has been completed, all steel work surfaces shall be thoroughly cleaned of rust, scale, welding slag or spatter and other contamination prior to any painting.
- Steel surfaces shall be prepared by Sand/Shot blast cleaning or chemical cleaning by seven tank process including Phosphating to the appropriate quality.
- The pressure and Volume of the compressed air supply for the blast cleaning shall meet the work requirements and shall be sufficiently free from all water contamination prior to any painting.
- Chipping, scraping and steel wire brushing using manual or power driven tools cannot remove firmly adherent mill-scale and shall only be used where blast cleaning is impractical

Protective Coating

- As soon as all items have been cleaned and within four hours of the subsequent drying, they shall be given suitable anticorrosion protection.

Paint Material

Followings are the type of paints that may be suitably used for the items to be painted at shop and supply of matching paint to site:
i) Heat resistant paint (Hot oil proof) for inside surface.
ii) For external surfaces one coat of Thermo Setting Paint or 2 coats of Zinc chromate followed by 2 coats of Synthetic Enamel paint. The color of the finishing coats shall be dark admiral grey conforming to No.632 or IS 5:1961.

Painting Procedure

- Al painting shall be carried out in conformity with both specifications and with the paint manufacture's recommendations. All paints in any one particular system. Whether shop or site applied, shall originate from one paint manufacturer.
- Particular attention shall be paid to the manufacturer's instructions on storage, mixing, thinning and pot life. The paint shall only be applied in the manner detailed by the manufacturer e.g. brush, roller, conventional or airless spray and shall be applied under the manufacturer's recommended conditions. Minimum and maximum time intervals between coats shall be closely followed.
- All prepared steel surfaces should be primed before visible re-rusting occurs or within 4 hours whichever is sooner. Chemical treated steel surfaces shall be primed as soon as the surface is dry and while the surface is warm.
- Where the quality of film is impaired by excess film thickness,(wrinkling, mud cracking or general softness) the supplier shall remove the unsatisfactory paint coatings and apply another. As a general rule, dry film thickness should not exceed the specified minimum dry film thickness by more than 25%. In all instances, where two or more coats of the same paints are specifies, such coatings may or may not be of contrasting colors.
- Paint applied to items that are not be painted, shall be removed at supplier's expense, leaving the surface clean, un-stained and undamaged.

Damages to Paints Work

Any damage occurring to any part of the painting scheme shall be made good to the same standard of corrosion protection and appearance as that originally employed. Any damaged paint work shall be made as follows:
a) The damaged area, together with an area extending 25mm around its boundary, shall be cleaned down to bare metal.
b) A priming coat shall immediately applied, followed by a full paint finish equal to that originally applied and extending 50mm around the perimeter of the originally damaged.
The repainted surface shall present a smooth surface. This shall be obtained by carefully chamfering the paint edges before & after priming.

Dry Film Thickness

To the maximum extent practicable, the coats shall be applied as a continuous film of uniform thickness and free of pores. Over-spray, skips, runs, sags and drips should be avoided. The different coats may or may not be same color.

Each coat of paint shall be allowed to harden before the next is applied as per manufacture's recommendations. Particular attention must be paid to full film thickness at edges.

The requirement for the dry film thickness (DFT) of paint and the material to be used shall be as given below:

Sl. No	Paint Type	Area to be painted	No of Coats	Total Dry film thickness(Min)
1	Powder Paint (2) Thermo setting powder	Inside outside	01 01	20 Micron 60 Micron
2	Liquid paint a) Zinc Chromate(Primer) b) Syenthetic Enamel(Finish Coat) c) Hot Oil paint	 Outside Outside inside	 02 02 01	 45 micron 35 micron 35 micron

29.0 SEALING GASKETS

All sealing washers / gaskets shall be made of oil and heat-resistant Nitrile/ Neoprene rubber/ synthetic rubber bonded cork type RC-70C gaskets. Gaskets made of natural rubber or cork sheet are not permissible.

30.0 SUPRESSION OF HARMONICS

The transformer shall be designed with attention to the suppression of harmonic voltage, especially the third and fifth.

31.0 GUARANTEE:

The manufacturers of the transformer shall provide a guarantee of 60 months from the date of date of commissioning. In case the Distribution transformer fails within the guarantee period the purchaser will immediately inform the supplier who shall take back the failed DT within 15 days from the date of the intimation at his own cost and replace/repair the transformer within forty five days of date of intimation with a roll over guarantee.

The outage period i.e. period from the date of failure till unit is repaired/ replaced shall not be counted for arriving at the guarantee period.

In the event of the supplier's inability to adhere to the aforesaid provisions, suitable penal action will be taken against the supplier which may inter alia include blacklisting of the firm for future business with the purchaser for a certain period.

32.0 TESTS

Routine Tests

Routine tests shall be carried out on all transformers and the tests shall be conducted in accordance with relevant National/ International Standards. No sampling is allowed. In addition, tank tests in accordance with IS:1180 shall be carried out.

The following routine measurements and tests shall be carried out in presence of Purchaser’s authorized representative(s):

a) Measurement of winding resistance. (For 500 KVA at all tap positions)

b) Voltage ratio measurement and check of polarity and vector group. Bushing positions shall have permanent markings at this stage of production;

c) Measurement of impedance voltages/ short circuit impedance at rated current and frequency (for 500 KVA transformers at normal, highest and lowest tap positions)

d) Measurement of load loss at half load & full load at 75^0C; (for 500 KVA transformers at normal, highest and lowest tap positions)

e) Measurement of neutral unbalance current;

f) Temperature rise test on one transformer of each rating and measurement of hot resistance.

g) Measurement of no-load loss and no-load currents at 50%, 75%, 90%, 100%, 110%, 115%, and 120% of rated voltages on one transformer of each rating; (For unit transformer of each Lot)

h) Induced over voltage withstand test at 22KV for 60 sec on the HV windings;

i) Power frequency voltage withstand tests on HV and LV windings;

j) Magnetic balance test

k) Polarization Index test P.I. value shall be not less than 1.5. P.I. = IR at 600 sec / IR at 60 sec.

l) Oil leakage test : The criterion of leakage shall be discoloration by oil of whitewash applied externally to suspected parts at an oil temperature of 90^0C or other method, as approved by the Purchaser;

m) Pressure test on transformer tank on one unit for each rating. Bushings and oil shall be subject to the following routine tests.

n) Bushing routine test: in accordance with IEC 137/IS 3347;

o) Oil dielectric and moisture content test: conforming to IEC 156 or IS 335. Routine test certificates shall include in addition to the test results, the purchaser’s order number, the transformer serial number, outline drawing number and transformer KVA rating.

Any other applicable tests shall be conducted at the discretion of the Purchaser without any extra cost to purchaser.

Type Tests

- The measurements and tests should be carried out in accordance with the standard specified in each case as indicated in the following table if the same tests were not conducted earlier at CPRI or any Govt. approved Laboratory on the transformers of the offered design.

Type Test	**Standard**
Temperature Rise Test	IEC 76/IS 2026
Impulse Voltage Withstand Test, including Full Waves and Chopped Waves as listed below	IEC 76/IS 2026
Noise Level Measurement	IEC 551
Short Circuit Test	IEC 76 / IS 2026

In accordance with IEC 76-3 the following sequence of impulses should have been/ should be applied;

- one full wave at 50% BIL;
- one full wave at 100% BIL;
- one chopped wave at 50% BIL;
- two chopped waves at 100% BIL and
- two full waves at 100% BIL.

- If the type test report(s) submitted by the bidder do not fulfil the criteria, as stipulated in this technical specification/ Bidder's offer, the relevant type test(s) has/ have to be conducted by the Bidder at his own cost in CPRI/ National Govt. approved laboratory in the presence of EMPLOYER's representative(s) without any financial liability to EMPLOYER, in the event of order placed on him.
- Even if the Type test report(s) confirm(s) the Purchaser's specification, the Purchaser at his discretion may ask the Supplier to repeat any or all specified type tests at CPRI/ National Govt. approved laboratory on sample(s), selected at random by the purchaser's representative(s) out of the offered quantity (first lot i.e. minimum one third of the total ordered quantity). The type test(s) are to be test-witnessed by the Purchaser's representative(s). For such type of repetition of type tests, the Bidder may quote Type Test Charges in the enclosed Price Schedule or conduct the tests free of cost.
- The supplier shall furnish calculations in accordance with IS: 2026 to demonstrate the Thermal ability of the transformers to withstand Short Circuit forces.

TEST VOLTAGE

Transformers shall be capable of withstanding the Power frequency and Impulse test voltage as described below:

Nominal system voltage	**Highest System voltage**	**Impulse Test voltage**	**Power frequency test voltage**
433 V (rms)			3 KV (rms)
11 KV (rms)	12 KV (rms)	75 KV (Peak)	28 KV (rms)

13.15. Installation, Testing & Commissioning of 3-phase outdoor Switched Capacitor Bank

Scope:

1.1 This specification covers design & supply of **1.98 & 3.96 MVAR (Employer may include the requirements as per its need)** capacitor bank along with all required equipments to be installed in 33kV sub stations. The capacitor bank shall consist of capacitor bank, circuit breaker, Series Reactor, control & relay panel, isolators, LAs, CTs and NCT, conductor, all type of necessary connectors along with suitable mounting structure. All these equipment shall have suitable terminal/equipment connectors as detailed in Technical specification.

1.2 The equipments to be supplied against this specification are required for vital installations where continuity of service is very important. The design, materials and manufacture of the equipment shall, therefore, be of the highest order to ensure continuous and trouble-free service over the years

1.3 The equipment offered shall be complete with all parts necessary for their effective and trouble-free operation. Such parts will be deemed to be within the scope of the supply irrespective of whether they are specifically indicated in the commercial order or not.

1.4 Configuration: The major equipments involved for each mechanically switched shunt capacitor bank are as follows:

1. 12.65 kV, 1980 kVAr (or any other rating as defined by Employer), 3-Phase, 50 C/s housed in Outdoor Type CRCA Panel, Capacitor bank having two variable steps of 792 kVAr & one Variable steps of 396 kVAr. Bank shall be complete with Capacitor units of 264/132 kVAr, Aluminum busbars, Pin & Post insulators, HRC fuses, Surge arrestor etc. with details as follows-(1) 11 kV, Aluminum Wound, Dry type Series reactors a) 0.52 kVAr for 792 kVAr step - 6 Nos., b) 0.25 kVAr for 396 kVAr step - 3 Nos. (2) 11 kV, 3-Phase Dry Type RVT - 1 No. (3) 12 kV 3 Phase Indoor type metal enclosed Vacuum Capacitor switches. - 3 Nos. (4) Indoor Type Automatic Control Unit - 1 No.(5) IP 55 , Outdoor CRCA cubicle Panel for accommodating capacitors, Series Reactor, Vacuum contactor, Surge arrestor & Fuses

2. 12.65 kV, 3960 kVAr, 3-Phase, 50 C/s housed in Outdoor Type CRCA Panel, Capacitor bank having two variable steps of 792 KVAr & two Variable steps of 1188 kVAr. Bank shall be complete with Capacitor units of 396/264 kVAr, Aluminum busbars, Pin & Post insulators, HRC fuses, Surge arrestor etc. With details as follows-

(1) 11 kV, Aluminum Wound, Dry type Series reactors

a) 0.52 kVAr for 792 kVAr step - 6 Nos. ,

b) 0.8 kVAr for 1188 kVAr step - 6 Nos.

(2) 11 kV, 3-Phase Dry Type RVT - 1 No.

(3) 12 kV 3 Phase Indoor type metal enclosed Vacuum Capacitor switches. - 4 Nos.
(4) Indoor Type Automatic Control Unit - 1 No.(5) IP 55 , Outdoor CRCA cubicle Panel for accommodating capacitors, Series Reactor, Vacuum contactor, Surge arrestor & Fuses etc

3. 11 kV Circuit Breaker
4. 11 kV Isolator with earth blade
5 11 kV lightning Arrestors
6. 11 kV Current Transformer
7. 11 kV Neutral current transformer
8. 11 kV Single phase Current Limiting Reactors
9. Control & Protection Equipment.

1.5. It is not the intent to specify herein complete details of design and construction. The equipment offered shall conform to the relevant standards and be of high quality, sturdy, robust and of good design and workmanship complete in all respects and capable to perform continuous and satisfactory operations in the actual service conditions at site and shall have sufficiently long life in service as per statutory requirements. The dimensional drawings attached with this specification and the notes thereto are generally of illustrative nature. In actual practice, notwithstanding any anomalies, discrepancies, omissions, in-completeness, etc. in these specifications and attached drawings, the design and constructional aspects, including materials and dimensions, will be subject to good engineering practice in conformity with the required quality of the product, and to such tolerances, allowances and requirements for clearances etc. as are necessary by virtue of various stipulations in that respect in the relevant Indian Standards, IEC standards, I.E. Rules, I.E. Act and other statutory provisions.
1.6 The Tenderer/supplier shall bind himself to abide by these considerations to the entire satisfaction of the purchaser and will be required to adjust such details at no extra cost to the purchaser over and above the tendered rates and prices.
1.7 The tenderer shall furnish in his offer a list of recommended spares with unit rates for each set of equipment that may be necessary for satisfactory operation and maintenance of circuit breaker and Isolators for a period of 10 years. The purchaser reserves right of selection of items and quantities of these spares to be ordered. The cost of such spares shall not be considered for tender evaluation.
1.8 The tenderer shall submit a list and unit rates of all the special tools, equipment and instruments required for erection, testing, commissioning and maintenance of the equipment. The purchaser shall decide the quantity of tools to be ordered. Prices of these tools shall not be considered for tender evaluation. However, the list of necessary tools/equipment which will be supplied free of cost with each CB may be furnished separately.

1.9 11 KV Multiple switched Automatic Capacitor bank(CRCA Cubicle panel) shall be manufactured by principle manufacturer of capacitor banks..

2.0 **STANDARDS**

The equipment shall conform (for performance and testing thereof) in all respects to the relevant Indian/International Standards specifications with latest amendments thereto.

2.1 INDIAN STANDARDS

IS NO.	Title
13925:1998	Specification for H.T. shunt Capacitor
IS 9920-2002	Vacuum Contactors/ Capacitor Switch
IS 9921 -1985	Isolator
IS 2705	Current Transformer
IS 3070	Lighting Arrestor
IS 3156	Residual Voltage Transformer.
IS 5553	Series Reactor
IEC 61000	Automatic Power Factor Controller

The other components such as VCB panel & other auxiliary equipments shall comply with the latest version of latest Indian/International standards.

2.3 Equipment conforming to other internationally accepted standards which ensure equal or higher quality than the above mentioned standards would also be acceptable. In such

case bidders, who wish to offer material conforming to standards other than listed above, shall clearly bring the salient points of difference between the standards forward/adopted and specified hereinabove. Four copies of such standards with authentic English Translation shall be furnished along with the offer. In case of conflict order of preference shall be (1) ISS (2) IEC (3) other standards. In case of any difference between provisions of these standards and provision of this specification the provision contained in this specification shall prevail.

3 0 **SERVICE CONDITIONS**

The capacitor Bank to be supplied against this specification shall be required to operate satisfactorily and continually under the following moderately hot and humid tropical climate conducive to rust and fungus growth

- Location: - To be defined by the Employer
- Maximum ambient air temperature (deg. C) To be defined by the Employer
- Minimum ambient temperature (deg. C) To be defined by the Employer
- Average daily ambient air temperature (deg/C) To be defined by the Employer
- Maximum relative Humidity (%) To be defined by the Employer
- Maximum altitude above sea level (M) To be defined by the Employer
- Average annual rainfall (MM) To be defined by the Employer
- Isoceraunic level (days per year) To be defined by the Employer
- Seismic level (Horigental accn.) To be defined by the Employer
- Maximum wind pressure 0kg/sqm) To be defined by the Employer

4 0 **PRINCIPAL PARAMETER**

The equipment covered under this specification shall conform to specific parameters given below:

4.1 CAPCITOR BANKS

Sl. No.	Item	Specification
1.	Nominal system voltage	11 KV
2.	Rated voltage of capacitor bank	12.65 KV
	Output of capacitor bank at 12.65 KV	1980 & 3960 KVAR (To be given by
4.	Rated line current	To be filled by Employer
5.	Connection of capacitor bank	Single star
6.	No. of phases	3
7.	Rated voltage of individual capacitor unit	To be filled by Employer
8.	Capacity of individual capacitor unit	To be filled by Employer
9.	Insulation level	RMS-28 KV
		Peak -75 KV
10.	Maximum temp. rise over ambient	10 C
	measured on container	
11.	Type of discharge	Internally though resistor provided
		within the Unit
12.	Type of fuse	External fuse
13.	Type of installation	Outdoors
14.	Power loss (Tan delta)	Not to exceed 0.2 watt/KVAR
		subject to tolerance as per standard.

Capacitor Bank Rating:

Sl.No.	Transformer Capacity (MVA)	Rating of Capacitor Bank (MVAr)	Steps configuration kVAr X No. of Steps (Switched)
1	5	1.98	396+792+792
2	8 & 10	3.96	792+792+1188+1188
3	Any other capacity as defined by Employer	Any other rating as defined by Employer	To be specified by the Employer

Note: The stages may be changed during detailed engineering Residual Voltage Transformer

5.0 TECHNICAL REQUIREMENT

5.1 CAPACITOR UNIT

The capacitor shall be of unit type construction suitable for indoor installation having high dielectric strength. No sun protection will be provided. The capacitor bank shall be complete with mounting frames, insulators and all other components for formation of capacitor bank. The bank shall be open type complete with inter connecting aluminum bus bars and adequate clearance shall be provided between phases and phase to earth..
The capacitor should be able to withstand 10% overvoltage and 30% over current (r.m.s. value) arising due to over voltage and harmonics

5.2 **ASSEMBLY**

Capacitor units of 132, 264 & 396 KVAR, 7.3 single phase shall be connected in parallel in each phase to form a three phase star connected capacitor bank. The bank shall be mounted on a steel frame work in suitable one/two tier formation and shall be so arranged that an individual unit of 132, 264 & 396 KVAR can be removed easily without disturbing the complete assembly/ other units.

5.3 **CONTRUCTION OF CAPACITOR UNIT**

A. **CONTAINER**

The container shall be built from CRCA of sufficient thickness (not less than 1.6 mm) to avoid damages to the tank in case of internal fault. It shall be of fabricated construction with all joints properly welded and designed to withstand rough handing and should be hydraulically tested before assembling the internal elements. It shall be adequately epoxy pointed. The lid of container shall be properly welded to the container.
The capacitor unit shall be hermetically sealed after the entire assembly has been dried and impregnated with suitable liquid (Dielectric.) The capacitor elements shall be thoroughly dried and impregnated with an **impregnate** which has been completely refined and degasified so as not to have any impurities or gas which may cause deterioration of the dielectric. The **impregnate** used shall have low viscosity and high chemical stability and should be non-PCB. The container shall be adequately insulated from capacitor elements. Sufficient 'Wall' insulation shall be provided so that the capacitor units meant for use of 11 KV nominal system can be place directly on grounded steel structures. The metallic surface of capacitor units shall be epoxy painted making capacitor units suitable for installing outdoor under moist tropical climatic conditions. **Capacitor panel shall be bolted type design. Capacitor Panel shall have IP-**55 **Degree of protection. Capacitor Panel shall be Powder coated**

B. CAPACITOR UNIT

The capacitor unit shall have **aluminum** foil as conducting layer. The dielectric used shall be polypropylene film by using layers of polypropylene film shall have the following compatibility criterion: -
(i) Polypropylene film shall conform to standard specification with latest amendments, for plastic film for new generation.
(ii) Compatibility between oil film (after thermal aging at 115 C for 96 Hrs.)
The **impregnate** used shall be non PCB liquid with **low be accumulating**, rapid bio degradation and low toxicity. Adequate number of such elements shall be assembled and enclosed in the enclosure to form a single phase unit with terminal bushings. The air in the

enclosure and moisture absorbed by the paper shall be removed under high vacuum at elevated temperature and replaced by suitable impregnating medium having high permeability, high dielectric strength and non-inflammable properties.

C. DISCHARGE DEVICE:

Suitable discharge device shall be connected across the capacitor unit in accordance with IS: 13925. The discharge device shall reduce the residual voltage from the crest value of the rated voltage to 50 V the or less within 10 Minutes after the capacitor is disconnected from the source supply.

D. EARTHING CONNECTIONS:

The container of each capacitor unit shall be provided with suitable earthing terminal clearly marked with Earth symbol.

E. MARKING:

The capacitor unit shall be provided with a rating plate and terminal markings as stipulated in IS: 13925. The bidder shall submit the type test report along with the bid.

F. FUSES

Each capacitor element shall be protected by External HRC fuse of suitable rating and interruption capacity so that a faulty capacitor element shall be disconnected by fuse. The fuse shall satisfactorily operate under ambient conditions. The following requirements shall be considered while selecting the right size of fuse.

a. Ability to withstand the maximum discharge current from healthy capacitor element.
b. Capability of handing fault current so as to Blow off before the in case rupture takes place thereby avoiding damage to adjoining capacitor elements/capacitor units.

G. BUSHINGS

Bushing shall be of porcelain or polycerate and shall be jointed to the case by welding method (Weldable type bushing) to ensure adequate and permanent seal. Leads shall be brought out through one-piece bushing and welded to the terminal stud to make a strong and positive electrical contract. Bushing terminal shall be of stainless steel.

Capacitors to be tested for cyclic Over voltage and 3 G test for mechanical shock & vibration, bidder has to clarify / confirm these points in GTP

5.4 PHYSICAL ARANGEMENT OF BANK

Star point of the capacitor bank shall be ungrounded. The mounting rack arrangement shall be such that one no. additional unit in each phase can be installed in future for increasing capacity.

5.5 AUTOMATIC CONTROL UNIT

(a) **Switching Arrangement:**

The Automatic control unit shall be provided inside the control; room to continuously monitor total load KVAR on secondary side of the transformer and shall automatically switch ON or switch OFF the capacitor banks through the operation of 12 KV Capacitor Switch in accordance with the parameter given in table no. 4.2 Overriding provision shall also be made for electrical switching ON or OFF of the capacitor switch by the operator from the ACU control box.

(b) **Time Delay:**

The switching ON operation will take place after period of 10 minutes. The switching OFF operation of relevant steps will be instantaneous.

(c) **Controls:**

The Automatic control unit shall instantly switch OFF the capacitor bank in the following contingencies occurring in any of the phases.

i) Voltage increased by 10% above the rated voltage of 11 KV.

ii) Power transformer current impedance (due to single phasing and for any other reasons) between any of the two phases exceeding 20% of the lowest, iii) Current increases in any capacitor unit by 30% above the rated current (only the relevant capacitor switch will open).Current between any of the two phases of the capacitor bank differs more than 15% of the lowest current of the 3 phases (only the relevant capacitor switch will open).

(d) **Monitoring Facility:**

A suitable display should be provided to indicate the capacitor current in each phases of the complete capacitor bank on the ACU panel inside the control room. Indications shall also be provided to indicate ON & OFF status of each capacitor bank. **Along with audio alarm indicating tripping of capacitor bank and ON /OFF, visual display window be provided on control panel. Automatic Control unit shall have GSM(4G/3G/2G/GPRS)/CDMA connectivity; suitable modem shall be connected along with control unit to transfer the data to remote locations. Provision of SIM will be under the scope of bidder. Bidder has to provide online Dashboard to the Employer users as per their requirements, Capable to show real time data and capable to generate MIS as per requirement. Bidder has to establish secure head end system on cloud which will be under the scope of bidder. Data transferred from Modem to Head end system through secure APN SIM, for the entire agreement period.**

GSM / GPRS MODEM Specifications:

• Quad-band 850/900/1800/1900MHz
• GPRS multi-slot class 12/10
• GPRS mobile station class B
• Compliant to GSM phase 2/2+
– Class 4 (2 W @ 850/900MHz)
– Class 1 (1 W @ 1800/1900MHz)
• Control via AT Commands (3GPP TS 27.007, 27.005 and enhanced AT Commands)

(e) **Control Power:**
The AC control voltage for operation of the ACU shall be taken from substation battery. The required control voltage shall be 230 VAC **supply**.

(f) **Temperature Variation:**
The control equipment and associate circuitry shall be suitable for operation at an ambient temperature in the range of + 5 deg C to (+) 50 deg C.

(g) **Protection of ACU:**
Besides in-built protection against lines surges and transient over voltages, suitable fuses/MCB shall be provided for protection against over current. The ACU shall remain fully functional during and after line surges and transient over voltages.

(h) **Control Unit Casing:**
Except for the terminals, the ACU shall be enclosed in a suitable casing so as to avoid ingress of dust.
ACU should be installed at inside of substation on Floor mounting arrangement.

5 6 **VACUUM CONTACTOR SWITCHES**
This specification covers 11 KV, 50 Hz, Indoor type automatic Vacuum Contactor Switch suitable for switching capacitor in steps.

(a) **Applicable Standards:**
Unless otherwise stipulated in this specification the Vacuum Contactor Switch shall comply with the latest version of IS:9920 (AC Switches for voltages above 1000 V). Capacitor should be tested by International Labs as per IEC 60265-1 (1998)

(b) **Rated Voltage:**
The rated voltage for the Vacuum Contactor Switch shall be 12 KV. This represents the highest system voltage corresponding to the nominal system voltage of 11 KV **12.65 KV**.

(c) **Rated Current:**
The standard rated normal current shall be 200A

(d) **Rated Capacitive Switching Current:**
The rated capacitive switching current shall not be less than 100 A Note: The capability of the Vacuum Contactor Switch shall also take into account the parallel switching of capacitor bank steps.

(e) **Rated Short Time Current:**
The rated short time symmetrical current for 1 second shall be 10KA (rms AC. component).

(f) **Rated Short Circuit Making Current:** The rated making current shall be 25 KA Peak .

(g) **Basic Impulse Level (BIL):**

The rated basic impulse level of Vacuum Contactor Switch to earth as also across the open terminals shall be 75 KV.

(h) **Control Supply:**

The control power for closing the Vacuum Contactor Switch shall be 230 V single phase AC supply. The closing mechanism shall be suitable for a voltage variation of (+) 10% to (-) 20%.

(i) **Design** & **Construction Requirement:**

Type:

a. The Capacitor Switch shall be of vacuum type.
b. The Vacuum Contactor Switch shall be of three phase construction and shall be suitable for remote operation.
c. The Vacuum Contactor Switch shall be suitable for indoor installation and shall have sealed weather proof type construction.
d. The enclosure of the Vacuum Contactor Switch shall be provided with two earthing terminals marked with the earth symbol.
e. The bushings provided on the switch shall have clamp type of terminals to directly receive aluminum conductors up to 10mm dia in both horizontal and vertical directions. The terminal arrangement shall be such as to avoid bimetallic corrosion.

(j) **Operating Mechanism:**

The operating mechanism shall be either solenoid or motor charged spring for which the control supply shall be as per clause 31.

(k) **Mechanical and Electrical Endurance:**

The Vacuum Contactor Switch shall be capable of performing not less than 10,000 mechanical operations and 10,000 electrical operations at 100A capacitive current without getting damaged.

(l) **Marking:**

The Vacuum Contactor Switch shall be provided with a legible and indelibly marked name plate with the following:

a) Name of the manufacturer.
b) Type, designation and serial number.
c) Rated voltage and current.
d) Rated frequency.
e) Number of poles.
f) Rated short time current (symmetrical).
g) Rated making current.
h) Rated capacitive switching current.
i) Date of manufacturing.
j) Property of respective Employer

(m) **Testes:** The Vacuum Contactor Switch shall be subjected to the following tests in accordance with the IS:9920 (Part-IV), & Should also be tested by international labs as per IEC 60265-1(1998)

(i) Type Tests

a) Tests to verify the insulation level, including withstand tests at power frequency voltages on auxiliary equipment.
b) Tests to prove that the temperature rise of any part does not exceed the specified values.
c) Making and breaking tests including tests for the rated capacitive current.
d) Tests to prove the capability of the switch to carry the rated short time current.
e) Tests to prove satisfactory operation and mechanical/electrical endurance.

(ii) Routine Tests

a) Power frequency voltage dry tests.
b) Voltage tests for auxiliary circuits.
c) Measurement of the resistance of the main circuits.
d) Tests to prove satisfactory operation.

5.7 AUXILARY EQUIPMENTS

Isolator:

(i) The Isolator shall be Outdoor type, 11 KV, 400Amp, Single throw, Double break, off load type, triple pole, Horizontal gang operated with earth switch.
(ii) Tests: The Isolator shall be type tested and shall be subjected to routine and acceptance test in accordance with IS: 1818-1972.
(iii) The bidder shall submit guaranteed technical particulars along with their bid.

5.8. LIGHTNING ARRESTOR

(i) The specification covers the supply, delivery, erection, testing & commissioning of 9 KV, 10 KA, Station class heavy duty, gapless, metal (zinc) oxide surge arrestors complete along with clamps, complete fitting and accessories for installation on outdoor type 11 KV switchgear, transmission lines, transformers etc.
(ii) Tests: The Lightning Arrestors shall be type tested and shall be subjected to routine and acceptance test in accordance with IS: 3070.
(iii) The bidder shall submit guaranteed technical particulars along with their bid.

5.8 B) Suitable one number RC surge suppressor shall be provide per bank inside of cubicle panel.

LA and Isolator shall be mounted on same structure and outgoing of Isolator shall be connected with CRCA capacitor panel through suitable power cable .

5.9 RESIDUAL VOLTAGE TRANSFORMERS

The residual voltage transformers shall be in door type, dry with primary in star and secondary in star & tertiary in open delta formation. The neutral of the primary winding shall kept fully insulated and would be isolated from ground. The tertiary winding in open

delta shall be used to energize the neutral unbalanced voltage withstand relay. The RVT should be suitable to discharge the capacitor bank to voltage not exceeding as per standards with latest amendments thereof. The RVT should be designed to with stand the temperature rise due to energy discharge in to it capacitors in case of tripping. All the type test as per IS including temperature rise test should be furnished.
RVT shall be mounted inside a cubicle.

5.10 HRC FUSES

Suitable indoor type 11 KV HRC fuses along with the mounting insulators etc. to provide proper protection for the capacitor unit shall form part of the equipment to be supplied.

5.11 SERIES REACTORS

0.2 % Series reactor per phase per step of capacitor rating for inrush current restriction to be connected on neutral end as per IS: 5553. The rated voltage shall be 12 KV. The reactor shall be dry type single phase reactors mounted on post insulators and designed to carry 130 % of rated current continuously without exceeding the temperature rise & shall be applicable for thermal class of insulation used. The reactor shall be mounted on structure.

i. Tests: The series reactor shall be type tested and shall be subjected to routine and acceptance test in accordance with IS: 5553.
ii. The bidder shall submit guaranteed technical particulars along with their bid.

5.12 CAPACITOR CUBICLE:

It shall be free standing outdoor type sheet steel enclosure fabricated from 2 mm. thick CRCA sheets. Capacitor cubical shall be mounted on mild steel channel frame and base frame shall be provided with mounting holes for fixing on concrete foundation. All doors and covers shall be designed to avoid ingress of water, moisture, dust etc. and shall be provided with suitable gaskets to achieve IP-55 degree of protection. Covers and doors shall be provided with electrical interlocks to avoid access to live parts. Viewing glasses shall be provided to view inside parts like fuses, contactors. CFL type internal panel lighting shall also be provided to have proper view in the night. Capacitor enclosure shall be duly powder coated. FRP canopy shall be provided at the top and which projects about 200 mm beyond cubicle on all sides. All LT internal wiring shall be fire retardant cable of 2.5sq.mm. All cable entries shall be from bottom through cable glands of suitable size. HT XLPE cable entry shall be through a cable entry box mounted on cubicle or fixed separately on foundation and coupled to the cubicle. Necessary Danger plate & Name plate etc shall be provided at prominent places. All other necessary fittings and accessories should be provided by manufacturer to ensure safe and smooth operation of the equipment.

Cubicle panel shall have provision of Internal Arc prevention as per IEC 62271-200
Cubicle panel shall be bolted type design.
Cubicle panel shall be IP 55 degree of protection.
Cubicle panel shall be powder coated.

5.13 BUS BARS AND INTERCONNECTION MATERIALS

Suitable bus bar arrangement shall be provided by the supplier and requisite quantity of bus bar material shall be provided for the Bank. All bus bars shall be aluminum flats with suitable cross section . Bus bar connections between Bank and RVT. Shall also be provided.

5.14 ACCESSIORIES

Each capacitor bank cubicle panel shall be provided with the following accessories:-

1. 2 Nos. earthing terminals
2. Clamps and connectors
3. Aluminum bus bar
4. RC Surge Suppressor one no per bank
5. RVT
6. Capacitors
7. Series reactor
8. Vacuum Contactor
9. Rating plate

All other accessories required for erection, assembly and commissioning of the capacitor bank

ACU shall be floor mounted and kept inside of substation building near to VCB panel.
LA and Isolator shall be mounted on external structure and to be kept outside.

5.15 RATING PLATE

Each unit shall be fitted with a rating plate giving clearly the particulars specified of marking as per standards:

5.16 CLEARNCESINSTALLATION AND MAINTENCACE INSTRUCTIONS:

The supplier shall provide 3 sets of detailed instruction manuals and drawings covering all aspects of installation and maintenance of the capacitor bank and the associated equipments.

5.17 OPERATION OF CAPACITOR BANK

a. The capacitors are proposed to be connected in 3 phase, 11 KV, 50 Hz system. The maximum symmetrical short circuit level on 11 KV systems is **26.2 kA for 1seconds**.

b. It is to be specifically noted that 1.5 & 3 MVAR capacitors banks are intended for use at our 33/11 KV receiving substations within our distribution network.

c. Maximum permissible over voltage shall be as per standards and latest amendments thereof.

d. Permissible increase in current loading due to any or all of the following shall not exceed 30% of the rated current.

1. Increased voltage
2. Increased frequency

3. Non sinusoidal voltage

e. The capacitors shall be suitable for operating in temperature category 50° C as per standards.

Note:- All the parameters which are not covered under the above mentioned specification will be considered according to IS.

6.0 TESTS

6.1 TYPES TESTS

All the offered equipment shall be fully type tested by the bidder as per relevant standards including the type tests mentioned below. Type test should have been conducted on the similar or higher capacity of equipments for 11 KV or 33 KV class of capacitor bank from recognized test laboratory preferably CPRI or other Govt. test labs within 5 years prior to date of opening of bid. The bidder shall furnish four sets of test reports as per relevant standards for each type of equipment offered. along with the bid. The offers received without type tests shall be tested as non-responsive and rejected.

a. Thermal stability
b. Capacitor less tangent measurement at elevated temperature.
c. A.C. voltage test between terminal & container.
d. Lightening impulse voltage test between terminal and container.
e. Short circuit discharge test.

6.2 ACCEPTING TEST

All acceptance tests stipulated in relevant standards and including those as mentioned below shall be carried out by the Supplier in presence of Purchaser's representative.

a. Capacitance measurement test
b. Capacitor loss tangent measurement test.
c. Voltage test between terminals.
d. A.C. voltage test between terminal and container.
e. Tests of internal discharges device.
f. Sealing test

The method shall be subject to agreement between the Supplier and Purchaser where it is not specified in the relevant standards. The Purchaser reserves the right to carry out any other test (s) of reasonable nature, in addition to above mentioned tests, at works/test house of the Supplier or any other recognized laboratory/Research Institute to satisfy that the material compiles with the intent of this specification

7.0 INSPECTION

The inspection shall be carried out by the Purchaser at two stages of manufacture i.e. inspection during manufacturing and final inspection and testing. The Supplier shall keep the Purchaser informed in advance of the manufacturing programmer so that the arrangement can be made for inspection. The Manufacturer shall grant free access to works, for Purchaser's representative at a reasonable time. Inspection and acceptance of any equipment under this specification by the Purchaser shall not relieve the Supplier of his obligation of

furnishing the equipment in accordance with this specification and shall not prevent subsequent rejection if the equipment is found to be defeat/not as per this specification.
All acceptance tests and inspection shall be carried out at the place of manufacture unless otherwise specifically agreed upon by the contractor and Purchase. The contractor shall offer to the inspecting official (s) representing the Purchase, all reasonable facilities without charge, to satisfy that the material is being furnished in accordance with this specification. The Purchase has the rights to have the tests carried out at his own cost by an independent agency wherever there is a dispute regarding the quality of the supply.
The contractor shall give not less than 15 days advance intimation to enable the purchase to depute his representative for witnessing the state/acceptance tests.

8.0 QUALITY ASSURANCE PLAN

8.1 The bidder shall have ISO-9001/9002 or any latest, certification'. The bidder shall invariably furnish the following information along with his bid part-I falling which his bid shall be liable for rejection. Separate information should be given be individual type of material offered.

(I) Statement giving list of important raw materials, name of Suppliers for raw material, list of standards according to which the raw materials are tested and list of tests normally carried out on raw materials in presence of bidder's representative, copies of tests certificates

(II) Information and copies of test certificates as in (1) above in respect of bought out items,

(III) List of manufacturing facilities available

(IV) Level of automation and list of areas where manual processing exists.
(V) List of areas in manufacturing process where stage inspections are normally carried out for quality control and details of such test.
(VI) List of testing equipment available with the bidder for stage and final testing of equipment offered and test plant limitations if any, vis-a vis the type test, special acceptance and routine test specified in the relevant standards. These limitations shall be very clearly brought out in the relevant schedule of deviations as deviations from specified tests requirements.

8.2 The successful bidder(s) shall within 30 days of placement of order submit the following Information: -

i. List of raw material and bought out items and names of the Suppliers selected from those furnished along with the bid.
ii. Type test certificates or the raw material and bought out items.
iii. Quality assurance plan (QAP) withhold points for purchase's inspection (to be finalized after mutual discussions between the bidder and the purchaser, at latter's office.)

HOLD POINT

A stage in the material procurement of manufacturing process beyond which work shall not proceed without the documental approval of the purchase.

NOTIFICATION POINT:
A stage in the material procurements, or manufacturing process for which advance notice of the activity is required to facilitate witness by the purchasers representatives.

8.3 The QAP of the contractor shall consist of the following details.

- An outline of the proposed work and program sequence.
- The structure of contractor organization for the contract.
- The duties and responsibilities assigned to the staff ensuring quality of work
- Hold and Notifications points.
- Submission of engineering documents required by this specification.
- The inspection of material and components on receipt
- Stage Inspection.
- Final Inspection.

9 0 **DOCUMENTATION**

All drawing shall conform to International standards organization (ISO), 'A' series of drawing sheets/Indian standards specification IS: 656. All dimensions shall be in SI units.

9.1 LIST OF DRAWINGS

The bidder shall furnish the following along with the bid: -

i. Two sets of drawing showing clearly the general arrangement, fitting details, electrical connections etc. required for erection & commissioning

ii. Technical leaflets (user's manual) giving operating instructions.

iii. Three copies of dimensional drawings.

9.2 The manufacturing of the equipment shall be strictly in accordance with drawings approved by purchaser and no deviation shall be permitted without the written approval of the purchase. Any manufacturing and fabrication prior to approval of the purchaser shall be at supplier risks.

9.3 Approval of drawing/work by the purchase shall not relieve at supplier of his responsibility and liability for ensuring the correctness and correct

9.4 Interpretation of the drawing for meeting the requirements of latest revisions of applicable standards, rules and code 6f practices. The purchase shall have power to reject any work or material which in his judgment is no in all accordance therewith.

9.5 Three sets of drawings for purchaser's approval shall be furnished within two weeks of placement of order. The purchaser shall communicate his comments/ approval within reasonable. The supplier, shall, if necessary, modify the drawings and resubmit three copies of modified drawings for an approval.

9.6 Three sets of separating manual, drawing, technical leaflets, inspection manual etc shall be

supplied to each consignee in the first instance.

9.7 One set of routine test certificate shall accompany such dispatch consignment.

10 0 **PACKING & FORWARDING**

The equipment shall be packed in creates suitable for vertical, horizontal transport as the case may be and suitable to withstand handling during transport and outdoor storage during transit. The supplier shall be responsible for any damage to the equipment during transit, due to improper and to the equipment during transit, due to improper and inadequate packing. The easily damageable material shall be carefully-packed and marked with the appropriate caution symbol. Wherever necessary proper arrangement for lifting such as fitting hooks shall be provided. Any material found short within the packing case(s) shall be supplied immediately by the supplier without any extra cost to purchaser.

Each consignment shall be accompanied with a detailed packing list containing the following information and shall be marked "PROPERTY OF respective <DISCOM>".

a) Name of the consignee
b) Details of consignment
c) Destination
d) Total weight
e) Handling and packing instructions
f) Bill of material indicating contents of each package.

In addition to the above the marking on each package shall per relevant standards.

10.1 The packing shall be done an per manufacture's standards practice ensuring that no material is damaged during transit by Rail/Road.

11.0 **SUPERVISION SERVICES:**

The bidders shall provide free of services of their engineers, If required during erection & commissioning of capacitor bank at various places.

Advance notice of 15 days shall be given to the contractor to depute his engineer to various substation in state of Uttar Pradesh.

12. **MANDOTRY SPARES AND TOOLS**

The bidder shall have suitable stock to carry out O&M as and when required.

13. TRAINING:-

13.1. Bidder must organize at least two training sessions every Division for substation operator and field staff at substation only after commissioning.

13.2. Bidder shall provide posters in Hindi regarding DOs and DON'Ts regarding operation of Capacitor Banks properly displayed in Control room at minimum two locations along with contact details of person to approach in case of problem/ fault.

14.FACILITY MANAGEMENT SERVICES

Bidder shall provide service for monitoring of working of capacitor bank by visiting every installed capacitor bank location once in three months and submit report asper attached sheet.

Indicative Scope of Work for Facility Management Services to be carried out for Keeping 12.65 kV, HT Capacitor bank System at 33/11kV Sub-Stations Healthy and Operational

1 Visiting each substation on quarterly basis , and log the measurement of 11 KV Incomer breaker data in following for

	Sl No	Name of S/s	Rating of bank	Incomers Energy meter serial no	Date of Current Recording	KHW	KVAH	PF1	Date of Last Recording	KWH	KVAH	PF2	Tota bet tv reco
	1												
	2												
	3												
	.												
	.												
	n												

2 These readings shall be **MRI based** and submitted to concerned Executive Engineer office for applying payment of F shall be paid on quarterly basis .

3 During quarterly visit , bidder shall check the complete capacitor bank for any deficiency , if any deficiency is noticed rectified within fortnight .**In addition to this the healthiness of relay/trip circuit and proper operation in underv conditions should be ensured by the bidder.**

4 At the event of any fault occurred ,shall be duly communicated to bidder by substation in charge or concerned SDO to be attended within 7 working days time , and resolution of such complaints specific to capacitor bank shall be done complaint attend date.

5 To establish one office in each zone - with provision of e-mail and mobile communication connectivity and shall have qualified technicians to attend faults / provide services .

6 All required spares shall be kept at FMS Zonal Centres for prompt service .

7 Any other activity required to ensure the contracted Capacitor bank System is operational for maximum time.

Annexure-B

General Technical Instructions

Technical Instructions of RDSS

General Technical Instructions

Following CEA regulations shall be applicable during execution of work:

a. Construction Regulation – Central Electricity Authority (Technical Standards for construction of electrical plants and electric lines) Regulation, 2010 (as amended time to time)

b. Safety Regulation for construction and O&M - Central Electricity Authority (Safety requirements for construction, Operation and Maintenance of electrical plants and electric lines) Regulation, 2011 (as amended time to time)

c. Connectivity Regulation – Technical Standard for connectivity to the grid (Amendment) Regulation 2013; Technical Standards for connectivity of the Distributed Generation resources, 2013; Central Electricity Authority (Grid Standard) Regulation, 2010 (as amended time to time)

d. Metering Regulations – Central Electricity Authority (Installation and Operation of meters) Regulations, 2006; Central Electricity Authority (Installation and Operation of meters) (Amendment) Regulations, 2010 and 2015 (as amended time to time)

e. Central Electricity Authority (Measures relating to safety and Electric supply regulations), 2010 and amendment regulation 2015 (as amended time to time)

1.1. 33 V Line support

9.1m meter long PCC Pole (or PCC Pole as per state practice shall be used for 33 KV line support). 152x152mm H-Beam (37.1kg/m) / Wide parallel Beams 160x30.44 kg/m can also be used as support in urban/forest area and or Steel Tubular Poles/ Wide parallel Beams 160x30.44 kg/m (Expandable through jointing plates) may be used in hilly area where head load shifting is the only option. Cement concreting shall be used for 33 KV support foundations in mixture 1:3:6 (1: cement, 3: coarse sand and 6 Stone ballast 40mm sizes). Each support shall be concrete (0.5mx0.5mx2m) = 0.5 cmt. 0.014 cmt shall also be used in muffing of the support. PCC pole shall not be provided with muffing.

1.1.1. Pole base plates as per specifications shall be used.

1.1.2. Pole earthing shall be performed through earthing coil duly connected with 8 SWG wire. The GI wires between pole structure and the earthing coil should not be used in cut length. Wherever, cut is evitable, proper nut bolt, washer and binding should be made as per REC specifications. The GI wire between support and earth coil should be placed 1 meter below the ground level.

1.1.3. Earth coil should be inserted 1200 mm away from pole.

1.2. 11 KV line Support and DTR Substation support

1.2.1. 8.0 meters or equivalent PCC Poles as per prevailing practices of the state shall be used for 11 KV line and substation support. 152x152mm H-Beam (37.1kg/m) or Wide Parallel Beam 160x30.44 kg/m can also be used as support in urban/forest area and or Steel Tubular Poles/Wide parallel Beam (with expandable lengths through jointing plates) may be used in hilly area where head load shifting is the only option.

The single PCC pole supports shall be erected with Stone bolder/stone ballast mixed with excavated earth in normal soil. PCC poles in Double Pole structures, turning point structure, Distribution Transformer Substation structure shall be grouted in cement concrete mixture of 1:3:6 (1: cement, 3: coarse sand and 6 Stone ballast 40mm sizes). Single pole supports in water logging area shall also be grouted in cement concrete mixture of 1:3:6 (1: cement, 3: coarse sand and 6 Stone ballast 40mm sizes). PCC pole shall be grouted with concrete (0.6mx0.6mx1.35m) = 0.486 cmt.. In special location, wherever, Project Manager specifically decides, to enhance additional strength, concreting may be used as support foundation.

In forest, wherever special care is to be made for elephant corridors, 13m long, 152x152mm RS Joist (37.1kg/m) / **Wide Parallel Beams 160x 30.44 kg/m** may be used for 11 KV line support.

152x152mm H-Beam (37.1kg/m)/ Steel Tubular Poles/ Wide Parallel Beams 160 x 30.44 kg/m shall be grouted in cement concrete mixture of 1:3:6 (1: cement, 3: coarse sand and 6 Stone ballast 40mm sizes) in all the formation.

1.2.2. Pole base plates as per specifications shall be used.

1.2.3. Pole earthing shall be performed through earthing coil duly connected with 8 SWG wire. The GI wires between pole structure and the earthing coil should not be used in cut length. Wherever, cut is evitable, proper nut bolt, washer and binding should be made as per REC specifications. The GI wire between support and earth coil should be placed 1 meter below the ground level.

1.2.4. Earth coil should be inserted 1200 mm away from pole.

1.3. Route And Terrain

1.3.1. The scope of HT/LT length of feeder are enclosed with the tender documents. On award of the contract, Contractor shall perform foot survey to access the route, pole location and thus Single Line Diagram of the line works. The survey shall be approved by Project Manager. Accordingly requirements of materials shall be finalized by the turnkey contactor in association with Project Manager.

1.4. Detailed Survey

1.4.1. The detailed survey shall be carried out for the approved feeders/spur lines by the Contractor and submitted for Employer approval.

1.5. Profile Plotting

1.5.1. Span: The number of consecutive spans between the section points shall not exceed design length considering wind pressure, type of poles and size of conductor.

1.5.2. Extension: An individual span shall be as near to the normal design span as possible. In case an individual span becomes too short with normal supports on account of undulation in ground profile, one or both the supports of the span may be extended by inserting standard body extension designed for the purpose according to technical specification.

1.5.3. Loading: There shall not be any upward force on poles under normal working conditions and the suspension poles shall support at least the minimum weight span as provided in the design. In case uplift is unavoidable, it shall be examined if the same can be overcome by adding standard body extensions to the poles failing which tension poles designed for the purpose shall be employed at such positions.

1.5.4. Horizontal Tensions on pin insulators are to be avoided by proper alignment of the line. In case where installation of DP structure is not possible to erect for turning the line, "two pins" arrangement with suitable jumpering shall be provided at all those locations where pins are subjected to horizontal tension. Bridling type V Cross arms for such installations shall be used by the agency accordingly.

1.6. Road Crossing

At all road crossings, the poles shall be fitted with horizontally aligned disc type tension insulator string(s) or bridling V-cross arm supports using double pin insulator per phase depending on the type of poles and line but the ground clearance at the roads under maximum temperature and in still air shall be such that it should not fall below 6.1m in case of 33 KV and 11 KV lines. Also, cradle guarding is to be used at all the road crossing locations as per drawings / specifications enclosed.

1.7. Railways Crossings

Railway Crossings at pre-planned locality shall be selected in such a way that minimum feeder length shall be re-routed. The line crossing should be executed as per prevailing practices and approved drawings of railways. Railways crossing shall preferably be executed through underground cabling. Horizontal drill machine shall be used for this purpose. Required permission to block the Railways traffic and approval for railway crossing shall be arranged by the Employer at his own cost. All liaison works shall be performed by turnkey Contractor.

1.8. Telecommunication, LT or HT Line Crossing

The angle of crossing shall be as near 90 degrees as possible. However, deviation to the extent of 30 degree may be permitted under exceptionally difficult situations. Cradle guarding is to be used at all such crossing locations as per drawings / specifications enclosed.

1.9. Details En-route

All topographical details, permanent features, such as well, trees, building etc. 75 m on either side of the alignment shall be detailed on the profile plan.

1.10. Clearances - General

For the purpose of computing the vertical clearance of an over-head line, the maximum sag of any conductor shall be calculated on the basis of the maximum sag in still air and the maximum design temperature. Similarly, for the purpose of computing any horizontal clearance of an over-head line, the maximum deflection of any conductor shall be calculated on the basis of the wind pressure specified by the State Government under rule 76 (2) (a) [or may be taken as 35º, whichever is greater]. Following clearances shall be maintained by the Contractor while executing the work:

1.6.1. CLEARANCE ABOVE GROUND OF THE LOWEST CONDUCTOR: No conductor of an over-head line, including service lines, erected across a street shall at any part thereof be at a height less than

(a)	For low and medium voltage lines	5.8 meters
(b)	For high voltage lines	6.1 meters

1.6.2. No conductor of an over-head line, including service, lines, erected along any street shall at any part thereof be at a height less than

a. For low, medium, and high voltage lines upto and including 11,000 volts, if bare - 4.6 meters
b. For low, medium, and high voltage lines Upto and including 11,000 volts, if insulated - 4.0 meters
c. For high voltage lines above 11,000 volts - 5.2 meters

For extra-high voltage lines the clearance above ground shall not be less than 5.2 meters plus 0.3 meter for every 33,000 volts or part thereof by which the voltage of the line exceeds 33,000 volts:

Provided that the minimum clearance along or across any street shall not be less than 6.1 meters.

1.6.3. CLEARANCE FROM BUILDINGS OF LOW AND MEDIUM VOLTAGE LINES AND SERVICE LINES:

Where line is to cross over another line of the same voltage or lower voltage, pole with suitable extensions shall be used. Provisions to prevent the possibility of its coming into contact with other overhead lines shall be made in accordance with the latest CEA regulations (as amended from time to time). The Contractor will required to under cross higher voltage lines by erecting gantries/suitable Rail Pole structures.

Where a low or medium voltage over-head line passes above or adjacent to or terminates on any building, the following minimum clearances from any accessible point, on the basis of maximum sag, shall be observed:-

a) For any flat roof, open balcony, verandah roof and lean-to-roof

i. When the line passes above the building a vertical clearance of 2.5 meters from the highest point; and
ii. When he line passes adjacent to the building a horizontal clearance of 1.2 meters from the nearest point, and

b) For pitched roof

i. When the line passes above the building a vertical clearance of 2.5 meters immediately under the lines, and
ii. When the line passes adjacent to the building a horizontal clearance of 1.2 meters.

The horizontal clearance shall be measured when the line is at a maximum deflection from the vertical due to wind pressure.

1.6.4. CLEARANCE FROM BUILDINGS OF HIGH AND EXTRA-HIGH VOLTAGE LINES:

Where a high or extra-high voltage over-head line passes above or adjacent to any building or part of building it shall have on the basis of maximum sag a vertical clearance above the highest part of a building immediately under such line, of not less than

(a)	For High Voltage Lines up to and including 33,000 volts	3.7 m
(b)	For Extra High Voltage Lines	3.7 m plus 0.3 m for every additional 33 KV or part thereof.

1.11. Electrical System Data

	33 KV	11KV
Nominal voltage	33 kV	11KV
Maximum system voltage	36 kV	12KV
BIL (Impulse)	170 kVp	75KV
Power frequency withstand voltage (wet)	75 kV (rms)	28KV

Minimum corona extinction voltage for 27 kV (rms) phase to earth — Not less than 27 kV, 50 Hz ac system under Dry condition

Radio interference voltage at one MHz for 27 kV (dry condition) — Not exceeding 1000 micro-volts

1.12. Pole Location

In locating poles on lines, the following general principles should be kept in mind:-

1. Keep spans uniform in length as far as possible.

2. Locate to give horizontal grade.

3. By locating the poles on high places short poles can be used and will maintain proper ground clearance at the middle of the span. In extremely hilly or mountainous country, poles are located on ridges there by greatly increasing the spans without greatly increasing the pull on the conductor. This is possible because the sag can be made very large and will maintain the required ground clearance. Special attention should be given to the locations of poles, where the ground washes badly. Poles should not be placed along the edges of cuts at or embankment or along the banks of creeks of streams.

1.13. Construction

The construction of overhead-lines may be divided into the following parts:-

(1) Pit marking, pit digging.
(2) Erection of supports and concreting.
(3) Providing of guys to supports.
(4) Mounting cross-arms, pin and insulators, and pin binding.
(5) Paying and stringing of the conductor.
(6) Sagging and Tensioning of Conductors.
(7) Crossings.
(8) Guarding.
(9) Earthing.
(10) Testing and Commissioning.

1.14. Erection of DP Structure for Angle Locations

For angles of deviations more than 10 degree, DP structure may be erected. The pit digging should be done along the bisection of angle of deviation.

After the poles are erected, the horizontal/cross bracings should be fitted and the supports held in a vertical position with the help of temporary guys of Manila rope 20/25 mm dia.

Wherever space is not found sufficient to install double Pole structure, single pole cut point may be installed. The support so erected must be grouted.

1.15. Concreting

The concreting mixture of one cum 1:3:6 ratios would mean 1 part cement, 3 parts coarse sand and 6 part 40 mm aggregate size stones. It may be noted that while preparing the concrete mixture, large quantities of water should not be used as this would wash away cement and sand.

1.16. Providing Of Guys To Supports

Guys are installed at locations where terminal poles are erected at sectional cut points. These cut points may be in same alignment or at turn points. Guys are installed to nullify tension on supports resulted due to conductors tension. In spite of careful planning and alignment of line route, certain situations arise where the conductor tries to tilt the pole from its normal position

due to abnormal wind pressure and deviation of alignment, etc. When these cases of strain arise, the pole is strengthened and kept in position by guys. One or more guys will have to be provided for all supports where there is unbalanced strain acting on the support, which may result in tilting/uprooting or breaking of the support.

Guys are braces fastened to the pole. In this work anchor type guy sets are to be used. These guys are provided at (i) angle locations (ii) dead end locations (iii) T - off points (iv) Steep gradient locations and (v) where the wind pressure is more than 50 kg / Sq.m.

The fixing of guys stays will involve (i) pit digging and fixing stay rod (ii) fastening guy wire to the support (iii) Tightening guy wire and fastening to the anchor. The marking of guy pit, digging and setting of anchor rod must be carefully carried out. The stay rod should be placed in a position so that the angle of rod with the vertical face of the pit is $30^{o}/45^{o}$ as the case may be.

Before start of erection of Stay sets, required concreting materials like Cement, Sand, Stone Chips and Construction water need to be made available near the pit.

G.I. stay wires of size 7/3.15 mm (10 SWG) & 7/4.00 mm (8 SWG), for 16 mm/20 mm stay rods respectively, are to be provided. 8.5 Kg. Stay Wire (7/4.00 mm) per Stay with 20 mm Stay rod for 33 KV line and 5.5 Kg. Stay Wire (7/ 3.15 mm) per Stay with 16 mm Stay rod for 11 KV lines are to be used. For double pole structure (DP), four stays along the line, two in each direction and two stays along the bisection of the angle of deviation (or more) as required depending on the angle of deviation are to be provided. Hot dip galvanized stay sets are to be used. One stay to counter the angular deformation force shall be used.

After concreting, back filling and ramming must be done well and allowed 7 days to set. The free end of the guy wire/stay wire is passed through the eye of the anchor rod, bent back parallel to the main portion of the stay/guy and bound after inserting the G.I. thimble, where it bears on the anchor rod. If the guy wire proves to be hazardous, it should be protected with suitable asbestos pipe filled with concrete of about 2 m length above the ground level, painted with white and black strips so that, it may be visible at night. The turn buckle shall be mounted at the pole end of the stay and guy wire so fixed that the turn buckle is half way in the working position, thus giving the maximum movement for tightening or loosening.

1.17. Guy Strain Insulators

Guy insulators are placed to prevent the lower part of the Guy from becoming electrically energized by a contact of the upper part of the guy when the conductor snaps and falls on them or due to leakage. No guy insulator shall be located less than 2.6 m from the ground. Guy insulators

are to be used in stay wires only. All stay conductors are to be provided with guy insulators as per following specifications.

11 KV line stay	Type C guy insulator (1 No)
33 KV line stay	Type C guy insulators (2Nos)

1.18. Fixing Of Cross-Arms

After the erection of supports and providing guys, the cross-arms are to be mounted on the support with necessary clamps, bolts and nuts. The practice of fixing the cross arms before the pole erection is also there. In case, the cross-arm is to be mounted after the pole is erected, the lineman should climb the pole with necessary tools. The cross-arm is then tied to a hand line and pulled up by the ground man through a pulley, till the cross-arm reaches the line man. The ground man should station himself on one side, so that if any material drops from the top of the pole, it may not strike him. All the materials should be lifted or lowered through the hand line, and should not be dropped.

1.19. Insulators And Bindings

Line conductors are electrically insulated from each other as well as from the pole by 'Insulators'. Following two type of insulators shall be used for the line insulation:

(1) Pin type
(2) Strain type

The pin type insulators will be used for straight stretch of line. The insulator and its pin should be mechanically strong enough to withstand the resultant force due to combined effect of wind pressure and weight of the conductor in the span.

The strain insulators are intended for use at terminal locations or dead end locations and where the angle of deviation of line is more than 10º. Strain insulators are also intending to use at major road crossing locations.

The pins for insulators are fixed in the holes provided in the cross-arms and the pole top brackets. The insulators are mounted in their places over the pins and tightened. In the case of strain or angle supports, where strain fittings are provided for this purpose, one strap of the strain fittings is placed over the cross-arm before placing the bolt in the hole of cross-arms. The nut of the straps is so tightened that the strap can move freely in horizontal direction.

All HT/LT insulators shall be tested for insulation tests before installation on line. They shall be dipped into water for 24 hrs. and then tested for insulation resistance tests at the stores. The insulators found fit in IR testing shall be sent to site for erection. 11KV and 33 KV insulators shall be tested by at-least 1 KV megger whereas LT insulators shall be tested by 500 Volts megger.

1.20. Conductor Erection

The main operations are:-

(a) Transportation of Conductor to works site.
(b) Paying and Stringing of Conductor
(c) Jointing of Conductor
(d) Tensioning and Sagging of Conductor

While transporting conductors drums to site, precautions are to be taken so that the conductor does not get damaged/injured. The drum could be mounted on cable drum support, which generally is made from crow-bar and wooden slippers for small size conductor drums. The direction of rotation of the drum has to be according to the mark in the drum so that the conductor could be drawn. While drawing the conductor, it should not rub causing damage. The conductor could be passed over poles on wooden or aluminum snatch block (pulley) mounted on the poles for this purpose.

When approaching the end of a drum length at least three coils shall be left in place when the stringing operations are stopped. These coils are to be removed carefully and if another length is required to be run out a joint shall be made as per the recommendations of the accessories manufacturer.

The mid span jointing is done through compressions or if helical fittings are used the jointing could be done manually. After completing the jointing, tensioning operation could be commenced. The conductor is pulled through come-along clamps to stringing the conductor between the tension locations.

Conductor splices shall not crack or otherwise be susceptible to damage in the stringing operation. The Contractor shall use only such equipment / methods during conductor stringing which ensures complete compliance in this regard.

All the joints on the conductor and earth-wire shall be of the compression type, in accordance with the recommendations of the manufacturer, for which all necessary tools and equipment like compressors, dies, etc., shall be obtained by the Contractor. Each part of the joint shall be cleaned

by wire brush till it is free of rust or dirt, etc., and be properly greased with anti-corrosive compound. If required and as recommended by the manufacturer, before the final compression is carried out with the compressors.

All the joints or splices shall be made at least 15 meters away from the pole. No joints or splices shall be made in spans crossing over main roads, railways and small river spans. Not more than one joint per sub-conductor per span shall be allowed. The compression type fittings shall be of the self-centering type or care shall be taken to mark the conductors to indicate when the fitting is centered properly. During compression or splicing operation, the conductor shall be handled in such a manner as to prevent lateral or vertical bearing against the dies. After compressing the joint, the aluminum sleeve shall have all corners rounded; burrs and sharp edges removed and smoothened.

During stringing of conductor to avoid any damage to the joint, the Contractor shall use a suitable protector for mid span compression joints in case they are to be passed over pulley blocks / aerial rollers. The pulley groove size shall be such that the joint along with protection can be passed over it smoothly.

1.21. Tensioning and Sagging Operations

The tensioning and sagging shall be done in accordance with the approved stringing charts or sag tables. The "initial" stringing chart shall be used for the conductor and "final" stringing chart for the earth-wire. The conductors shall be pulled up to the desired sag and left in running blocks for at least one hour after which the sag shall be rechecked and adjusted, if necessary, before transferring the conductors from the running blocks to the suspension clamps. The conductor shall be clamped within 36 hours of sagging in.

The sag will be checked in the first and the last section span for sections up to eight spans and in one additional intermediate span for sections with more than eight spans. The sag shall also be checked when the conductors have been drawn up and transferred from running blocks to the insulator clamps.

At sharp vertical angles, conductor and earth-wire sags and tensions shall be checked for equality on both sides of the angle and running block. The suspension insulator assemblies will normally assume verticality when the conductor is clamped.

Tensioning and sagging operations shall be carried out in calm weather when rapid changes in temperature are not likely to occur.

1.22. Clipping In

Clipping of the conductors into position shall be done in accordance with the manufacturer's recommendations. Jumpers at section and angle towers shall be formed to parabolic shape to ensure maximum clearance requirements. Fasteners in all fittings and accessories shall be secured in position. The security clip shall be properly opened and sprung into position.

1.23. Fixing of Conductors and Earth wire Accessories

Conductor and earth-wire accessories supplied by the Contractor shall be installed by the Contractor as per the design requirements and manufacturer's instruction within 24hours of the conductor / earth-wire clamping. While installing the conductor and earth-wire accessories, proper care shall be taken to ensure that the surfaces are clean and smooth and that no damage occurs to any part of the accessories or of the conductors.

1.24. Replacement

If any replacements are to be effected after stringing and tensioning or during maintenance e.g. replacement of cross arms, the conductor shall be suitably tied to the pole at tension points or transferred to suitable roller pulleys at suspension points.

Sagging of conductor has to be in accordance to the Sag Tension chart. In order to achieve it, it is preferred to pull the conductor to a tension a little above the theoretical value so that while transferring it from the snatch blocks to the pit insulators and to take care of temperature variation. Proper sag could achieve. Sagging for 33/11 KV line is mostly done by "Sighting". A horizontal strip of wood is fixed below the cross-arm on the pole at the required sag. The lineman sees from other end and the sag is adjusted by increasing or decreasing the tension. The tension clamps could then be finally fixed and conductor be fixed on pin-insulators. All fittings, accessories like guys, cross-arms, etc., could be checked as they should not have de-formalities.

The maximum permissible spans for all the lines of 33/11/0.4 KV are prescribed according to the design of the supports. Sag-tension charts for these conductors are to be followed.

1.25. Tying Of Conductor On Pin Insulators

Conductors should occupy such a position on the insulator as will produce minimum strain on the tie wire. The function of the wire is only to hold the conductor, in place on the insulator, leaving the insulator and pin to take the strain of the conductor.

In straight line, the best practice is to use a top groove insulator. These insulators will carry grooves on the side as well. When the conductor is placed on the top groove, the tie wire serves only to keep the conductor from slipping out.

On corners and angles (below 5 degree deviations) the conductors should be placed on the outside of the insulators. On the far side of the pole, this pulls the conductor against the insulator instead of away from the insulator.

1.26. Kind And Size Of Tie Wire To Be Used

Helically formed fittings are to be used for tying the insulators, end terminal connectors etc.. The tie should always be made of soft annealed wire so that it may not be brittle and injure the line conductor. A tie wire should never be used for second time. Specifications of helically formed fittings are given in this section.

1.27. Rules Of Good Tying Practice

a. Use only helically formed fittings.
b. Use of size of tie wire which can be readily handled yet one which will provide adequate strength.
c. Use length of tie wire sufficient for making the complete tie, including an allowance for gripping with the hands. The extra length should be cut from each end if the tie is completed.
d. A good tie should

(a) Provide a secure binding between line wire insulator and tie wire.
(b) Have positive contacts between the line wire and the tie wire so as to avoid any chattering of the contacts.
(c) Re-enforce line wire in the vicinity of insulator.

e. Apply without use of pliers.
f. Do not use the wire which has been previously used.
g. Do not use hard drawn wires for typing.

1.28. Conductors At Different Voltages On Same Supports

In urban area, lines are to be erected with provision for forming lines of two different gradients as under

a) 11 KV Line and LT Lines

b) 33 KV Line and LT Lines

Where conductors forming parts of systems at different voltages are erected on the same supports, the Contractor shall make adequate provision to guard against danger to linesmen and others from the lower voltage system being charged above its normal working voltage by leakage from or contact with the higher voltage system; and the methods of construction and the clearances between the conductors of the two systems shall be as described in the specifications.

The agency shall be intimated by the Project Manager in writing about the locations where such provisions is intended by him. At all such locations, the Contractor shall make adequate provision to guard against danger to linesmen and others from the lower voltage system being charged above its normal working voltage by leakage from or contact with the higher voltage system.

1.29. Earthing

Earthing shall generally be carried out in accordance with the requirements of latest CEA regulations (as amended from time to time) and the relevant regulations of the Electricity Supply Authority concerned and as indicated below:

a) All metallic supports shall be earthed.
b) For PCC poles the metal cross-arms and insulator pins shall be bonded and earthed at every pole for HT lines.
c) All special structures on which switches, transformers, fuses, etc., are mounted / likely to mount should be earthed.

d) The supports on either side of the road, railway or river crossing should be earthed.

e) All supports (Steel & PCC) HT lines passing through inhabited areas, road crossings and along such other places, where Earthing of all poles is considered desirable from safety considerations should be earthed.

f) In special locations and special structures, road crossings etc., pipe/rod Earthing should be done on either side of the construction.

g) At other locations the coil Earthing may be adopted. The coil Earthing consists of 10 m length of 8 SWG. G.I. wire compressed into a coil 450 mm length and 50 mm dia and buried 1500 mm deep as per REC standard J-1.

Following shall be the earthing requirements:

No	Description	Type of Earthing
1	Single Pole - PCC/RS Joist/steel tubular	1 No. Coil/Spike Earthing at each SP
2	Double pole - PCC/RS Joist/steel tubular	2 Nos. Coil/Spike Earthing at each DP
3	Substation Poles structure - PCC/RS Joist/steel tubular	GI Pipe/ Chemical Earthing 3 Nos
4	Road crossing	GI Pipe / Chemical earthing on either side one each
5	Telephone line crossing	GI Pipe / Chemical earthing on either side one each
6	DP with Isolating switch	Coil/Spike earthing 2 Nos and GI Pipe / Chemical earthing 1 No

1.30. Anti-Climbing Devices

In order to prevent unauthorized persons from climbing any of the supports of HT lines without the aid of a ladder or special appliance, certain anti-climbing devices are provided to the supports. Barbed wire binding is to be adopted for this purpose at a distance of 30 to 40 cm at a height of 3.5 to 4 m from ground level. The barbed wire shall conform to IS – 278 (Grade A1). The barbed wired shall be given chromatin dip as per procedure laid down in IS: 1340. At-least 3.5 kgs barbed wire is to be used per pole for the purpose.

1.31. Testing And Commissioning

When the line is ready for energization, it should be thoroughly inspected in respect of the following: -

a) Poles-Proper alignment, concerting and muffing.
b) Cross-arms – Proper alignment.
c) Finishing of fabricated steel items used.
d) Insulators – Proper finish, cleanliness, insulation resistance.
e) Binding, clamps and jumpers – To check whether these are in reach.
f) Conductor and earth wire – Proper sag to check whether there are any cuts, etc.
g) Guys: To check whether the Guy wire is tight and whether the Guy insulators are intact.
h) Earthing System: To check whether the earthing connections of supports and fittings are intact. Measure earth resistance with earth tester.

After the visual inspection is over and satisfied, the conductor is tested for continuity/ground, by means of megger. At the time of testing through megger person should not climb on the pole or touch the guarding, conductor, guy wire etc.

a. Before charging any new line, it should be ensured that the required inspection fee for the new line is paid to the Electrical Inspector and approval obtained from him for charging the line.

b. The line should be energized before the officer who has been authorized by the Project Manager in this regard.

c. Before energizing any new line, the Contractor of the line shall notify to the workmen that the line is being energized and that it will no longer be safe to work on line. Acknowledgement of all the workmen in writing should be taken in token of having intimated them.

d. Wide publicity by Tom-toming should be arranged in all the localities through which the line, that is to be energized passes, intimating the time and date of energizing and warning public against the risk in meddling with the line.

e. The Officer-in-charge of the line shall personally satisfy himself that the same is in a fit state to be energized.

1.32. River Crossing

No special structures are to be erected for this work. River crossing more than normal span of poles are not considered under the package. For small rivers etc., data for the highest flood-level should be obtained for previous years. The structures should be located at such places that they should be approached under flood condition. Normal DP structures are to be used for such crossings on approval of Project Manager.

In case of river crossing with longer span, special designed structures are to be used for the purpose.

1.33. Guarding

Guarding is to be provided for the lines, so that a live conductor, when accidentally broken, is prevented to come in contact with other electric lines, telephone or telegraph lines, roads, and persons or animals and carriages moving along the road, by providing a sort of cradle below the main electric line.

Guarding is not required for crossings of 66 KV and higher voltage lines where the transmission line is protected by fast acting relay operated circuit breaker of modern design with a tripping time of the order of 0.25 sec. from occurrence of fault to its clearance. For all other crossings, guarding is essential for all telecommunication lines and major road crossing.

The guarding shall consist of GI guard cross arm of length 2.5 mtrs made out of 65x65x6 mm angle & shall be hot dipped galvanized generally conforming to IS : 2633/72. The clamps shall also be hot dipped galvanized generally conforming to IS: 2633/72 & suitable for 13 m 52 kgs/m rail pole & for 8.0 meters longs RCC poles. Guarding shall be erected with ground & line clearances as per the I.E. rules. Cradle guard wire should be of 8 SWG GI Wire provided with lashing of 10 SWG GI wire at a distance of 2 m along the length of the guarding. Tension clamps, threaded eye bolts, turn buckles, thimble, tying wires and hardware are as per specified in the specifications. A sketch showing arrangement of guarding at road crossing is enclosed with tender drawing.

The minimum height between any guard wires and live crossing conductor shall not be less than 1.5 m in case of a railway crossing.

1.34. Repair to conductors

The conductor shall be continuously observed for loose or broken strands or any other damage during the running out operations. Repair to conductors, if necessary, shall be carried out with repair sleeves. Repairing of the conductor surface shall be carried out only in case of minor damage, scuff marks, etc. The final conductor surface shall be clean, smooth and free from projections, sharp points, cuts, abrasions, etc. The Contractor shall be entirely responsible for any damage to the poles during stringing.

1.35. LT Lines and Service connection

1.7.1. The LT line shall be erected of single phase or three phase arrangements through AB Cable depending on site requirements. Every 6^{th} pole of LT line shall be earthed with GI spike/GI Coil as per specifications.

1.7.2. In all those locations where LT AB cable is to be erected on the same support in which 11KV or 33KV line is also erected, proper isolation is to be maintained.

1.7.3. All single phase service connections released under the RDSS schemes shall be provided with one earth point near the energy meter. This point is connected with the proper earthing system through GI wires. 10mm diameter earth knob in form of bolt and nut is to be installed on energy meter

board. This earth point is to be maintained by service providing Distribution Company after installation and energization. In up-stream network, this earth point is to be connected with earth point.

1.7.4. Service connection is to be issued on proper surveying of the location so that excessive erection of LT line or 11 KV line may be avoided. The service wire is to be hanged on supportive GI wire between pole support and the house. Before installing service wires and GI wire, GI pipe on the consumer premises is to be erected using clamps/ nails/proper binding etc. In case of hut or poor structure at consumer premises, GI pipe is to clamp on wooden planks/wooden structure existing in the house. The GI pipe should be supported for neutralizing tension by means of GI tie wire support. In pukka/brickwork/cement concrete foundations, house, GI support pipe is to be clamped by means of MS clips.