NEPAL ELECTRICITY AUTHORITY

(An Undertaking of Government of Nepal)

Distribution and Consumer Services Directorate

Planning and Technical Services Department

Distribution System Rehabilitation Project

INTERNATIONAL COMPETATIVE BIDDING (ICB)

Tender No: ICB/PTSD/2073/074-01

BIDDING DOCUMENTS

FOR

Rehabilitation of Existing 33/11 kV Substations

(Volume III of III: **Works Requirement (Technical Specification))**

January, 2017

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SECTION - V

Works Requirements

This Section contains the Specification, the Drawings, and supplementary information that describe the Works to be procured.

Scope of Work

1. Description of the Project:

1.1 General:

The main components of the **Distribution System Rehabilitation Project** include **"Design, Supply, Delivery, Installation/Erection, Testing and commissioning of different equipments as specified in BOQ for Rehabilitation of existing 33/11 kV Substation Works."** The scope of supply of plants and related services under this Project, but not limited to, are given below:

1.2 This Tender Document covers the construction/rehabilitation of existing substation works and all the necessary civil, structural, mechanical and electrical works, including the design, supply, manufacturing, delivery, erection, construction, commissioning, trial operation and test of the equipment, works and materials as specified or referred to in the technical specifications of this Tender Document.

1.3 If any discrepancies in the specifications and drawing are found, shall be discussed and rectified before or at the time of final approval of drawings.

1.4 The bidders are requested to visit site(s) at its own to get the general idea about substation location and quote the price accordingly.

1.5 The Contractor shall have adequate manpower to execute the works at site(s) to complete the work within the scheduled time.

1.5.1 Equipment and Materials:

The Contractor to his designated store area shall deliver all equipment and materials. Such materials shall be delivered, unloaded and placed in stores in an acceptable manner and approved by the Employer or his authorized representative.

1.5.2 Erection:

When a substation area has been completed and accepted by the Employer, the Contractor will make an inventory of the assemblies erected, and submit it to the Employer for approval and final payment.

Before the Taking-Over of the works, the Contractor shall clean up all areas in which he has worked, place all unused materials in the designated stores and settle any claims, which may have resulted from his work and occupancy of the area. He shall then remove all equipments, vehicles, manpower and facilities, which, he has brought in except those which may be specifically exempt by the Employer.

1.6 Contract Scope:

This section outlines all major work to be carried out by the Contractor all the new and existing substations. All engineering design and materials shall be subject to the Employer/Employer's Representative approval.

2. Special Requirements of the Project

2.1 General

2.1.1 This specification covers the general requirements for design, manufacture, assembly, shop test, delivery, field, test, dismantling and installation commissioning of works for substation equipment.

2.1.2 Any deviation from this specification or the Technical Specification shall be clearly stated with reasons.

2.2 Conditions of Service

2.2.1 All plant and equipment supplied under this Contract shall be suitable for the following system and site conditions.

(a) System electrical parameters

(1)	System voltage	33kV and 11kV
(2)	Number of phase	3
(3)	Frequency	50Hz

(b) Climatic conditions

(1) Ambient temperature

- Maximum 55 deg. C
- Minimum 0 deg. C
- Annual average 32 deg. C

(2) Wind velocity

- Maximum 34.4m/sec

(3) Relative humidity

- Maximum 100%
- Minimum 20%

(4) Monsoon season June-August

(5) Precipitation

- Maximum 1,000 mm/month
- Minimum Zero/month

(c) Altitude of site Less than 1000m from sea level

(d) Seismic force O.15G

(e) Isokeraunic level 50

The information in this Sub-Clause is given solely for the general assistance of Bidders and no responsibility for it will be accepted nor will any claim based on this article be considered. The Bidder is advised to survey the Sites covered under this Contract to acquaint himself with site conditions.

2.2.2 The Contractor shall be responsible for surveying, borings, geologic and subsoil conditions for all foundations, and for the precise location of each substation in the project.

2.2.3 All necessary soil tests to determine the earth resistivity, the design of the ground grid and all foundations shall be performed by the Contractor at each substation site.

2.2.4 The Contractor shall locate, and record on the construction drawings, all interfacing utility lines or other obstructions.

Damage to existing line equipment and structures shall be repaired by the Contractor at his expense.

2.3 Codes and Standards

2.3.1 All plants and equipment supplied under this Contract shall conform to or be of higher quality than the latest applicable standard as listed in the following:

IEC - International Electro technical Commission

ANSI - American National Standard Institute

BS - British Standard

NEMA - National Electrical Manufacturers Association

IEEE - Institute of Electrical and Electronics engineers

ASTM - American Society of Testing and Materials

ASME - American Society of Mechanical Engineers

IPCEA - Insulated Power Cable Engineers Association

ISO - International Organization for Standardization

ASCE - American Society of Civil Engineers

ACI - American Concrete Institute

NEC - National Electrical Code (ANSI CI)

ISI - Indian Standard Institute

2.3.2 If the Specifications contained in this Contract conflict in any way with any of the reference standards, the Specifications shall take precedence. If there are conflicts between different specified reference standards covering the same material or equipment, the standard which will provided the highest quality and most suitable application as determined by the Employer/Employer's Representative shall prevail.

2.3.3 References to standards or to equipment of a particular manufacturer shall be regarded as followed by the words “or equivalent” except as otherwise noted. The Contractor may propose alternative standards, or equipment, which shall be equal to those, specified. If the Contractor for any reason proposes alternatives to or deviations from the above standards, or desires to use equipment not covered by the above standards, the Contractor shall state the exact nature of the change, the reason for making the change, and shall submit, for the approval, relevant specifications of the equipment in the original language, and in case that these specifications are written in language other than English, the English version shall be attached and shall govern. The decision of the Employer/Employer's Representative in the matter of equality will be final.

2.4 Scope of Works

2.4.1 The scope of works under this Contract shall include manufacture, shop test, delivery to each substation site in the Contract, receiving, assembly, erection, installation of the 33/11 kV substation equipments, field test, all civil work, and commissioning of all equipment necessary for rehabilitation of existing substations. The work includes but is not limited to the following:

(a) Lattice type steel structures for transmission line incoming/outgoing, supporting structures, all nuts, bolts and miscellaneous steel required for mounting and installation of all the equipment and materials furnished.

Support structure for 33 kV (Disconnecting switch) shall be the part of the switch itself. That is to say extra payment shall not be made.

Support structure of 33kV vacuum circuit breaker (VCB) shall also be the part of the circuit breaker. No extra payment shall be made for this.

Steel structure excluding above items shall cover under heading of galvanized steel structure for gantry and support as mentioned in the price schedule. Any specifically mentioned items shall not come under this steel structure.

(b) Outdoor type 33kV VCB, switchgears including circuit breakers, disconnecting switches, power fuse, instrument transformers, lighting arresters, insulators and bus materials complete with all fittings and connectors.

(c) Cables, wires, ground rods, fittings and connectors for the entire, grounding and static protection systems for each substation.

(d) Power transformers, 12kV VCB switchgears, station service transformers, and panel boards for substation AC/DC supply.

(e) Maintenance free Batteries and appropriate battery chargers for 110V DC supply system.

(f) All panels for control, metering, relaying, alarms, recording of events, etc. required for operation and protection of the entire substation.

(g) Cables and wires complete with terminal lugs and accessories for control, metering, relaying, alarms, carrier, and communication. AC and DC station power and lighting, and any other cables and wires required to interconnect all equipment of the entire substations.

(j) All civil works including, foundation and cable duct.

2.4.2 The Contractor shall submit detailed drawings, instruction and maintenance books, and spare parts lists with recommended stock quantities for the equipment furnished, prepare and submit detailed engineering, design and construction drawings pertaining to all mechanical and electrical equipment and installations in each substation. The drawings to be furnished by the Contractor for each individual substation shall include, but not be limited to the following:


(a) Single line and three-line diagram for existing substation and proposed up-gradation

(b) General layout of substation and property plan layout

(c) 33kV electrical layout and elevations, plans and details

(d) Structural erection and fabrication drawings

(e) Substation grounding calculation, plans, elevations and details

(f) Foundation layouts, plans and elevations indicating top of foundations, details for anchor bolt installation, including all data required for civil works.

(g) Cable trench, duct and conduit layout plan, elevation and details

(h) One line diagram for AC and DC station service power supply

(I) Substation lighting and convenience outlet plan, elevation, and details

(j) Substation control building electrical equipment layout, plan, elevation and details, including cable trench, cable tray, wire gutters, conduits, and specifying location and installation details for equipment furnished.

(k) Detailed material list for each substation

(m) Elementary AC and DC diagram for control, metering, relaying, communication, alarm etc., required to describe in detail the operation of all systems in each substation. Wire numbers and terminal numbers for each device shall be clearly marked on all AC and DC elementary and schematic diagram.

(n) Interconnection diagram for all substation equipment. AC and DC station service equipment and all building equipment.

(o) Detailed cable schedule list and cable summary, specifying cable identification number, routing and length of each cable for each substation.

(p) Switchgear and panel board front and rear elevation drawings showing dimensions and identification of each device and complete nameplate schedule.

(q) Calculation and coordination of protection relays.

(r) Instruction books, spare parts lists, material lists and any other documents pertaining to each substation and required for construction, operation, maintenance and repair.

All the instructions, manuals and relevant information in the drawings must be in English.

Unless otherwise specifically mentioned, the drawings and data pertaining to the Works shall be according to this clause.

a) General

All drawings shall be prepared in AutoCAD and the Contractor shall submit 3 sets of such electronic drawing files in Compact Disc to the Employer and the Consultant.

b) The Contractor shall submit the drawings and data to the Employer for approval in the following manner and designated deadlines.

For supply of equipment and/or installation work

Item	No. of Copies	Deadline & Remarks
Proposed work program	3	Within 30 days from the date of signing of Contract.
Principal equipment drawings for approval	3	Within 90 days from the date of signing of Contract.
Principal installation drawings for approval	3	Within 120 days from the date of signing of Contract.
Revised drawings for approval	3	Within 30 days after receiving drawing for revision.
Final drawingswith reproducible copies	5	Within 30 days after receiving approval.

AutoCAD files of Final Drawings in Compact Disc	2	Within 30 days after receiving approval.
Schedule of manufacturing and transportation	2	Within 30 days from the date of signing of Contract.
Plan for shop tests	2	Not less than 45 days before testing
Results of shop tests for approval	4	Upon completion of tests
Records of shop tests	4	Upon approval of results of shop tests
Plan for field-tests	2	Not less than 15 days before testing
Report for field tests	4	Within 7 days after completion of each test
As-built drawings	5	Within 30 days after completion of installation work
AutoCAD file of as-built drawings	3	Within 30 days after completion of installation work
Instruction manuals and drawings with reproducible copies for installation	5	30 days after shipment of Equipment

For Civil Works

Item	No. of Copies	Deadline & Remarks
Detail construction schedule & method	3	Within 30 days from the date of signing of Contract
Drawing for approval (principal	3	Within 90 days from the date of signing

drawings for construction)		of Contract.
Revised drawings for approval	3	Within 15 days after receiving drawings for revision
AutoCAD file of approved drawings in Compact Disc	2	Within 15 days after receiving drawings for revision
Reports of Field Tests	4	Within 7 days after completion of each test
As-built drawings	5	Within 30 days after completion of construction works
AutoCAD files of as-built drawings in Compact Disc	3	Within 30 days after completion of construction works

Others

Item	No. of Copies	Deadline & Remarks
Monthly Progress Reports with photographs	3	By 10th of following month
Packing list (copy)	5	At each shipment
Invoice (copy)	5	At each shipment
Bill of lading (copy)	5	At each shipment
Certificate of origin (copy)	1	At each shipment

In addition to the general requirements mentioned above, the following shall also be observed for the Civil Works:

I. Work Schedule Within 30 days after signing of the contract

II. Approval drawings for:

A. Switchyard

General Layout Plan	3 copies within 30 days after signing of the contract
Foundation Layout Plan	3 Copies within 30 days after approval of General Layout Plan
Detail Structural Design/calculation	5 Copies within 30 days after approval of Equipment foundation /Structure Foundation Layout Plan
Detail Working Drawing of	5 Copies within 30 days approval of Equipment foundation /Structure Structural design

2.4.2.1 Drawings: Titles, scales and Sizes

The title of the drawing, Contract Number, the signature of the Contractor's engineer and the date shall appear in the bottom right-hand corner of each drawing in the following format:

Project Name:

Contract No…….

Name of the Substation …….

Item No…….

Brief Description ……

In general the scales of the drawings shall be 1:200. The Contractor, however, can prepare and submit drawing in any other appropriate scales with the prior approval of the

Employer. The Contractor shall use any one of the following sizes for the preparation of drawings as appropriate:

A0	841 x 1189 mm	(33.11 x 46.81 in)
A1	594 x 841 mm	(33.39 x 33.11 in)
A2	420 x 594 mm	(16.54 x 23.39 in)
A3	297 x 420 mm	(11.69 x 16.54 in)
A4	210 x 297 mm	(08.27 x 11.69 in)

2.4.2.2 Employer's approval

The Employer will approve each drawing within thirty-five (35) days after receipt at his office. One print of each of the drawings submitted for approval will be returned by the Employer or Employer's Representative, marked either "APPROVED", "APPROVED EXCEPT AS NOTED", or "RETURNED FOR CORRECTION".

(a) The notations "APPROVED", or "APPROVED EXCEPT AS NOTED" will authorize the Contractor to proceed with the manufacturing drawings, subject to the corrections, if any indicated thereon. The notation "RETURNED FOR CORRECTION" shall require the Contractor to make the necessary revisions on the drawings and submit for approval within thirty-five (35) days in the same manner as before. Approval of the Contractor's drawings shall not in any way relieve the Contractor of any part of his obligation to meet all the requirements of the Contract or of the responsibility for the correction of the drawings.

(b) Reproducible: Reproducible of all final approved drawings shall be made on CDs.

(c) All final as-built drawings shall be supplied in CD-ROMs (three sets).

2.4.3 The Contractor shall provide spare parts and tools for each substation as specified in this specification.

2.4.4 Furnish qualified supervision and construction personnel for the installation, testing, commissioning and final system testing and checking out of the equipment listed above

and detailed in the Schedule of Materials. The work shall be performed in close cooperation and collaboration with the Employer/Employer's Representative.

2.4.5 Coordination of the substation work with the installation of others shall be the responsibility of the Contractor. The Employer will furnish the information needed to coordinate the substation work with the other work.

2.5 Assistance by the Employer

The Employer will give assistance to the Contractor as much as possible in the following; this however will be without any obligations, legal or otherwise.

(a) Facilitating access to all locations involved in carrying out the works.

(b) General guidance to the Contractor for all negotiations with the Authorities in Nepal.

2.6 Variation in Quantities of Work

The Quantities listed in the Prices Schedules represent the estimated quantities for tender purpose only. The Contractor agrees to make no claim for anticipated profits or for alleged losses because of any difference between the quantities actually furnished and installed and the estimated quantities as indicated in this Tender Document.

2.7 Time Schedule and Progress Report

2.7.1 Within 30 days from the date of signing of the Contract, the Contractor shall submit to the Employer/Employer's Representative a time schedule and progress chart covering work to be done at each manufacturing plant and installation at site. The Contractor shall show the several salient features of the work.

2.7.2 The proposed project period is as specified in the General Condition of Contract. Failure to meet these dates may result the Employer to enforce the provisions of “Liquidated Damages” to the Contractor. The Bidder shall submit the project schedule prepared by PERT/CPM with the Tender.

2.7.3 The Contractor shall submit the actual progress and the estimated earnings at the end of the month. Three (3) numbers of copies shall be furnished to the Employer/Employer's Representative with the monthly report.

2.7.4 The time schedule will be subject to review by the Employer/Employer's Representative for compliance with the Contract Documents and shall be revised if necessary by the Contractor to bring it into such compliance. The schedule shall be reviewed and revised if necessary at intervals not to exceed four weeks. In addition, the Employer/Employer's Representative shall be advised promptly of any proposed changes in the schedule.

2.7.5 The Contractor shall prepare and submit monthly to the Employer/Employer's Representative a report covering the progress on design, manufacturing and installation work at the Site during the month of record. The reports shall be accompanied by suitable illustrations and photographs and by copies or working schedules as necessary to effectively evaluated and document the progress of the work. The reports shall cover at least the following activities:

(a) Manufacturing status of equipment at each factory

(b) Shipping status

(c) Arrival of equipment and schedule for arrival of other required equipment

(d) Installation of Contractor’s equipment at the Site

(e) Performance record of critical items of Contractor’s equipment

(f) Quantitative progress on work at the Site

(g) Scheduled progress for work at the Site

(h) Description of conditions encountered that have affected the progress of the Works adversely and of action taken to alleviate the conditions and regain the anticipated progress.

(I) Description of matters, which the Contractor anticipates, will require contract interpretation, engineering decisions, or policy determinations.

(j) Numbers of employees in various categories at the Site and projected numbers for the following three months.

(k) Schedule showing the progress of planned and actual for each salient activities of the work.

The Contractor shall submit the report by end of the following month.

2.7.6 The employer has provided a time schedule for the execution of the work with this document. The contractor may revise the schedule of different items but the total completion time shall remain the same.

2.8 Drawings and Data

2.8.1 The Contractor shall prepare and furnish to the Employer/Employer's Representative such drawings, calculations, and data on materials and equipment (hereinafter in this provision called data) as are required for the proper control and completion of the work, including but not limited to those drawings, data and calculations specifically required elsewhere in the Technical Specifications.

2.8.2 The Metric System shall be used and notations shall be in English. Drawings, calculations, and data shall be furnished as specified. All drawings and data will be subject to review by the Employer/Employer's Representative conformity with the Technical Specifications and Contract Drawings and upon meeting review requirements shall become Employer.

2.8.3 Within 30 days from the date of signing of the Contract, the Contractor shall prepare and furnish to the Employer/Employer's Representative a schedule for submission of all drawings and data. Each drawing to be submitted for the work of the Contract shall be listed on the schedule, and the schedule shall contain separate columns for scheduled submitted dates and actual submittal dates. The schedule will be reviewed by the Employer/Employer's Representative and the Contractor shall correct any defects noted therein. The schedule shall at all times present a complete plan for orderly submission of such drawings and data and shall be updated and resubmitted monthly showing actual submittal dates and revised scheduling. The Contractor shall promptly notify the


Employer/Employer's Representative of any occurrence requiring substantial revision of the schedule giving a detailed explanation of the cause of the revision. Revised schedules will be revised and corrected in the same manner as the original schedule.

2.8.4 Neither the review nor lack of review of any drawings, calculation or data shall waive any of the specification or Contract drawings, or responsibility for correctness of the drawings, calculations or data and defective work, materials, and equipment may be rejected notwithstanding conformance with drawings, calculations and data reviewed by the Employer/Employer's Representative. The Employer/Employer's Representative shall have the right to require the Contractor to make any changes in the design which may be necessary, to make the apparatus conform to the requirements and intent of the specifications, with no additional cost to the Employer.

2.8.5 Any drawing changed by the Contractor during the development of his design after review by the Employer/Employer's Representative shall be submitted for approval.

2.9 Quality Control

2.9.1 The Contractor shall provide and maintain a Quality Control Plan (QCP) to ensure compliance with quality standards of the Technical specification, the Contractor shall furnish to the Employer/Employer's Representative six (6) copies of his complete quality control procedures, manual, and a description of the quality control organization.

2.9.2 The Employer/Employer's Representative will monitor the Contractor’s methods, procedures and processes for compliance with the QAP and the quality standards of these specifications Failure of the Contractor to effectively maintain the quality control program throughout all phases of the work will be considered a failure to prosecute the work with the diligence required by the Contract Documents.

2.10 Painting

2.10.1 All sheet steel work shall be phosphated in accordance with the following procedure and in accordance with BS 2569 and BS 5493.

2.10.2 Oil, grease, dirt shall be thoroughly removed by emulsion cleaning.

2.10.3 Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.

2.10.4 After phosphating, through rinsing shall be carried out with clean water, followed by final rinsing with dilute dichromate solution and even drying.

2.10.5 The phosphate coating shall be sealed by the application of two coats of stoving type zinc chromate primer. The first coat may be ‘flash dried” while the second coat shall be stoved.

2.10.6 After application of the primer, two coats of finishing synthetic enamel paint shall be applied, each coat followed by stoving. Touch up shall be applied after completion of tests. All panels should have same color. The color for the finishing paint shall be approved by the Employer/Employer's Representative.

2.10.7 The final finished thickness of paint film on steel shall not be less than 100 microns.

2.10.8 Finished painted surface of panels shall present at aesthetically pleasing appearance free from runs and drips.

2.10.9 A small quantity of finishing paint shall be supplied for minor touching up required at site after the installation of the panels.

2.11 Packing and Shipment

2.11.1 The Contractor shall prepare all materials and equipment for shipment in such manner as to protect them from damage in transit and in storage prior to installation. Materials that might otherwise be lost shall be boxed or wired in bundles.

2.11.2 All finished surfaces or ferrous metals, including screw threads that will be exposed during shipment or while awaiting installation shall be cleaned and shall be given a heavy uniform coating of rust-preventive compound devices subject to damage shall be suitably wrapped or otherwise protected from damage.

2.11.3 Each complete field assembly shall be given an identification number or letter, and each part of each field assembly which is not permanently connected in shop assembly shall be legibly marked. Except on bolts and other small parts, all such marks shall be made with oil-resistant paints. Diagrams showing all such markings shall be supplied. Each place of subassembly separately packed for shipment shall be labeled or tagged with the specification number and the mark number of such piece or the numbers of the parts


grouped in such subassembly, or contained in the package. The individual substation name shall be clearly and legibly marked on each package and crate.

2.11.4 The spare parts shall be packed separately from other articles. Packages of spare parts shall be clearly identified and shall be accompanied by a list of contents, which set forth directions for storing.

2.11.5 The Contractor shall prepare a packing list for each and every shipment made. In the case of several packages included in a single shipment, more than one package may be included on one packing list, providing all required information is shown for each package.

The following information shall be provided for each package:

(a) Description of package, i.e. box, crate, drum, bundle etc.

(b) Package number

(c) General description of contents corresponding to the invoice

(d) Equipment number where applicable

(e) Gross, tare and net weights in kilograms

2.11.6 Painting of Control Building :

It shall cover the followings:

a. Two coat of cement paint shall be inside and outside of the control building. The color choice shall be of the owner.
b. The paint shall be from reputed manufacturer. The Contractor shall have to take the written consent from the owner for the maker of the paint to be used; failing to do so may lead to nonpayment. Please note that thinner shall not be allowed for diluting the metal or wood prima, enamel paint i.e. paint shall be used without diluted.
c. One coat of wooden prima and two coats of enamel point shall be used for wooden parts of window and door. Same shall hold for grill of window.
d. Repairing of patches inside and outside of control building. The ratio of mortar shall be 1:4.

e. Replacement of broken glass, wooden panel and damaged hinges and locks etc.

f. The repairing of the door, window shall be in such way when closed there shall not be free flow of air. That is to say, the repairing shall be suitable for air conditioning.

2.12 Tools and Appliances

The Bidder shall supply complete, new and unused sets of all special tools or gages, which will be required for normal operation and maintenance. The Bidder shall furnish the list of tools and appliances in the Tender Document. To the Greatest extent possible, the tools for each specific operation shall be stored in a single, locked, portable, steel box suitably and clearly marked for convenient identification. These shall be the part of equipments.

2.13 Spare Parts

2.13.1 The Bidder shall propose recommended spare parts required for three years maintenance in addition to the spare parts specified in the price schedule of Tender Document and shall include a price list of these parts in a separate sheet of paper. The price of such spare parts proposed by the bidder shall not be taken into account for financial evaluation. Sufficient information shall be provided to permit the Employer/Employer's Representative to estimate spare parts requirements.

2.13.2 All spare parts supplied under the Contract shall be strictly interchangeable with the parts for which they are intended to be replaced and shall be treated and packed for long storage under the climatic conditions prevailing at the site. Each spare part shall be clearly marked or labeled on the outside of its packing with its description and purpose, and when more than one spare part is packed in a single case or other container, a general description of its contents is to be shown on the outside of such cases or container and a detailed list enclosed inside. All cases, containers and other packages must be suitably marked and numbered for purpose of identification.

2.13.3 All cases, containers or other packages are liable to be opened at the site for such examinations as the Employer/Employer's Representative may consider necessary and all such opening and subsequent repacking shall be at the expense of the Contractor.

2.13.4 All spare parts must be delivered to Site in advance of the trial operation. The Contractor shall ultimately prepare and deliver five (5) copies of the final consolidated spare parts list, arranged specifications-wise.

2.13.5 It shall be in the interest of the Contractor to organize the delivery and systematic storage of spare parts before the trial operation to obviate post erection difficulties and delays. Any spare part consumed by the Contractor before Performance Certificate shall be replaced without any cost to the Employer.

2.14 Technical Requirements

2.14.1 Electrical auxiliary power supply

The electrical auxiliary and control power source shall be as follows:

(a) AC auxiliary power source

- 3 phase, 4-wire, 50Hz. 400/230V
- 1 phase, 50Hz, 230V

(b) DC control power source: 110V

2.14.2 Wiring

The equipment to be provided as part of this Contract shall be fully wired in accordance with the following general requirement.

(a) All wiring shall be carried out in general purpose 600 volt grade PVC copper wire complying with the requirements of IEC. The wire core size shall not be less than 2.5sqmm. All wire cores shall be multi stranded and flexible.

(b) Wires shall be neatly bunched and adequately supported so as to prevent sagging and strain on termination.

(c) All inter panel wiring between panels that directly adjoin one another shall be made through suitable holes in the common panel side sheets. All inter panel wiring shall start and terminate on terminal blocks; direct wiring between other items of equipment will not be acceptable.

(d) Joints or splices in panel and inter panel wiring not be acceptable.

(e) The wiring of panels, cubicles or kiosks shall be identical.

(f) All wire termination shall be made with compression type connectors. Wires shall not be spliced or tapped between terminal points.

(g) Not more than two wires shall be connected to any terminal at each end. If necessary, a number of terminals shall be jumpered together to provide additional wiring points.

(h) Wiring leads and cable cores shall be permanently marked a both ends with an approved type of marking device having black letters and numbers impressed on a white background.

2.14.3 Terminal Blocks

(a) Multiway terminal blocks complete with screws, nuts, washers and marking strips for terminal identification shall be furnished for terminating the internal wiring and outgoing cables.

(b) Control terminals shall be washers head screw type, each suitable for connection of at least two numbers copper conductor cables of requisite cross-section at each end through compression type (solderless) lugs. Screw type terminals with screw directly impinging on conductor or any other of terminal, which does not accept compression type lugs, are not acceptable. The successful Bidder shall have to take prior approval of the terminals to be used in the block from the Employer/Employer's Representative.

(c) Each terminal shall be marked with designations obtained from schematic diagrams.

At least 20% spare terminals shall be provided in the terminal blocks.

2.14.4 Nameplate

(a) Nameplates or rating plates shall be stainless steel and shall be engraved in English language. Instruction plates, warning signs and any marking whatever on the equipment and parts and accessories thereof shall be in English.

(b) The switch handles shall be carved with the function number or word colored in white.

(c) The details of the matters to be shown on the nameplates, etc. shall be indicated in the drawings for approval.

2.14.5 Switchyard Surface Cleaning:

The scope of works under this heading comes as following:

1. Taking out grass from its root, So that the chances of sprouting are minimized. The realignment and leveling of existing switchyard gravel.

2.14.6 Surface Dressing with Crushed Stone:

It covers the followings:

1. Filling up by gravel in the patch
2. Filling up the in the switchyard if it not.
3. Crushed stone to be used shall be 40 mm size and depth of 15 cm.

2.14.7 Switchyard Painting:

It shall cover the followings:

a. One coat of red oxide point and two coat of Aluminum point
b. The point shall be from reputed manufacturer. The contractor shall have to take the prior written acceptance from the owner for the manufacturer of the point.
c. Thinner shall not be used.
d. Painting of transformer and equipment shall be by spray gun.
e. Special care shall be taken to avoid spray on bushing and name plate
f. Painting shall be done on the followings:
g. Gantry / Steel Structure, Transformer and other equipment's.
h. Galvanized steel structure shall not be pointed.

2.14.8. Repairing of Cable Trench (out door):

It shall cover the followings:

a. Repairing / replacement of cable trench slab.

b. Repairing of any damaged or likely to be damaged part of cable trench.
c. Repairing of patch works.
d. Repairing / replacement of cable support tray or angle etc.
e. The repairing shall look line new one.

2.14.9 Repairing of Cable Trench (Indoor):

a. Same as in item No 2.14.8.
b. If there is no cover over the cable trench, it shall have to be supplied / constructed by the contractor

3 Construction and Installation Works:

It shall include construction, erection, assembly, installation, testing and commission of the equipments and steel structure. After the construction and installation works the equipments shall run trouble free and smooth.

3.1 Foundation Works:

It shall include the following:

a. Foundation works shall be per the specification provided in Section VII

3.2 Clamp:

Clamp to be used for fixing the channel to the pole shall be made of mild steel strip of 500mm x 5 mm section. This shall be hot dip galvanized. The zinc costing shall be 610 gram per square meter.

3.3 Trolley of VCB:

This shall be the trolley of V.C.B. cubicle, complete with vacuum interrupter etc. It shall be purchased as spare.

3.4 Galvanization:

All the steel structures used as support to the equipments, gantry and column shall be galvanized through the process as prescribed in IS/ IEC standard but the zinc coating shall be 610 gram per square meter (85 micron).


3.5 Lightning Mast

The Lightning Mast shall be designed, supplied and installed as per the standard practices and as per the site conditions. The design details of the Lightning Mast shall be submitted to the owner for approval.

3.6 Minor Items and Works:

While reinforcing / constructing substations under this contract, minor items like shifting of switchyard lighting poles, shifting of gantry structure, dismantling of existing wall/ fence, equipment shifting and relocating the switch yard steel fencing, interconnection of new and old earthing system, shifting of electrical equipment from one place to another inside and outside the switch yard or in control room etc. which are not mentioned in the price schedule shall have to be done for completing the substations electrically and mechanically sound. These items and works may include labor and materials. It is not practical to mention such minor items specifically in the price schedule. The cost of such items and works shall be included and spread up in the different items of construction and installation works as mentioned in the price schedule. No extra payment shall be made to the contractor for such minor items and works . So the bidders are requested to send an expert to each substation to assess the requirements of such items and works for completing the substation technically sound and to submit the bid accordingly.

4 Environmental Mitigation Measures

4.1 Physical Environment

The following mitigation measures shall be undertaken to reduce the adverse impacts on the physical environment during construction of the substation.

(i) Changes in land use and landscape: The construction activities will be planned properly. The construction material will be stored at the designated places and the haphazard dumping of the construction spoils will be strictly prohibited. Discharge of cement slurry, garbage and other solid wastes generated by the construction activities and workforce will be avoided where possible.

(**ii) Disposal of the construction spoils:** The excavated material will not be left haphazardly. It will be leveled on the ground. Further, the disposal material of substation will be carried out within the acquired land for substation.

(**iii) Stockpiling of the construction materials:** The Contractor will have to negotiate with the owner of the property for the use of their premises even if it is for the short period.

(iv) Nuisance to the nearby properties: Although some nuisances may be unavoidable, the Contractor will have to minimize such nuisance. The Contractor will have to work in close-coordination with the local community while working in the settlement areas.

(v) Impact on the infrastructure: The Contractor shall ensure that there will be no interference with the existing infrastructure including utility facilities during contraction.

(vi) Change in air quality: Though change in water quality is unlikely during construction activity, sprinkling of water shall be carried out by the Contractor at least once a day during dry season.

4.2 Biological Environment

None

4.3 Socio-economic and cultural Environment

In the construction phase following mitigation measures shall be adopted to minimize the impacts:

(i) Loss of farmland and other category of land: Any damage to the farmland by the construction activity will have to be restored and rehabilitated.

(ii) Occupational safety and hazard: The Contractor will provide appropriate training in handling equipment and machinery to the workers and laborers before contraction. All workers employed by the Contractors shall be insured against accident.

(iii) Loss of standing crops: The Contractor shall make compensation for the loss of standing crops due to project activities.

(iv) Employment of project affected people: Priority will be given to the project affected people while hiring workers and laborers during project construction. Nepal being a signatory to the International Convention against the Child Labor, the Contractor shall not employ child labor in construction.

TECHNICAL SPECIFICATION

(Electrical Equipment)

1. 33 kV CIRCUIT BREAKER

1.1 General

This specification covers the design, manufacture, assembly, shop test, supply, delivery, installation works and field test of 33kV vacuum circuit breakers complete with all accessories for efficient and trouble free operation as specified here in under.

Circuit breakers shall be offered from reputed makes like Hitachi /GE /ABB/Mitsubishi / LG /Fuji / Siemens or Areva or equivalent.

The equipment specified in this Section shall conform to the latest edition of the appropriate IEC specifications and/or other recognized international standards. In particular:

IEC 60056	High-voltage alternating switchgear
IEC 62271	High-voltage alternating switchgear and control gear
IEC 60376	Specification and acceptance of new sulphur hexafluoride
IEC 60529	Degree of protection provided by enclosures
IEC 60694	Common specifications for high-voltage switchgear and control gear standards

Manufacturer of 33 kV Circuit Breaker shall hold valid ISO 9001quality certificate (including design).

1.2 Equipment to be furnished

1.2.1 The equipment to be furnished shall strictly be in accordance with the specifications and the Price Schedule.

1.3 Design Requirements

1.3.1 The circuit breakers shall be suitable for 3 phase, 50Hz in 33kV system.

1.3.2 Circuit breaker shall be installed outdoor in a hot and humid climate. All equipment and accessories shall be provided with tropical finish to prevent fungus growth.

1.3.3 The maximum temperature rise in any part of the equipment at specified rating shall not exceed the permissible limit as stipulated in relevant standards. The de-rating of the equipment shall be made taking 45 deg. C as an ambient temperature of the site, if it is designed for any lower ambient temperature.

1.3.4 The rated peak short circuit current or the rated short time current carried by the equipment shall not cause:

(a) Mechanical damage to any part of the equipment.
(b) Separation of contacts.
(c) Insulation damage of "Current Carrying Part".

1.3.5 Technical particulars of the circuit breaker shall be as per Appendix 1.5.1.

1.3.6 All auxiliary equipment shall be suitable for 3 phase 4 wire, 50Hz, 400 V.

1.4 Construction Features

1.4.1 This circuit breaker shall be outdoor, three phase, single throw, pneumatically or spring charged motor operated, vacuum type, trip free in any position, complete with operating mechanism and supporting structure.

1.4.2 Bushing or tanks shall be accurately aligned and assembled with the operating mechanism as a complete rigidly mounted unit on a structural steel base or frame at the factory, to permit shipment and installation as an assembled unit.

1.4.3 Contacts

The contacts shall be designed to have adequate thermal and current carrying capacity for carrying full-rated current without exceeding the allowable temperature rise as specified by IEC standards. They shall be designed to have long life so that frequent replacement or maintenance will be unnecessary. The surfaces of both moving and stationary arcing contacts, which are exposed directly to the arc, shall be faced with suitable arc resisting material.

1.4.4 Local test switch

Each mechanism shall be equipped with a local test switch for electrically testing the closing and tripping operations of the circuit breaker. A separate manually operated cutout device to disconnect the circuits to remote closing, re-closing and tripping devices shall be provided on each circuit breaker. A warning nameplate requiring operation of this device before operation of the local test switch shall be mounted adjacent to the local test switch.

1.4.5 Emergency trip

Each circuit breaker shall be provided with an emergency hand trip device. This device shall be provided with mechanically interlocked contacts to disconnect circuits from remote closing and re-closing devices.

1.4.6 Position indicator

The circuit breaker shall be equipped with mechanical position indictor. The indicator shall be provided for each pole.


1.4.7 Operating mechanism

The operating mechanism of the circuit breakers shall be spring charged by 110V D.C. motor and with mechanical charging.

The tripping circuit mechanism and the closing control circuit mechanism shall each have a nominal voltage rating of 110 volts DC. The tripping circuit shall operate satisfactorily for a tripping operation over a voltage range of 70-110%. The closing control circuit shall operate satisfactorily over a voltage range of 85-110%.

1.4.8 Operation Counter

There shall be the counter to read the number of operation of VCB.

1.4.9 Accessories

The Contractor shall furnish following accessories as an integral part of the circuit breaker:

(a) Padlocks and duplicate keys
(b) Operation counter
(c) Earthing terminals
(d) Nameplate
(e) Other necessary accessories
(f) Operating handle

1.4.10 Spare parts

Following spare parts shall be provided in required quantities as listed in Price Schedule.

1.5 Tests

1.5.1 Routine tests

One circuit breaker of each type ordered under the Contract shall be fully assembled at the manufacturer's works and subjected to routine tests in accordance with IEC 56 and shall comprise but not limited to the following.

(a) Construction inspection
(b) Leakage test
(c) Operating speed check
(d) Dielectric test
(e) Pressure test
(f) Control and secondary wiring check test
(g) Mechanical operation test
(h) Operating mechanism system check


1.5.2 Design tests

The Bidder shall submit the Type Test Report for identical circuit breaker with the following test, but not limited to;

(a) Bushing tests
(b) Dielectric withstand test
(c) Current carrying test
(d) Normal current switching test
(e) Short circuit switching test
(f) Mechanical operation life test

If a circuit breaker has been used for design tests, the test breaker will not be accepted unless the following minimum maintenance are completed, including any other provisions not included herein, but required to render the breaker equivalent of a new breaker:

(a) Replace all latches and pins
(b) Replace all major parts which are subject to fatigue, including, but not restricted to, contacts, movable cross-heads, spring and linkages.

1.5.3 Field tests

After installation at Site, the circuit breaker shall be subjected but not limited to the following field tests:

(a) Construction inspection
(b) Measurement of insulation resistance
(c) Operating speed check
(d) Mechanical operation test
(e) Operating mechanism system check

1.6 Performance Guarantee

The performance guarantee figures quoted on the schedule of technical data shall be guaranteed within the tolerances permitted by relevant standard and will become a part of successful Tender's Contract.

1.7 Drawings, Data and Manuals

1.7.1 The following drawings and data shall be furnished along with the Tender.
(a) General equipment layout
(b) Outline drawings of the breaker and control cubicle with accessories


1.7.2 After award of Contract the successful Bidder shall submit the required number of copies of the following drawings and data for approval of the Employer/Employer's Representative.

(a) General equipment layout
(b) Outline drawing of the breaker and control cubical with accessories.
(c) Loading data and foundation detail.
(d) Elementary control wiring diagram.
(e) Internal wiring diagram.
(f) External connection diagrams, showing terminal boards and other external connection points for each assembly and the required interconnecting wiring.
(g) Drawing showing typical cross-section of the operating mechanism and breaker mechanism.
(h) Drawing showing typical cross-section and assembly of interrupting device.
(i) Drawing showing assembly of principal component parts and accessories.
(j) Drawing showing details of bushing or porcelain supporting columns, including dimension details of flanges and outline dimensions.

(k) Drawing to show details at all points where adjustments may be made to operating dimension mechanism, breaker mechanisms and contacts.
(l) Any other drawings and data required for design and installation of circuit breaker.
(m) Instruction manual for storage, installation, operation and maintenance of circuit breaker and operating mechanism.

1.8 Nameplate

Each circuit breaker shall be provided with nameplate of weather resistant material fitted in a visible position showing the following items as a minimum.

(a) Manufacturer’s name
(b) Manufacturer’s serial number and type designation
(c) Year of manufacture
(d) Rated voltage, kV
(e) Rated insulation level, kV
(f) Rated frequency, Hz
(g) Rated normal current, A
(h) Rated short-circuit breaking current, kA
(i) Rated interrupting time cycles
(j) Weight of circuit breaker, kg

1.9 Special Tools

In addition to the tools, which are regularly furnished with such breakers, the Contractor shall also supply all necessary special tools or equipment for assembling and


disassembling the breaker. The Contractor shall submit an itemized list of such equipment.

APPENDIX 1.5.1
TECHNICAL PARTICULARS OF 33 kV CIRCUIT BREAKER

1.	Type		Vacuum, outdoor type
2.	Quantity required		As per Price Schedule
3.	Voltage rating		
	(a)	Nominal system voltage	33kV
	(b)	Rated maximum voltage	36kV
4.	Insulation level		
	(a)	Impulse withstand voltage	170 kV
	(b)	Power frequency withstand voltage(1 min)	75 kV
5.	Frequency		50Hz
6.	Current rating		
	(a)	Rated continuous current at 45 deg. C ambient	800A
	(b)	Rated interrupting current	25 kA
7.	Re-closing duty cycle (Rated operating sequence)		0-0.3 sec-CO-3 min.-CO
8.	Auxiliary supply		
	(a)	Control circuit	DC 110V
	(b)	Space heater and auxiliary equipment	AC, 3Ph-4W, 400V, 50Hz

9.

Total maximum break time	60 ms
First pole to clear factor	1.5
Additional Auxiliary Contacts	8 NO, 8 NC
Maximum make time	120 ms
Spring charging motor	110 V DC


2. 33 kV Disconnecting Switch

2.1 General

This specification covers the design, manufacture, assembly, shop test, supply, delivery, installation works and field test of disconnecting switches complete with all accessories for efficient and trouble-free operation as specified herein under.

The equipment specified in this Section shall conform to the latest edition of the appropriate IEC specifications and/or other recognized international standards. In particular:

IEC 60129 High-voltage alternating current disconnectors and earthing switches
IEC 60529 Degree of protection provided by enclosures

Manufacturer of Disconnecting Switch shall hold valid ISO 9001quality certificate (including design).

2.2 Equipment to be furnished

2.2.1 The equipment to be furnished shall strictly be in accordance with the specifications and the Price Schedule.

2.3 Design Requirements

2.3.1 The disconnecting switches shall be used for the 33kV. 50Hz, 3 phase system.

2.3.2 The equipment shall be installed outdoor in a hot, humid climate. All equipment, accessories and wiring shall be provided with tropical finish to prevent fungus growth.

2.3.3 The maximum temperature rise in any part of the equipment at specified rating shall not exceed the permissible limits as stipulated in relevant standards. The de-rating of the equipment shall be made taking 45 deg. C as an ambient temperature of the site, if it is designed for any lower ambient temperature.

2.3.4 The rated peak short circuit current or the rated short time current carried by the equipment shall not cause:

(a) Mechanical damage to any part of the equipment
(b) Separation of Contacts
(c) Insulation damage of "Current Carrying Part."

2.3.5 The grounding switch shall be capable of making to a dead short circuit without damage of the equipment or endangering operator.


The disconnecting switches shall be rotating post type with contact blades moving through horizontal plane.

2.3.6 The rating, the accessories to be furnished and the schedule of equipment are detailed in Appendices.

2.3.7 The disconnecting switches shall be able to carry the rated current continuously and rated short time current for three seconds without exceeding the temperature limit specified in the relevant standard.

2.3.8 The disconnecting switches shall be capable of withstanding the dynamic and thermal effects of maximum possible short circuit current at the point of its installation.

2.4 Construction Features

2.4.1 The 3-pole disconnecting switches shall be gang operated type so that all the poles make and break simultaneously.

2.4.2 The disconnecting switches shall be designed for upright mounting on steel structure.

2.4.3 The disconnecting switches shall have padlocking arrangement in both "open" and "closed" positions.

2.4.4 All current carrying parts shall be non-ferrous metal or alloy. All live parts shall be designed to avoid sharp points and edges.

2.4.5 All metal parts shall be of such material and treated in such a way as to avoid rust, corrosion and deterioration due to atmospheric conditions. Ferrous parts shall be hot-dip galvanized.

2.4.6 Bolt nuts, pins, etc. shall be provided with appropriate locking arrangement such as locknuts, spring washers, key etc.

2.4.7 Bearing housing shall be weatherproof with provision for lubrication. The design, however, shall be such as not to require frequent lubrication.

2.4.8 All bearings in the current path shall be shorted by flexible copper conductor of adequate size (minimum-70sqmm) to allow the specified fault current through it without injury.

2.4.9 Main contacts

The main contacts shall be of silver-plated copper alloy and controlled by powerful springs designed for floating and pressure point contact.

The contacts shall have sufficient area and pressure to withstand the electromagnetic stresses developed during short circuit without excessive heating liable to pitting or welding.

Contacts shall be adjustable to allow for wear, shall be easily replaceable and shall have minimum movable parts and adjustments.
The blade shall be made of electrolytic copper tube or aluminum tube of liberal section. Rotating feature of the blade at the end of tube travel for contact wiping shall be provided.

Arcing horns shall be provided to divert the arc from main contacts to the separating horns after the main contacts have opened. Arcing horns shall be renewable type.

2.4.10 Insulators and terminals

Insulators shall be post type; brown glazed and composed of stacked units.

The porcelain used for insulators shall be manufactured by wet process and shall be homogeneous and free from cavities and other flaws.

Caps and pins shall be of the highest quality malleable iron or forged steel and smoothly galvanized.

Arcing horn as required shall be furnished.

All insulators of identical ratings shall be interchangeable.

The terminals of the disconnecting switch shall be provided with terminal connectors.

2.5 Operating Mechanism

2.5.1 Disconnecting switches for 33kV.

The operating mechanism for 33kV shall be manually operated.

The manual operating mechanism shall be of torsion type suitable for operation in the horizontal plane. The operating handle shall be equipped with each switch and shall be arranged for mounting on the steel base supporting structures. Means shall be provided on each switch for taking up loose motion in the operating mechanism and for adjusting the travel of each blade independently. The Contractor shall furnish all supplemental members required to secure the installation of the complete switch mechanism to the supporting structures.

All switches shall be self-locking in the open and closed positions independent of the control shaft restraint. Each mechanism shall be provided with an indicator showing direction of rotation for opening or closing, and shall be provided for grounding and for padlocking in the open and closed positions.

Each operating mechanism shall be furnished complete with all necessary operating pipes, inter phase shafts, pipe couplings, guide bearings, ground braids, mounting brackets, mounting bolts, operating handle, auxiliary switches and offsets required for operation from the ground. All operating rods and levers shall be cut to length and all machining operations and threading shall be complete in the factory.

The manually operated disconnecting switches shall also be provided with a minimum four (4) normally closed and four (4) normally open auxiliary contacts for remote indications.

2. 6 Assembly

Each disconnecting switches along with its base frame and operating mechanism shall be completely assembled and checked at manufacturer's works for correct alignment and operation prior to dispatch.

All parts and accessories shall have appropriate match marks and part number for identification at site.

2.7 Tests

2.7.1 Type and routine tests on the equipment and components shall be in accordance with latest revision of IEC Standards or equivalent standards.

Each switch shall include but not limited to the following tests:

(a) Routine tests

- Power frequency voltage dry test
- Measurement of resistance of main circuit
- Control and secondary wiring check test
- Mechanical operation test

(b) Design tests

- Insulator test
- Dielectric test, including impulse withstand test
- Radio influence test
- Short-time current test
- Voltage drop test the voltage drop across one complete phase of a switch shall be measured when carrying rated current.
- Temperature Rise Test

If type tests have been previously conducted on identical disconnecting switch, the Contractor may furnish the certified copies of such previous reports instead of performing


tests. The Bidder shall submit copy of design test report from accredited testing laboratory for the disconnecting switch of the offered model along with the bid.

2.7.3 Field tests

After installation at Site, the disconnecting switches shall be subjected but not limited to the following field tests:

(a) Construction inspection
(b) Measurement of insulation resistance
(c) Mechanical operation test

2.8 Drawings, Data and Manuals

2.8.1 The following drawings and data shall be furnished with the Tender.

(a) General arrangement drawing with different sections showing constructional features.
(b) Technical leaflets on disconnecting switches offered explaining the function of various parts, principle of operation and special features (if any).
(c) Typical type test results on identical equipment offered in the Tender.

2.8.2 The various drawings, data and manuals shall be submitted for approval and afterwards for final distribution in quantities and in procedures as set-up elsewhere. The various drawings and data to be furnished shall include:

(a) Outline dimensional drawings of the equipment showing general arrangement and location of fittings.
(b) Transport/shipping dimensions with weights.
(c) Foundation and anchor bolt details including loading condition.
(d) Assembly drawing for erection at site with part numbers and schedule of materials.
(e) Electrical schematic and wiring diagram.
(f) Any other relevant drawings and data necessary for erection, operation and maintenance.
(g) Instruction manual and data sheets.
(h) Any other relevant data, drawing and information necessary for review of the items stated above.


APPENDIX A-1

TECHNICAL PARTICULARS OF 33kV DISCONNECTING SWITCH (WITH GROUNDING SWITCH)

1.	Type		3-pole, single throw, outdoor
2.	Quantity required		As per Price Schedule
3.	Voltage ratings		
	(a)	Nominal system voltage	33 kV
	(b)	Rated maximum voltage	36 kV
4.	Frequency		50 Hz
5.	Insulation levels		
	(a)	Basic impulse level (BIL)	170 kV
	(b)	Power frequency withstand voltage (1 min.)	75 kV
6.	Current ratings		
	(a)	Continuous current	800 A
	(b)	Short time current (1 seconds)	25 kA
	(c)	Peak short time current	32 kA
	(d)	Making current of grounding switch	32 kA
7.	Operating mechanism		manually gang operated

APPENDIX A-2

TECHNICAL PARTICULARS OF 33kV DISCONNECTING SWITCH (WITHOUT GROUNDING SWITCH)

1.	Type		3-pole, single throw, outdoor
2.	Quantity required		As per Price Schedule
3.	Voltage ratings		
	(a)	Nominal system voltage	33 kV
	(b)	Rated maximum voltage	36 kV
4.	Frequency		50 Hz
5.	Insulation levels		
	(a)	Basic impulse level (BIL)	170 kV
	(b)	Power frequency withstand voltage (1 min.)	75 kV
6.	Current ratings		
	(a)	Continuous current	800 A
	(b)	Short time current (1 seconds)	25 kA
	(c)	Peak short time current	32 kA
7.	Operating mechanism		manually gang operated

3. Instrument Transformer

3.1 General

This specification covers the design, manufacture, assembly, shop test, supply, delivery, and installation works and field test of instrument transformers as specified herein under.

The equipment specified in this Section shall conform to the latest edition of the appropriate IEC specifications and/or other recognized international standards. In particular:

IEC 60044 Voltage transformers
IEC 60044 Instrument transformers
IEC 60529 Degree of protection provided by enclosures

Manufacturer of instrument transformer shall hold valid ISO 9001(including design) quality certificate.

3.2 Equipment to be furnished

The Following Equipment shall be furnished, if seemed necessary, after the approval of Schematic Diagram submitted by the Bidders or as Instructed by the Owner. The Schematic diagram should be prepared and submitted by the Bidders with Technical Proposal, after studying the existing Protection and Metering System, such as to provide necessary and adequate Protection to the Transformer Bay as a Whole. The Bidders are required to make the Site visit and access necessary Data and Drawings from the respective Substation. Similarly, the details about the Ratio / Burden / Class will be finalized after the approval of the Schematic Diagram or as Instructed by the Owner.

33 kV Current Transformer for Measurement & Protection
33 kV Bushing current Transformer for Protection
11kV Bushing Current Transformer for Protection
11kV Current Transformer for Measurement & Protection.
11kV / 110V Potential Transformer for measurement & Protection
33kV / 110V Potential Transformer for measurement & Protection

3.3 Design Requirements

3.3.1 Instrument transformers shall be suitable 33kV 50Hz. 3 Phase with neutral solidly grounded system.

3.3.2 Instrument transformers shall be installed outdoor in a hot, humid climate. All equipment and accessories shall be provided with tropical finish to prevent fungus growth.


Burden of the instrument transformers stated herein is the minimum value required. Where higher burden is required to suit the designs, the Contractor shall supply the same without additional cost.

3.4 Construction Features

3.4.1 The instrument transformers shall be oil-filled construction and shall be designed for outdoor service and suitable for vertical mounting.

3.4.2 The core and coils of current transformer shall be mounted in a steel tank on the top of the unit with the primary coil leads extending through insulated bushings for series or multiple connections. A steel base shall support the high voltage bushing and tank. The high voltage bushing shall be sealed to the tank and the base with oil-tight joints.

3.4.3 The primary terminals of instruments shall include provisions for externally connecting the primary winding. The secondary terminals shall be enclosed in a weatherproof terminal box.

3.4.4 Porcelain bushings shall have adequate mechanical and electrical strength. The color of porcelain shall be brown.

3.4.5 Junction boxes

Junction boxes shall be rigid weatherproof type complete with terminal blocks suitable for cable size having the range up to 2x6 sq. mm for termination of the secondary connections (such as delta or wye connection). They shall be made of metal, which will resist corrosion on both inside and outside surfaces; otherwise they shall be suitably protected by galvanizing. Cover of the junction box shall be of hinge door type complete with door handle. Two drainage holes shall be provided at the bottom of the junction box. In case the junction boxes are steel sheet, the thickness of such steel sheet shall be at least 1.2mm. Junction boxes shall be sized and arranged to provide easy access for external cables and adequate space for internal wiring and installed equipment. Enclosure protection class of the junction boxes shall be IP55W

The terminal blocks used should be provided with shorting links on the top of the unit with the primary coil leads extending through insulated bushing for series or multiple connections .A steel base shall support the high voltage bushing and tank. The bushings shall be sealed to the tank and the base with oil tight joints.

3.4.7 Termination

(a) Current transformers

All current transformer secondary winding terminals shall be connected to terminals on terminal located in the junction boxes. In addition, a short -circuit type terminal block

shall be provided for each maximum ratio of each core at the terminal blocks in both the secondary terminal box and junction box.

(b) Potential transformer

All PT's secondary terminals shall be connected to terminals on terminal blocks located in the junction boxes.

3.4.8 Protective devices

(a) The secondary phase wire for external connection shall be equipped on all potential transformers with switch and fuse. Fuses shall be rated to provide external short-circuit protection and shall be high rupturing capacity non-deteriorating type. Switches shall be rated not less than 250V AC 50Hz. Switches and fuses shall be contained within the junction box provided for termination. Supply fuse failure supervision shall be provided.

3.4.9 Accessories

The following items shall be provided for each instrument transformer:

(a) Nameplate
(b) Oil level gauge
(c) Oil valves or plugs
(d) Power factor test terminals
(e) Necessary terminal connections
(f) Grounding terminals
(g) Other necessary accessories

3.5 Tests

Tests shall be performed as specified hereunder.

3.5.1 Current transformer

(a) Routine tests

Each current transformer shall be subjected to the following tests.
- Applied potential test
- Induced potential test
- Accuracy tests (including excitation curve for relaying class)
- Polarity check
- Winding resistance measurement for each ratio


(b) Design tests

Bidder shall submit Type Test Report per IEC and/or other recognized international standards.

3.5.2 Potential transformer

(a) Routine tests

Each capacitor voltage transformer shall be subjected but not limited to the following tests:

- Power frequency withstand voltage (dry) test.
- Dielectric tests for electromagnetic unit
- Accuracy tests
- Polarity check
- Ratio test

(b) Design tests

Bidder shall submit Type Test Report per IEC and/or other recognized international standards.

3.5.3 Field tests

After installation at Site, all instrument transformers shall be subjected but not limited to the following tests:

(a) Constructions inspection
(b) Polarity check
(c) Ratio test
(d) Measurement of insulation resistance

3.6 Drawings, Data and Manuals

3.6.1 The following drawings and data shall be furnished with the Tender.

(a) Outline dimensional drawings of the equipment
(b) Characteristics and performance data
(c) Type test certificates of similar equipment

3.6.2 After award of Contract the successful Bidder shall submit the required number of copies of the following drawings for approval of the Employer/Employer's Representative.

(a) Outline dimensional drawings of the equipment
(b) Transport/shipping dimensions with weights
(c) Foundation and anchor bolt details


(d) Characteristic and performance data including ratings, ratio and phase angle curves, accuracy for standard burdens, and thermal burden ratings.

(e) Instruction books including complete information for installation, testing, operation and maintenance with renewal parts data.

(f) Any other relevant drawings and data necessary for review of the items stated above.

APPENDIX A-1

TECHNICAL PARTICULARS OF 33kV CURRENT TRANSFORMER

1.	Type	Outdoor, oil immersed for protection and metering
2.	Quantity required	As per Price Schedule
3.	Rated primary voltage	33 kV
4.	Max. System voltage	36 kV
5.	Impulse withstand voltage	170 kV
6.	Rated frequency	50 Hz
7.	Number of cores	2
8.	Current Ratio	400-200-100/5A for Transformer 1200-600-300/5 for 33 kV Line
9.	Rated Burden	50 VA
10.	Accuracy	5P20 and 0.5 for metering
11	Power Factor	0.85
12	Over voltage factor	1.1 Continuous 1.5 For 30 sec
13	No of secondary windings	as required
14	Over load factor	200%
15.	Short time thermal rating	25 kA

APPENDIX A-2

TECHNICAL PARTICULARS OF 33kV POTENTIAL TRANSFORMER

1.	Type	Outdoor, oil immersed
2.	Quantity required	As per Price Schedule
3.	Rated primary voltage	33/ √3 kV
4.	Max. System voltage	36kV
5.	Impulse withstand voltage	170kV
6.	Rated frequency	50Hz
7.	Connection	Line to ground
8.	Number of secondary winding	2
9.	Voltage ratio	33,000/ √3/110/√3V
10.	Rated burden for each winding	100 VA
11.	Accuracy	5P and 0.5 for metering
12.	Power factor	0.85
13.	Rated voltage factor	1.1 continuous, 1.5 for 30 sec

Note: The CT Ratio given above are tentative one, the final decision shall be taken prior to the approval of Drawings.

4. Lightning Arrester

4.1 General

This specification covers the design, manufacture, factory test, delivery, field test and installation of lightning arresters, complete with all accessories.

The equipment specified in this Section shall conform to the latest edition of the appropriate IEC specifications and/or other recognized international standards. In particular:

IEC 60099-4 Metal-oxide Surge arrester without gap for ac system
IEC 60099-5 Surge arrester - Selection and application recommendations
IEC 60529 Degree of protection provided by enclosures

Manufacturer of Lightning Arrestor shall hold valid ISO 9001(including design) quality certificate.

4.2 Equipment to be furnished

4.2.1 The equipment to be furnished shall strictly be in accordance with the specifications and the Price Schedule.

4.3 Design Requirements

4.3.1 The lightning arresters shall be station type, single pole, gap less type rated voltage 30kV for 33kV system. The nominal discharge current shall not be less than 10kA.

4.3.2 The active part of the lightning arresters shall be accommodated in porcelain insulators which are suitably reinforced to prevent explosion of an arrester.

4.3.3 Pressure relief device shall be provided for the safe discharge of internal pressure.

4.3.4 The lightning arresters shall be mounted on galvanized steel structure. Terminal connectors for both line and ground terminals shall be furnished.

4.3.5 Surge monitoring device consisting of surge counter, etc., along with insulating bases for mounting at the bottom of the arrester, shall be furnished.

4.4 Test

4.4.1 All routine tests shall be performed on each piece of arrester as per IEC. In addition, the following tests shall be carried out.

(a) Construction test

(b) Insulation resistance test and leak current test

4.4.2 Type Test certificates on similar equipment shall be submitted by the bidder as per IEC specifications and/or other recognized international standards and routine test certificate carried out for following tests shall be furnished for approval of the Employer/Employer's Representative.

(a) Voltage withstand test
(b) Impulse voltage characteristic test
(c) Discharge voltage characteristic test
(d) Discharge current withstand test
(e) Duty cycle test
(f) Pressure relief test
(g) Contamination test

4.5 Drawings and Data

4.5.1 The following documents shall be furnished along with the Tender.

(a) Standard catalog identifying the models and ratings being furnished.
(b) Outline drawings including dimensions

4.5.2 The following drawings and data shall be furnished in required number of copies after award of contract for approval of Employer/Employer's Representative.

(a) All updated documents furnished with the Tender.
(b) Outline drawings including dimensions
(c) Foundation and anchor details including dead load
(d) Transport/shipping dimensions with weight
(e) Any other relevant data, drawings and information

4.6 Nameplate

Each lightning arrester shall be provided with a nameplate of weather resistant material fitted in a visible position showing the following items as a minimum.

(a) Manufacturer’s name
(b) Manufacturer’s serial number and type designation
(c) Year of manufacture
(d) Rated voltage
(e) Nominal discharge current


APPENDIX A-1

TECHNICAL PARTICULARS OF 30kV LIGHTNING ARRESTER

1.	Type	Outdoor, station type
2.	Quantity required	As per Price Schedule
3.	Mounting	Pedestal
4.	Rated frequency	50 Hz
5.	System voltage	33 kV
6.	Rated voltage	30 kV
7.	Impulse withstand voltage (BIL)	170 kV
8.	Power frequency withstand voltage	70 kV
9.	Nominal discharge current	10 kA
10	Surge Counter	shall be the ISO 9001 holding Company

5. CONTROL AND RELAY PANEL

5.1 General

5.1.1 This specification covers Study, Design, Manufacture, Assembly Factory Test, Supply, Delivery, Installation works and Field Test and Commissioning of Control and Relay Panels as specified herein under. The panel shall be used for the protection of the following:

Manufacturer of Control, Protection Equipment, and Relays shall hold valid ISO 9001quality certificate (including design).

Transformer Protection equipment/ relays as required shall have to be supplied and installed accordingly.

5.1.2 It is not the intent to specify completely herein all details of Design and Construction of Equipment supplied. However, the equipment supplied shall conform, in all respects, to high standards of Engineering, Design and Workmanship and be capable of performing in continuous commercial operation up to Contractor's guarantee in a manner acceptable to the Employer who will interpret the meaning of Drawings and Specifications and shall have the power to reject any work or material which in his judgment are not in full accordance therewith.

The Bidder shall submit his proposed Control Panel Arrangement & Layout. The Bidder is warned that the available space in the existing control rooms is very limited and the panels shall be of such size to fit in available space.

The cost of any relocation of equipment in the control room and outdoor switchyard necessary to complete the specified works shall be included in his bid price and no additional payment will be made for such work.

5.1.3 The indication and annunciation schemes for existing substations shall be compatible with the existing system as far as possible.

5.1.4 Manufacturers for Protection Equipment

All protection relays like over current, earth fault, differential, definite time over current etc shall be of static type and shall be from following manufacturers or equivalent.

a)	AREVA	b)	Fuji
c)	CGELEC	d)	Reyrolle / Easun Reyrolle
e)	ABB	f)	Siemens
g)	Toshiba	h)	Mitsubishi

In case of equivalency the manufacturer must submit the authentic documents from internationally recognized testing agency establishing that the offered product is equivalent to above referred make.

5.2 Equipment to be furnished

5.2.1 Control and Relay panels shall be more or less of the color matching with the existing one.

5.2.2 In addition to the above, the following shall be supplied:

(a) Floor channel seals, vibration damping pads, kick plates, earthing pads and holding down bolts and nuts.
(b) Special tools and tackle.

5.3 Construction Features

5.3.1 The Panel Dimensions specified are tentative only and it is the responsibility of Bidder to ensure that all the equipment required can be properly accommodated in the respective space. The panels shall also be of a size & type which can be easily accommodated within the space of existing Panels & existing control room without the necessity for expansion of the control room. Such oversized panels will not be accepted.

5.3.2 The 33 kV panel shall be of Simplex type or Duplex type as per the layout of the respective Substation.

In case, the Panels are Duplex type, it shall comprise two vertical front and rear panel sections connected back-to-back by formed sheet steel roof tie members and a central corridor in between. The corridor shall facilitate access to internal wiring and external cable connections. Both ends of the corridor shall be provided with double leaf doors with lift off hinges.

Doors shall have handles with built-in locking facility. Separate cable entries shall be provided for the front and rear panels. However, interconnection between panels shall be by means of inter panel wiring at the top of the panels.

If the panels are of Simplex type, it shall comprise of two vertical fronts side by side, with door at rear sections with built in locking facility.

5.3.3 Panels shall be completely metal enclosed and shall be dust, moisture and vermin proof. Panel enclosures shall provide a degree of protection not less than IP 54 as per IEC.

5.3.4 Panels shall be free standing, floor mounting type and shall comprise rigid welded structural frames enclosed completely with specially selected smooth finished, cold rolled sheet steel of thickness not less than 3mm for front and rear portions and 2mm for sides,


top and bottom portions. There shall be sufficient reinforcement to provide level surfaces, resistance to vibration and rigidity during transportation and installation.

5.3.5 All doors, removable covers and panels shall be gasketed all around with gaskets. Ventilation louvers, if provided, shall have screens and filters. The screens shall be made of either brass or GI wire mesh.

5.3.6 Design, materials selection and workmanship shall be such as to result in neat appearance inside and outside with no welds, rivets or bolt heads apparent from outside, with all exterior surfaces true and smooth.

5.3.7 Panels shall be suitable for floor mounting. Metal sills in the form of galvanized steel channels properly drilled shall be furnished along with anchor bolts and necessary hardware for mounting to a concrete floor. Any irregularity between the sills and flooring shall be sealed to prevent entry of dust, moisture and vermin. Panels shall have additional rolled channel plinth at the bottom with smooth bearing surface. The panels shall be fixed on the sills with intervening materials. The type of anti-vibration strips which shall be supplied by the Contractor shall be subject to the approval of the Employer.

5.3.8 Cable entries to the panels shall be from the bottom unless otherwise specified. The bottom plates of the panels shall be fitted with removable plates of adequate size for holding the cables using cable connectors to seal from dust and moisture. All cable connectors required shall be provided by the Contractor and shall be screwed type and shall be suitable for PVC armored cables.

Control and relay panel enclosure protection class shall be of IP 54. When in closed position there shall not be any chances of entering lizards, mousse etc. inside the panel.

5.4 Component Mounting

5.4.1 All equipment on front of panel shall be mounted flush or semi-flush. In case of semi-flush mounting, only flange or bezel shall be visible from the front.

5.4.2 Equipment shall be mounted such that removal and replacement can be accomplished individually without interruption of service to adjacent equipment. Equipment mounted inside the panel shall be so located that terminals and adjacent devices are readily accessible without the use of special tools. Terminal markings shall be clearly visible.

5.4.3 Cut-outs and wiring for free issue items, if any, shall be according to corresponding equipment manufacturer's drawings. Cut-outs, if any, provided for future mounting of equipment shall include cover plates.

5.4.4 The centerline of switches, push buttons and indicating lamps shall be not less than 750mm from the bottom of the panel. The centerline of relays with targets and/or requiring adjustment, motors, test switches, and recorders shall be not less than 450mm from the bottom of the panel. No components shall extend below 200mm.

It will be preferable if existing panel layout is used to give uniform appearances.

5.4.5 The centerline of switches, push buttons and indicating lamps shall be matched to give a neat and uniform appearance. Likewise, the top lines of all meters, relays and recorders, etc. shall be matched.

5.4.6 No equipment shall be mounted on the doors without prior approval of the Employer.

5.4.7 In the existing substation, panels shall be as far as possible matched with the existing panels in the control room in respect of Dimensions, Color, Appearance, Size and Arrangement of equipment on the front.

5.4.8 The standard phase arrangement when facing the front of the switch-board shall be R-S-T from left to right, from top to bottom, and front to back. All relays, instruments, other devices, buses and equipment involving three phase circuit shall be arranged and connected in accordance with the standard phase arrangement.

5.5 Mimic Diagrams

5.5.1 Mimic diagrams shall be provided on panels as required. Mimic diagrams shall be screwed on to panels and shall be made of anodized aluminum or plastic of approved fast color material which can be easily cleaned. The width of the mimic bus shall be subject to approval of the Employer.

5.5.2 The colors for the various voltages in the mimic diagram shall be as per the existing colors.

5.5.3 When semaphore indicators are used for disconnecting switch positions, they shall be so mounted in the mimic that the disconnecting switch's 'close' position shall complete the continuity of the mimic. Similarly, when control switches of stay-put type are mounted in the mimic, the 'close' position of the switch shall complete the mimic.

5.6 Annunciators

5.6.1 Annunciators of the visual and audible type shall be provided on the panels when called for in the equipment lists, if enclosed. Annunciators shall be suitable for operation for the voltages specified.

5.6.2 Annunciators shall be of facia type with 35mm x 50mm (minimum) translucent plastic window for each alarm point. Annunciator facia plates shall be engraved in block letter with respective alarm inscriptions, which will be furnished to Contractor by Employer. Alarm inscriptions shall be engraved on each window in not more than three lines and size of the lettering shall be not less than 3mm. The inscriptions shall be visible only when the respective light is lighted. If any other type of Annunciators are to be used, prior approval from the Owner should be taken before manufacturing.

5.6.3 The annunciators shall be suitable for operation with normally open fault contacts which close on a fault. When specified in bill of materials, some of the annunciator points shall be suitable for operation with normally closed faults contacts which open on a fault. It shall be possible at site to change annunciators from "open to fault" to "close to fault" and vice versa. Annunciators shall be suitable for accepting fleeting faults of duration not less than 15 milliseconds.

5.6.4 Annunciators shall be compact self-contained units with associated relays mounted behind the facia units. In case the associated relays cannot be housed behind the annunciator facia units, these shall be mounted and wired in a separate panel which shall be included in the offer. However, the latter arrangement is not preferred due to additional space requirement and wiring interconnections. Alarm relays and facia units shall be interchangeable.

5.6.5 Annunciator facia units shall be suitable for flush/semi-flush mounting on panels. Replacement of individual facia inscription plates and lamps / LED / LCD shall be possible from front of the panels.

5.6.6 One alarm buzzer common to annunciators on all the panels shall be provided. Similarly, "Sound Cancel", "Acknowledge", "Reset" and "Lamp Test" push buttons common to annunciators on all the panels shall be provided. These common devices shall be located in a particular panel as determined by the Employer.

5.6.7 In case of static annunciator schemes, special precaution shall be taken by the Contractor to ensure that spurious alarm conditions do not appear due to false influence of external magnetic fields on the annunciator wiring and switching disturbances from the neighboring circuits.

5.6.8 Each annunciation window shall be provided with two lamps to provide safety against lamp failure. Lamps shall operate in parallel such that failure of one will not affect operation of the other.

5.6.9 Sequence of Operation of the Annunciator shall be as follows:

Alarm Condition	**Fault Contact**	**Audible Alarm**	**Visual Alarm**
Normal	Open	Off	Off
Abnormal	Close	On	Flashing
Sound cancel	Close or Open	Off	Flashing
Acknowledge	Close or Open	Off	Steady On
Back to Normal	Open	Off	Steady On
Reset	Open	Off	Off
Lamp Test	Open	Off	Steady On


In case 'RESET' push-button is pressed before abnormality is cleared, the lamps shall continue to glow steady and shall go out only when 'Normal' condition is restored.

5.6.10 Any new annunciation appearing after the operation of "Sound Cancel" for previous annunciation, shall provide a fresh "Audible Alarm" with accompanied "Visual Alarm" even if the process of "Acknowledging" or "Resetting" of previous alarm is going on or yet to be carried out.

5.6.11 Provision of testing facilities for flasher and audible alarm circuits of annunciators shall be provided.

5.7 Specific Protection Requirements

5.7.1 Relay Protection

5.7.1.1 Overcurrent and Earthfault Protection

i. Non-Directional Phase Overcurrent Protection shall:

- be single pole & have an inverse characteristic with a definite minimum time of 3sec.at 10times setting.
- have a variable setting range of 5-250% in step of 1% of rated current
- have a time multiplier range of 0.025-1 in step of 0.001 for phase fault

ii. Non-Directional Earth Fault Protection shall :

- be single pole type.
- have an inverse characteristic with a definite minimum time of 3sec. at 10 times setting.
- have a variable setting range of 5-250% in step of 1% of rated current
- have a time multiplier range of 0.025-1 in step of 0.001 for earth fault

5.7.1.2 Directional Overcurrent Protection (not applicable)

i. Phase over current relay shall :

- be single pole X 3 type
- have an inverse characteristic with a definite minimum time of 3secs. at 10 times setting.
- have a variable setting range of 50-200% of rated current.
- have a characteristic angle of 45 degree.

- have a directional controlled low transient over-reach high set instantaneous unit of continuously variable setting range 200-1200% times of rated current.

- be of voltage polarized directional controlled type.

ii. Directional Earthfault overcurrent protection **(Not applicable)**

Earth fault overcurrent relay shall;

Single pole type.

be of zero-sequence voltage polarized directional controlled.

have an inverse characteristic with a definite minimum time of 3 sec. at 10 times setting.

have an adjustable setting range of 10-80% of rated current.

have a directional controlled low transient over reach high set with a continuously variable setting range of 5-20 times of rated current.

have a characteristics angle of 45 degree.

5.7.1.3 Local Breaker Back Up Protection

Relay shall :

- be triple pole type.
- have an operating time of less than 15 milliseconds.
- have 2 over current and 1 Earth fault elements.
- have a re-setting time of less than 15 milliseconds.
- have a setting range of 30-320% of rated current.
- have a separate time delay relay with a continuously adjustable setting range of 0.1-1 second.
- have necessary auxiliary relays to make a comprehensive scheme.
- have a continuous thermal withstand two times rated current irrespective of setting.
- provide both retrip and back-up trip output contacts.

5.7.1.4 Differential Relay

The Differential Relay shall be used for 6/8 MVA transformer Protection. It shall be of Three phase with Six through current restraint inputs. The Relay shall have built in trip relay, indicator & test switch. It shall have complete phase and Earth fault Protection.

The Harmonic restrained operation time of the Relay shall be Approximately 30ms at 3times of pickup current. Similarly, unrestrained operation time shall be 10-20ms at 2times pickup current with minimum impulse time of 3minutes.

The Relay shall have variable percentage restraint for external fault, even at use of OLTC.

The Relay shall have second harmonic restraint from all the three phases for inrush security & fifth harmonic restraint for all three phase for over excitation security. The sensitivity shall be settable to 10 - 50% of rated current of 1A.

Un-restrained operation settable to 20 times of rated current.

The relay shall be provided with separate interposing CT for ratio and Phase Angle matching and equalizing of zero sequence current, or by other programming method.

5.7.2 Manufacturer of Protection Relay shall be as specified

5.7.3 Other Requirements

i. Layout of panel in the control room, individual panel layout incorporating the hardware and control wiring diagrams and schematics shall be prepared by the Contractor and be sent to the Employer for approval.

ii. All auxiliary relays, if and when required for the completeness of the various protection schemes covered in this order, shall be deemed to be included in the scope of supply whether or not such items are specifically mentioned in the enclosed bill of material.

ii. Omission of hardware specifically mentioned in Price schedule material such as auxiliary relays/protective relays, etc. if found necessary during detailed engineering shall be shipped to the Employer with spare parts, without any extra cost to the Employer.

iv. All terminal blocks for CT and PT circuits shall be of disconnecting line type. Suitable plastic covers for all terminal blocks shall be provided in order to prevent dust accumulation.

v. Panels shall be mounted to concrete foundation on galvanized steel channels with an intervening layer of anti-vibration strips made of shock absorbing materials which shall be supplied by the Contractor.

vi. Cable entries for all the panels shall be from bottom. The bottom plates of the panels shall be fitted with removable plates of adequate size for holding cables and sealing from dust and moisture.

i. A ground bus of bare copper strip of minimum size 25 x 6mm along the length of each panel shall be provided and shall be connected to the ground mat of the station.

APPENDIX: 1.4 .1

BILL OF MATERIAL

The bill of materials shall cover only the major equipment or such information as will require particular information from the Bidder. Bidder is to be understood that, all other associated auxiliary equipment and accessories, although not listed in the bill of materials, but necessary for the complete and sound function of the control board as described in this specification, shall be furnished by the Contractor.

LINE & TRANSFORMER CONTROL & RELAY PANEL

1. Major Components

	Legend	Description	Quantity per Panel
1.	ANN	Annunciator assembly, 24 active points,110V DC, 4 rows high by 6 columns wide, flush mounted, and with: 3-separately mounted push buttons 2-separately mounted indicating lamps, one white lamp, and one red lamp Following minimum annunciation shall be provided: 1. Transformer HV Backup Protection trip	1 Lot
		2. Transformer LV Backup Protection trip	
		3. Transformer Differential Protection trip	
		4. Transformer Buchholz Alarm / Trip	
		5. Transformer Low Oil Level	
		6. Tap Changer Buchholz Alarm / Trip	
		7. Tap Changer Low Oil Level	
		8. Circuit Breaker Trip	
		9. Transformer Winding Temperature High	
		10. Transformer Winding Temperature Extra High	
		11. Tap changer Temperature High	
		12. Tap changer Out of Step	
		13. Transformer Cooling System Fail	
		14. Pressure Relief Device Operated	
		15. AC Fail	
		16. DC Fail	
		17 –22. Spare	
2.	Relay	Only main relays and instruments are listed here. All the trip relays and auxiliary relays required for satisfactory operation of the scheme shall be included by the Contractor.	
2.1	50/51/50N/ 51N	Overcurrent and Earth Fault Protection with Instantaneous Protection	1 Lot


2.2	50B	Breaker Failure Protection	1 Nos
2.3		Trip circuit supervision relay	1 Nos
2.4	51E	Transformer Protection	1 Nos
2.5	87	Differential Relay	1 Nos
2.6		Interlocks, Switching & Tripping Relay	1 Lot
3.	A	Indicating ammeter , Digital 0-100A; 0-200A;0-400 400-200-100/5A	3 Nos
4.	MWH	Electronic type with 0.2 Class	1 Nos
5.	P.F.	Power factor 0.6-1-0.6 lead	1 Nos
6.	KVA	0-10 MVA	1 Nos
7.	CS	Breaker control switch, and with : 2-separately mounted indicating lamps,	1 Nos
8.	CS	Disconnecting control switch, and with: 2-separately mounted indicating lamps	1 Nos
9.		Electrically operated mimic disconnect device, 110V DC, to indicate the position of disconnecting switch	1 Lot
10.		Electrically operated mimic connected to position of line ground switch	1 Lot
11.		Trip Transfer Switch, for transferring trip signal, reclosing relay, PT circuit to bus tie Breaker. (wherever required)	1 Lot
12.		Multiple Adjustable Ratio Intermediate Current Transformer for Differential Protection, if required	1 Set

6. Cables

6.1 General

This specification covers the design, manufacture, factory test, supply, delivery, field test and installation of all Power, Control and Instrumentation cables required for the entire project.

Manufacturer of 12kV power cable shall be holder of valid ISO 9001 Certificate (Including Design)

6.2 Equipment to be furnished:

a. 12 kV XLPE Power Cable
b. 600 volt power cable
c. Control and instrumentation cable
d. Communication cable

6.2.1 The equipment to be furnished shall strictly be in accordance with the specifications and the Price Schedule.

6.2.2 The Contractor shall be responsible for estimating and supplying the quantity of various types and sizes of the cables. In course of actual execution if it is found that additional cross-section, types or quantities of cables are required than those indicated in his proposal, the same shall be supplied without any additional charge to the Employer.

6.3 Design Requirement

6.3.1 12kV power cable

(a) General

The 12 kV power cable shall be cross linked polyethylene insulated, shielded and armored cable.

(b) Conductor

Conductor shall consist of stranded annealed copper wires. They shall comply with IEC Publication. The maximum conductor temperature shall be 90 deg. C.

(c) Current rating

The maximum current rating for the cable routes and conditions of installation shall be stated for 12 kV power cable by the Contractor.

(d) Anti-termite covering

Anti-termite protection shall be applied to the cable and shall consist of a non-magnetic metallic barrier.

(e) Outer covering

The outer covering of the cable shall be extruded, continuous black PVC suitable for the operating temperature of cable and shall meet the requirements of IEC standard.

(f) Cable drum

Cable drum shall be non-returnable and shall be made of timber, pressure impregnated against fungal and insect attack. Alternatively cable drum may be made of steel suitable protected against corrosion.

(g) Outdoor and indoor termination for high voltage cable.

Outdoor and indoor termination shall be done by heat or cold shrinkable type termination kits.

Termination for cable shall be provided in sufficient quantities for complete installations of substations.

(h) Jointing accessories

Cable shall be installed in maximum possible length and straight through jointing between shorter lengths will not be permitted without the prior written authority of the Employer/Employer's Representative. Jointing accessories for stranded copper conductor cables shall be designed for identification ferrules.

(i) Voltage identification

The plastic over sheath shall be embossed with the name of the manufacturer, name of the Employer, number of conductors, the cross sections, type of insulation followed by:

Electric cable - 12,000 volts

(j) Phase identification

Phase identification for either triplexed or multi conductor cable shall be in accordance with follows:

- Phase A (R): Red
- Phase B (S): Yellow
- Phase C (T): Blue

6.3.2 1100 volt PVC insulated cable.

(a) General

The low voltage cables shall be 1100v grade polyethylene insulated, armored and PVC sheathed. Low voltage power cables shall be suitable for grounded neutral with phase to phase voltage level of 400V and phase to neutral voltage of AC system and 110V DC system.

(b) Conductor

Conductor shall consist of stranded annealed copper wires. They shall comply with IEC publication. The cable is intended for use at normal conductor operating temperatures not exceeding 75 deg.C.

(c) Insulation

The electrically and thermally stable polyethylene insulation shall be extruded onto the conductor so as to prevent contamination and voids in the insulation.

(d) Current rating

The maximum continuous current rating for the cable routes and conditions of installation shall be stated for low voltage power cable by the Contractor.

(e) Anti-termite covering

Anti-termite protection shall be applied to the cable and shall consist of a non-magnetic metallic barrier.

(f) Jacket

The cable core assembly shall be covered with a flame retardative and moisture resistant PVC jacket, which is free-stripping from the insulation. The overall jacket shall be clean, dry, and free of grease and shall be suitable for ink or paint application.

(g) Identification

Each cable shall have a printed legend on the overall jacket with a manufacturer's name, name of the Employer, voltage class, the number and size of conductors, type of insulation.

The colors for core identification and color sequence shall be in accordance with follows:

- Single-core: Black
- Twin: Red and black
- Three-core: Red, yellow and blue
- Four-core: Red, yellow, blue and black

6.3.3 Control and instrumentation cable

(a) General

All control and instrumentation cable shall be 600V grade as per IEC multicore, color-coded, PVC insulated, cable armored cable. Each multicore cable shall have not less than 20 percent or 4 spare cores whichever is the greater.

(b) Conductor

Copper conductor shall be stranded circular non-compacted copper conductor of minimum cross-section of 2.5 sq. mm.

(c) Insulation

The electrically and thermally stable PVC insulation shall be extruded onto the conductor so as to prevent contamination and voids in the insulation.

(d) Assembly

Multi conductor cables shall be assembled in accordance with applicable IEC standard.

A flame retardative binder tape may be used underneath the overall jacket of multi-conductor cables, if required to achieve the desired flame retardative characteristics. Tapes, if used, shall be non hygroscopic.

(e) Anti-termite covering

Anti-termite protection shall be applied to the cable and shall consist or a non-magnetic barrier.

(f) Jacket

The cable core assembly shall be covered with a flame retardative and resistant jacket, which is free-stripping from the insulation.
The overall jacket shall be clean, dry, and free of grease and shall be suitable for ink or paint application.

Cable jacketing and the interstices within the jacket shall be free of water. Evidence of water shall be grounds for rejection of the cable.

(g) Identification

Each cable shall have a printed legend on the overall jacket, with the manufacturer's name, name of the Employer, voltage class, the number and size of conductors, and a


unique number or code indicating the production run or batch. The identification shall remain legible for the life of the cable.

6.4 Special Requirement

Small cut piece lengths of cables will not be accepted. Cables up to 500 meters in length or as approved by Employer/Employer's Representative shall be of one length shipped in a drum of adequate size. For higher quantities, multiple lengths/drums may be shipped subject to the approval of Employer/Employer's Representative.

6.5 Drawings, Data & Manuals

The following information shall be furnished along with the Tender.

(a) Manufacturer’s leaflets giving constructional details, dimensions and characteristics of different cables.
(b) Current rating of cables including de-rating factor due to grouping, ambient temperature and type of various installation.
(c) Write-up with sketches illustrating the manufacturer’s recommendation for splicing, jointing and termination of different types of cables.
(d) Type test report of all types of power, control and instrument cables. The Bidder shall clearly describe the type and routine tests to be performed on cables.
(e) Drum length for each type of cable.

6.6 Tests

6.6.1 Routine and design tests

a) The bidder shall submit the Type Test Report as per IEC or any equivalent international standard.

b) The following tests shall be included in the routine test by the manufacturer at the factory as minimum requirements for this specification:

(a) Construction inspection
(b) Conductor resistance test
(c) High voltage test
(d) Insulation resistance test
(e) Physical and aging test for insulation and jacket

6.6.2 Field tests

After installation at site, cables shall be subjected but not limited to the following tests:

(a) Measurement of insulation resistance
(b) DC dielectric test

6.7 Performance Guarantee

The performance figures quoted on schedule of Technical Data shall be guaranteed within the tolerance permitted by relevant standard and shall become a part of the Contract. In case of failure of the cables to meet the guarantee, the Employer/Employer's Representative reserve the right to reject the equipment. The Contractor shall have to rectify the defect t no extra cost to the Employer and without delaying the commissioning schedule.

7. Battery and Battery Charger

7.1 General

This specification covers the design, manufacture, delivery, installation and field test of the maintenance free battery and suitable battery charger for 110V DC system complete with all necessaries for efficient and trouble-free operation as specified herein under.

Manufacturer of battery and battery charger shall be holder of valid ISO 9001 Certificate (Including Design).

The Battery charger shall also include D.C. distribution board.

7.2 Equipment to be furnished

110 V Battery and Battery Charger

7.2.1 The equipment to be furnished shall strictly be in accordance with the specifications and the Price Schedule.

7.3 Design Requirements

7.3.1 Battery & Battery charger

7.3.1.1 Maintenance free Battery

(a) The Maintenance free Battery shall be rated for supplying total DC load of the each substation. The duration of the load shall be ninety (90) minutes. The total DC load cycle shall consist of the following:

0-1 min. - Simultaneous tripping of all breakers on under voltage. In case the circuit breakers charge after tripping, starting current of the spring charged motor of all the above circuit breakers shall be considered for the entire 0-1 minute period.

- Emergency lighting load

- Control, indication, protection and annunciation load

1-89 minutes - Emergency lighting load

- Control, indication, protection and annunciation load.

Last minute - Control, indication, protection and annunciation load, emergency lighting load.

- Closing of breaker - one at a time and spring charging if spring charging occurs after closing of breaker. Consider staring current of one spring charging motor and running current of another spring charging motor to occur simultaneously during the entire one minute a period.

The Contractor shall compute the Ampere hour rating (10 hour rating) of the battery considering margin over the above duty cycle so that the battery shall be capable of delivering the ultimate DC load of the substation when the future switchgear and its protection panel will be installed in the same substation. The minimum capacity shall be not less than 240 AH.

(b) The Contractor shall compute the Ampere-hour capacity at 10-hour discharge rate based on the above cycle and furnish the calculation. The minimum ambient temperature shall be 5 deg. C. The minimum voltage at the end of the load cycle shall not be less than 1.75 volts per cell.

(c) The batteries shall be storage type as specified.

(d) The cells shall be maintenance free Lead acid type.

(e) Each cell shall be in a suitable leak proof container with sealed cover.

(f) The batteries shall be furnished complete with cell interconnectors and a suitable rack protected with acid resistant paint. The arrangement of the rack shall be such as to allow easy access and adequate space for normal maintenance in battery room.

(g) Rated life of each battery shall be at least ten (10) years.

(h) The Bidder shall furnish along with the Tender, his proposed layout of the battery racks to suit the space available.

7.3.1.2 Battery charger

(a) The battery charger shall be suitable for maintenance free batteries and solid-state electronic type using silicon rectifiers and complete with all switches, fuses, contactors and instruments.

(b) The battery charger shall be suitable for 400 volts +10%, 3-phase, 50Hz supply. The charger shall have fully automatic voltage regulation and electronic current limiting. The voltage regulation shall be within +1% for a 0-100% load variation and +10% voltage variation on the AC side. Cooling shall be by means of natural convection.

(c) The minimum rating of the battery charger shall be not less than 75 amperes.

(d) The battery charger shall be housed in a freestanding floor mounted cabinet with enclosure protection of IP-30 as per IEC.

(e) The instruments, switches and lamps shall be flush or semi flush mounted on the front panel.

(f) The battery charger shall be constant voltage type with provision of voltage variation from float charging to boost charging voltage. The float charging voltage shall be between 2.1 to 2.2 volts per cell or at any other voltage recommended by the battery manufacturer. At float charging voltage the charger shall furnish the continuous DC load consisting of control, indication, annunciation, breaker spring charging mechanism and continuously "On" emergency light as well as float charge its associated battery. The boost charging voltage shall be about 2.4 to 2.5 volts/cell or at any other voltage recommended by the battery manufacturer. During equalizing or boost charging, the continuous DC load shall be fed by the charger. The loads that cannot tolerate the high equalizing or boost charging voltage shall be connected through dropper diode. The battery charger shall recharge the completely discharged battery to fully capacity in 9 hours. The charger shall have 10% excess capacity.

(g) The manufacturer of above said battery charger shall be holder of valid ISO 9001 certificate.

7.3.2 Wiring

The wiring shall be complete in all respects so as to ensure proper functioning of control, protection and metering scheme.

All wiring shall be completed up to terminal blocks.

Wiring shall be done with 2.5 sq.mm. (minimum) Class 5 stranded copper conductor, flexible PVC insulated wire. The wire shall have a voltage grade of 600V as per IEC. Lower cross section of wires may be used for solid-state devices only.

Each wire shall be identified at both ends with wire designations in accordance with the approved wiring diagram. Interlocking type ferrules shall be used for identification.

Not more than two wires shall be connected to any terminal at each end. If necessary, a number of terminals shall be jumpered together to provide wiring points.

Wires shall be neatly bunched and adequately supported so as to prevent sagging strain on termination. Wires shall not be spliced or tapped between terminal points.

All spare contacts of relays and contactors shall be wired up to the terminal block.

7.3.3 Cable termination

The equipment shall be designed to facilitate cable entry from bottom. Removable plates shall be furnished with compression type cable glands to make entry dust tight and no weight is transferred on the terminal. The glands shall be suitable for terminating cable armor. Compression type cable lugs as required shall be furnished for termination of power and control cables.

Sufficient space shall be provided to avoid sharp bending and for easy connection. A minimum space of 200 mm from the gland plate to the nearest terminal block shall be provided.

7.3.4 Terminal blocks

Terminal blocks shall be specified in Technical Requirements under Sub-Clause 2.4 of Section VA.

7.3.5 Ground bus

A copper ground bus of 25 mm x 6 mm cross section shall be furnished along the entire length of each panel.

All devices shall be grounded to the ground bus.

7.4 Accessories

7.4.1 The following accessories shall be furnished for the batteries:

(a) One (1) connector bolt wrench
(b) One (1) cell testing voltmeter with leads.
Battery racks
Other necessary accessories

7.4.2 The charger shall be complete with the standard accessories including but not limited to the following:

(a) Solid state surge protectors on the AC and DC sides
(b) AC failure alarm relay
(c) DC time delay low voltage relay
(d) Ground detection alarm for positive and negative leads
(e) Manual voltage adjust switch
(f) DC ammeter and voltmeter


7.5 Tests

7.5.1 The bidder shall submit Type Test Report as per the latest standard of IEC or any equivalent international standard.
Routine tests at manufacturer's works and acceptance test at site shall be carried out on battery as per stipulation of latest standard of IEC.

The test shall include following tests:

(a) General inspection.
(b) Leakage test and internal short test for each cell.
(c) One cell shall be type tested for discharge at ten-hour rate to 1.85V DC at 25 deg. C.

After initial charging the following tests shall be performed at site:

(a) Capacity test
(b) Efficiency test

7.5.2 The battery charger shall be subjected to the following tests at manufacturer's works:

(a) Measurement on insulation resistance
(b) High voltage test
(c) Performance test
(d) Temperature rise test

7.6 Drawings, Data and Manuals

7.6.1 The following drawings and detail shall be furnished with the Tender:

(a) Layout arrangement of battery and battery charger in the available space shown in the drawing.
(b) Schematic and wiring diagram of battery charger
(c) Cell voltage characteristic for battery
(d) Technical leaflets on battery and battery charger

7.6.2 The following drawings and manuals shall be submitted by the successful Bidder for approval

(a) Dimensional layout arrangement of battery and battery charger
(b) Dimensional outline drawing of battery charger panel clearly showing the location of meters, switches etc.
(c) Wiring diagram of the battery charger panel
(d) Instruction manuals of battery and battery charger


7.7 Performance Guarantee

The performance figures quoted in Schedule of Technical Data shall be guaranteed within the tolerance permitted by relevant standard. In case of failure of the equipment to meet the guarantee, the Employer reserves the right to reject the equipment. The Contractor shall have to rectify the defect as no extra cost to the Employer and without delaying the commissioning schedule.

8. GROUNDING SYSTEM AND LIGHTNING PROTECTION

8.1 General

This specification covers the design, supply, delivery, installation and testing of the complete Grounding System as described herein.

8.2 Codes and Standards

The complete station grounding work shall be in accordance with the recommendation in the "Guide for Safety in Substation Grounding" IEEE No. 80 and the requirements of this section.

8.3 Equipment to be furnished

Complete installation of the ground grid, test link chamber, grounding of all equipment located in the substation as specified herein but not be limited to the supply of grounding conductors, jointing materials and all accessories to complete this grounding installation shall be covered under this specification.

8.4 Grounding Installation Features

8.4.1 The installation shall be complete in all respects for efficient and trouble free service. All work shall be carried out in a first class neat workmanlike manner. Grounding conductors shall be handled carefully to avoid kinking and cutting of the conductors during laying and installation. All exposed ground conductor runs shall be taken in a neat manner, horizontal, vertical and parallel to building walls or columns and shall not be laid haphazardly. All connections to the grounding grid shall be made with the bare copper stranded cable.

8.4.2 For all connections made to equipment or to the structures, the grounding conductor, connectors and equipment enclosures shall have good clean contact surfaces. Grounding conductor connection to all electrical equipment, switchgear, transformers, motors, panels, conduit systems, equipment enclosures, cable trays, distribution boards, equipment frames, bases, steel structure, etc., shall be by pressure type or bolting type connectors.

8.4.3 All lap, cross and tee connections between two grounding conductors both below and above grade shall be made by thermo welding process or compression type connector. The various joints shall have adequate mechanical strength as well as necessary electrical conductivity not less than that of the parent conductors of the joints. All accessories for grounding installation shall be of quality and design approved by the Employer/Employer's Representative.

8.4.4 Grounding conductors, when crossing underground trenches, directly laid underground pipe and equipment foundation, if any, shall be at least 500 mm below the bottom elevation of such trenches/pipes.

8.5 Grounding Conductor

8.5.1 Main ground grid

The main ground system shall consist of a grounding grid buried minimum one meter below grade level. The grounding grid shall consist of one no. 100 sq. mm (min) stranded bare copper conductor cable.

8.5.2 Ground electrodes

The ground electrodes shall be 16 mm diameter and 1.5-meter long (min.) copper clad steel. These shall be driven into ground and connected to the main ground grid.

8.5.3 Risers

The risers shall consist of stranded bare copper conductor or connected at one end to the main ground mat and at the other end to the equipment.

8.6 Design Requirement

8.6.1 The Contractor shall measure the soil resistivity and calculate the total length of buried ground conductor, number of grounding electrode and their depth and spacing to achieve a grounding system resistance of not more than 1.0 ohm.

8.6.2 The Contractor shall calculate the cross-section considering the maximum fault level.

8.7 Tests

On completion of the installation, either wholly or in sections, it shall be tested in compliance with relevant code by the Contractor in the presence of the Employer/Employer's Representative. The cost of any test including labor, material and equipment charges shall be borne by the contractor. The ground grid resistance to remote earth shall be 1.0 ohm or less. If this low resistance cannot be obtained as per his design, then additional grounding conductors shall be buried in the earth, or if necessary, buried in treated soil to obtain the required low ground resistance.

8.8 Lightning Protection

The outdoor equipment of the substation and the substation building shall be protected against lightning. The lightning protection shall be achieved by one or more lightning masts or horizontal lightning conductors above the protected equipment. The design of


the lightning protection system shall be subject to the approval of the Employer/Employer's Representative.

8.9 Drawings

After award of the Contract, the Contractor shall furnish the grounding layout drawing with dimensions showing the location of grounding grids, electrodes, test link chambers and risers backed up by necessary calculations for Employer/Employer's Representative approval. The work shall have to be started at site only after getting approval from the Engineer. If alternation is required for any work done before getting Employer/Employer's Representative approval, the same shall have to be done by the Contractor at no extra cost to the Employer.

9. LOW VOLTAGE DISTRIBUTION BOARD

9.1 General

This specification covers the design, manufacture, assembly, testing at manufacturer's works, supply and delivery, properly packed of low voltage distribution boards.

9.2 Standards

The equipment covered by this specification shall unless otherwise stated be designed, constructed and tested in accordance with the applicable section of the latest relevant IEC Specification. The equipment conforming to any other national standard, which ensures equivalent quality, is acceptable. In such cases the Bidder shall clearly indicate the standard adopted and furnish a copy of the English version of the standard along with the proposal. Should there be any dispute on design standard; the most stringent one shall be followed.

9.3 Equipment to be furnished

9.3.1 The equipment to be furnished shall strictly be in accordance with the specifications and the Price Schedule.

9.3.2 Each distribution board must have sufficient number of spare feeder (at least 20% of various sizes used in the Distribution Boards with a minimum 1 no. on each bus). The incoming molded case circuit breakers and bus bar ratings shall be selected considering the spares also.

9.3.3 The distribution boards shall be complete with all accessories and materials.

9.3.4 The base channel frames for the distribution boards for grouting in the floor complete with anchor bolts, nuts and leveling attachments.

9.3.5 Special tools and tackles for erection and maintenance of the distribution boards and other equipment.

9.3.6 The Contractor shall furnish as many distribution boards as required to cater to his requirements, without any additional cost. If Tender's requirement, the same shall be supplied without any extra cost to the Employer.

9.4 Design Requirements

9.4.1 The AC distribution board is meant for miscellaneous loads such as but not be limited to battery charger, illumination, ventilation and air conditioning, space heater, station auxiliaries, etc.

9.4.2 The DC distribution board is meant for distribution of DC power to switchgear, control, relay and metering panel, emergency lighting fire protection system etc.

9.4.3 The distribution boards will be located indoor in a hot and humid atmosphere. All equipment, accessories and wiring shall be provided with suitable finish for prevention of fungus growth.

9.4.4 The AC distribution board shall be designed for operation in a 400V + 10%. 3 phase, 4-wire, 50 Hz + 5% neutral ground system. The DC distribution board shall be designed for 110V DC, 2-wire system.

9.4.5 The de rating of the equipment shall be done taking 45 deg. C as an ambient temperature of the site, if it is designed for lower ambient temperature. Furthermore, design and selection of all equipment shall be made liberally with a good margin of safety factors.

9.5 Construction Features

9.5.1 General

The distribution boards shall be self standing sheet steel cubicle or wall mounted panel having following features:

(a) The construction shall be compartmentalized.
(b) All distribution boards shall be dead front type. All switches, circuit breakers, etc. shall be operable from the front.
(c) All bolts and nuts exposed to external atmosphere shall be cadmium plated or zinc passivated.
(d) The working height shall be limited to a maximum of 2,000 mm. The design shall be such as to permit easy extension of distribution boards at site on either end.
(e) The distribution boards shall consist of vertical sections, fabricated from a minimum of 2mm thick sheet steel, shaped and reinforced to form a rigid freestanding structure.
(f) The minimum clearance of the power terminal lug from the bottom plate shall be maintained as 200 mm.
(g) The AC distribution board designed for 4-wire system shall have a fully insulated neutral bus of cross-section same as the main phase buses.
(h) Anchor bolts and nuts for each distribution board shall be supplied along with the distribution board.
(i) All distribution boards mounted indoor shall be provided with enclosure protection of IP 50 as per IEC.

9.5.2 Bus bars

Bus bars shall be copper, liberally sized for the specified current ratings (both short circuit and continuous currents). Maximum temperature of the bus and bus connection shall be limited to 90 deg. C.


All bus bars, links, etc., shall be covered to prevent accidental contacts.

Buses shall be spaced with adequate clearance between phases and between phase and ground.

Bus supports shall be of molded insulators suitable for polluted atmosphere.

All bus works shall be braced to withstand stresses due to short circuit current, corresponding to the respective fault level of the system to which it is connected. The bus bars shall be able to withstand for 1 second the above short circuit current thermally.

Appropriate color code shall be used to identify the various phases of bus bars and the neutral (wherever applicable).

9.6 Specific Requirement

9.6.1 Molded Case Circuit Breakers (MCCB)

The molded case circuit breakers shall be of panel mounting type. It shall have all the live parts enclosed in a molded case and all contacts shall be silver-plated. The breakers shall be trip free and with quick-make and break operating mechanism. The molded case circuit breakers shall be provided with magnetic short circuit protection and thermal overload device. The characteristic curve of these protections shall be furnished along with the offer. The protection device of the incomer MCCB shall be coordinated with feeder MCCB. Each breaker shall have a common trip, causing on overload on one pole to trip all other poles.

The MCCB handle, after breaker tripped due to a fault shall occupy a mean position. The breaker shall be capable of interrupting a RMS current corresponding to the fault level of the system to which the respective distribution board is connected.

It shall be possible to close and trip the breaker without opening the compartment door. The breaker shall be provided with mechanical On-Off indicator at the front properly marked. Each circuit breaker shall be provided with alarm switch and auxiliary switch. The rating of the MCCB's shall be so selected that maximum standardization consistent with the economy is possible. The incoming and bus section breakers shall have shunt trip coils.

9.6.2 Cable termination

Distribution board shall be designed to facilitate cable entry from bottom. Removable plates shall be furnished with compression type cable glands to make entry dust tight and no weight is transferred on the terminal. The glands shall be suitable for terminating cable armor. Compression type cable lugs as required shall be furnished for termination of power and control cables.

Sufficient space shall be provided to avoid sharp bending and for easy connection. A minimum space of 200mm from the gland plate to the nearest terminal block shall be provided.

9.6.3 Ground bus

Grounding terminals on the distribution board shall be provided at either end for connection of copper ground conductor to ground grid.

9.6.4 Nameplate

Nameplates showing “Feeder Designation” shall be provided for each module of distribution board at front door top. Also nameplate shall be furnished at the top for each distribution board.

Material for nameplate shall be a plastic sheet, 3mm thick or approved equivalent. The letters shall be white on black background.

The nameplate shall be held by self-tapping screws. The size of the nameplates shall be proportionate to the size of the modules. Also individual panel number and danger plate shall be furnished at the back of the panel.

9.7 Tests

9.7.1 Routine and type test

Type test certificates and results shall be as per relevant IEC. Specification for all the equipment offered under the scope of this specification shall be furnished.

Each distribution board shall be completely assembled, wired adjusted and tested for operation under simulated conditions to ensure correctness of wiring and proper functioning of all equipment.

All component parts such as MCCB’S, meters, etc., shall be tested in accordance with relevant IEC Specification.

All current carrying parts and wiring shall be subjected to a high potential test.

All routine tests shall be conducted on all distribution boards.

9.8 Drawings, Data & Manuals

The following drawings and details shall be furnished along with the Tender.

(a) Bidder’s proposed distribution scheme in single line diagram for all distribution boards.

(b) Bidder's proposed typical general arrangement drawing showing constructional features and layout of individual equipment along with the following:

- Space required in the front as well as back of distribution board.
- Power cable entry points
- Bus bar clearance, phase to phase and phase to neutral
- General cross-section drawing of the cubicle

(c) Technical leaflets on : MCCB, Terminal Boards, Insulators.

11.8.2 After award of contract the successful Bidder shall submit the following drawings for approval of the Employer/Employer's Representative.

(a) Confirmed outline dimensional drawing of all distribution boards, showing the general arrangement and indicating the following:

- Space required in the front and back
- Power cable entry points
- Bus bar clearance phase to phase to neutral
- Configuration of bus bars
- Technical details of supporting insulator and their spacing
- Outgoing power termination arrangement
- Transport/shipping dimensions with weights
- Foundation and anchor bolt details including dead load and impact load

Any other relevant drawing and data necessary for approval shall also be submitted by the bidder.

10. STEEL STRUCTURE

10.1 General

This specification covers the design, manufacture, testing, delivery and installation of steel structures to be used for supporting electrical equipment and gantry structure.

10.2 Codes & Standards

The steel structure shall be designed, manufactured and tested in accordance with ASTM or equivalent.

10.3 Scope of Works

The works includes, but is not necessarily limited, the following:

(a) Calculate and design as per requirements of this specification
(b) Prepare complete detailed shop drawings and submit for approval of the Employer/Employer's Representative.
(c) Prepare bill of materials and complete dispatch list.
(d) Furnish all materials, labor, tools, plant, consumable, etc., including bolts, nuts, washers for fabrication in shop and on site and for erection.
(e) Fabricate and deliver to job site, unload, store and erect structural steel for towers and all equipment frames.
(f) Assemble bolt on ground at job site fabricated members for erection.
(g) Erect fabricated materials and connect by field bolting.
(h) Align and level erected structural steel.

10.4 Technical Requirements

10.4.1 The steel structures for extension of existing substations shall be so designed and fabricated that the connecting and joining works can be done with ease and exactness.

10.4.2 Design load of conductors shall be as follow:

	Description	**Tension of conductor per phase**
-	Incoming line	1,000 kg
-	Internal bus	500 kg
-	Overhead ground wire	300 kg

10.4.3 Steel structure dimensions, framing, member size and length, number, size and length of bolts, thickness of each filler and other necessary details to fabricate each piece shall be shown on the approved detail drawings. No change shall be made without the written approval of the Employer/Employer's Representative.


10.4.4 Bolts shall have hexagonal heads and hexagonal nuts with the same dimension between flats on bolt heads and nuts. Bolt holes are not to be more than 1.5mm larger in diameter than the corresponding bolt diameter. The design is to be such as to keep the number of different parts as small as possible and is to facilitate transport, erection and inspection.

10.4.5 No welding will be permitted in steel structure fabrication

10.4.6 Bill of material shall give the size, length and galvanized weight of each member and the total weights of steel structures. It shall also include the number of bolts, nuts and washers per structure.

10.4.7 Workmanship shall be first class throughout.

All pieces must be straight, true to detail drawings and free from lamination flaws and other defects. All clipping, back-cuts, grindings, bends, holes, and etc. must be true to detail drawings and free of burrs.

10.4.8 Threads of bolts and nuts shall be cleanly rolled or cut and the face and head of nut shall be truly at right angle to the axis of the bolt.

10.4.9 After fabrication has been completed and accepted, all materials shall be clear of rust, loose scale, dirt, oil, grease and other foreign substances.

10.4.10 All materials including nuts and bolts shall be hot dip galvanized. The process of galvanization shall be as per latest version of IEC or ISI. The thickness of zinc coating shall not be less than 85 microns (610 gm/sq. m).

10.4.11 The material shall not be hammered or otherwise straightened in a manner that will injure the protective coating. If the material has been harmfully bent or warped in the process of fabrication or galvanizing, such defects shall be cause for rejection.

10.4.12 One of each type of structure shall be assembled in the shop to such extent as to insure proper field erection. Reaming of untrue holes will not be permitted. Shop-assembled parts shall be dismantled for shipment.

10.4.13 The structures shall include all necessary access ladders to give access to the various levels of the structures.

10.4.14 In addition to dead dynamic loads imposed by equipment, steel work shall be designed to withstand simultaneously wind loads as follows:

(a) On flat surface: 121kg/sq mm

(b) For lattice structures: 121kg/sq mm on 1.71 times the times the projected area of the members of one face of the structure.

10.4.15 All structures shall be designed so that no failure or permanent distortion shall occur when tested with applied forces equal to 2.5 times to maximum simultaneous working loadings.

10.4.16 At or near ground level, all uprights shall be provided with holding down bolts provided under this contract.

10.4.17 Details and fastenings shall be designed to have factor of safety against failure not less than the main members of the structure.

10.4.18 Pockets and depressions likely to hold water shall be avoided and all parts of the structures shall be properly drained.

10.4.19 Bolts and nuts shall be galvanized and fitted with spring washers. Taper washers are to be added where necessary. Threads of bolts shall be spun galvanized and threads of nuts shall be oiled.

10.4.20 All member shall be cut to jig and holes shall be drilled or punched to jig.

Parts shall be carefully cut and holes accurately located so that the members are in position the holes can be accurately aligned before being bolted up., Drifting of holes will not be permitted.

10.5 Tests

10.5.1 All tests shall be carried out by the Contractor using his own instruments, testing equipment as well as qualified testing personnel.

10.5.2 The following shop test shall be performed with relevant provision of ASTM or equivalent.

(a) General inspection
(b) Material test
(c) Assembly test
(d) Galvanizing test

10.5.3 The results of all tests shall conform to the specified requirements as well as agreed guarantee figures finalizes with the Contractor.

10.5.4 Employer/Employer's Representative shall have the right to inspect any material, workmanship etc. of the equipment and may reject any item defective or unsuitable for the use and purpose intended, or not in accordance with the intent of the Employer/Employer's Representative.

10.6 Drawings

10.6.1 The Contractor shall submit the calculation sheet, design & shop drawing and guaranteed performance data.

10.6.2 The shop detail drawings shall show the details of all parts to be fabricated.

10.6.3 Erection drawings shall include bills of materials for each type of structure with the piece mark, size, length and calculated weight of each member.

10.7 Packing, Marking and Shipping

10.7.1 Methods of packing, marking, shipping, and storing shall be submitted to the Employer/Employer's Representative for review and acceptance.

10.7.2 Members of steel structure shall not be dropped or dragged on the ground and shall not be set on the ground for an extended period of time.

All steel shall be maintained clean and free of foreign matter and at no time shall it be set on wet or muddy ground.

10.7.3 Boxes of bolts, nuts and similar connectors, and hardware assemblies shall be stacked off the ground and shall be covered with plastic sheets for protection from elements.

10.7.4 Materials, which are defective or damaged, when delivered, shall be repaired or replaced and shortages shall be made good immediately by the Contractor.

11. MISCELLANEOUS MATERIALS

11.1 General

This specification covers the design, fabrication, properly packed for transportation, deliver, installation, testing and putting into efficient and trouble-free operation of the bus material and insulator complete with all accessories.

11.2 Equipment to be furnished

11.2.1 The equipment to be furnished shall strictly be in accordance with the specifications and the Price Schedule.

11.3 Technical Requirements

11.3.1 Insulators

(a) General

All types of insulators shall satisfactorily withstand the specified climatic and service conditions. The strength of insulators as given by the electro-mechanical tests load shall be such that the factor of safety when supporting their maximum working loads shall be not less than two and a half.

Design shall be such that stresses due to expansion and contraction in any part of the insulators and fittings do not lead to development of defects.

All insulators, whether, cylindrical, post or string, shall have plain shed profiles.

Damaged insulators shall be replaced.

Arcing horns are not required on post type and string insulators within substations.

(b) Materials

Porcelain insulators shall be in accordance with IEC where applicable. Porcelain shall be sound, free from defect and thoroughly verified and the glaze shall not be depended upon for insulation.

Porcelain glaze shall be smooth, hard, of a uniform shade of brown and shall completely cover all exposed parts of the insulators. Outdoor insulator fittings shall remain unaffected by atmospheric conditions producing weathering, acids, alkalis, dust and rapid changes in temperature that may be experienced under working conditions.

Suspension and tension insulators shall comprise porcelain units with ball and socket fittings.

Retaining pins or locking devices for insulating units shall be of phosphor bronze or other approved material, and shall effectively prevent accidental separation of the units.

Unless otherwise approved, the individual units of both the suspension and tension insulator sets shall be identical and interchangeable.

(c) Number of discs

String insulators shall comprise of 3 nos. of 11 kV, 70 KN disc insulators.

(d) Marking

Each insulator shall have marked on it the manufacturer's name or trade mark, the year of manufacture and the manufacturer's reference mark. Tension and suspension insulators shall also be marked with the guaranteed electromechanical strength. Marks shall be legible and indelible.

(e) Post insulator

Post insulator shall be cylindrical type, solid core porcelain, provided in accordance with following requirements:

-	Rated voltage	36 kV
-	Nominal voltage	33 kV
-	Impulse withstand voltage	170 kV
-	Color	Brown

Test shall be divided into three groups in accordance with IEC 168.

(f) Standard particulars of insulator units

Insulator units shall comply with the following requirements. (IEC 305)

-	Porcelain disc diameter	254mm
-	Unit spacing	146mm
-	Creepage distance	292mm
-	Electro mechanical failing load	6,800kg
-	Dry power frequency withstand voltage	70kV
-	Wet power frequency withstand voltage	40kV
-	Dry impulse withstand voltage	110kV
-	Puncture voltage	110kV

Dimension and tolerances of ball and socket coupling shall comply with IEC Publications 120 (1977), and the internal height of the socket shall also comply with the requirements of IEC Publication 372-1.

11.3.2 Bus Conductor and fittings

(a) General

Bus bars and electrical connections in outdoor substations shall be in accordance with BS, ASTM or equivalent national standards in respect of current rating and material analysis.

Bus conductor to be supplied shall be aluminum tube and aluminum conductor steel reinforced. Minimum size and material of each bus shall be as following

	Bus	Material	Min. Size
-	33kV Main	Al Tube	As per actual
-	33kV Branch	Al Tube	As per actual
	Overhead ground wire	GSW	55 sq. mm.

In case of existing substation conductors and connectors to be used for extension shall be as nearly as possible identical with the existing equipment.
Materials used for busbars and connections shall be stressed to not more than two-fifths of their elastic limit. Provision shall be made for expansion and contraction with variation in conductor temperature and bus bars shall be arranged so that they may be readily extended in length with a minimum of disturbance to existing equipment.

Bus bars shall be in continuous lengths between supports. Connectors shall be of approved type, and if necessary type tested. Connection dependent upon site welding techniques will not be permitted.

Unless otherwise approved, bus bars and connections shall be so arranged and supported that under no circumstances, including short circuit conditions, can the clearances between live metal and earth of earthed metal work or between other conductors be less than the specified in the drawings. The extension of bus bar in the existing substation shall match with the existing one.

(b) Strain bus and fittings

The conductor shall be aluminum conductor steel reinforce (ACSR) of sufficient current carrying capacity matching with the existing substations.

The conductor shall be constructed of hard-drawn aluminum and zinc-coated steel-wires which have the mechanical and electrical properties in accordance with the latest revisions of ASTM.

The direction of lay of the outer layer shall be right-hand. The direction of lay shall be reversed in successive layers: contiguous layers shall in all cases have opposite lay.


The external form and surface of the finished conductor shall be uniformly cylindrical upon completion of manufacture and shall remain so when erected in place on the line.

The surface of the conductor shall be free from points, sharp edges, abrasions or other departures from smoothness or uniformity that would tend to increase radio interference and corona loss. When the conductor is subjected to tensions up to 50 percent of its rated ultimate strength, the conductor surface shall not depart from its general cylindrical form, nor shall any of the strands move relative to each other in such a way as to get squeezed out of place and disturb the longitudinal smoothness of the conductor. Strands of a section of "popped" cable shall not protrude more than 1/2 of their diameter of a strand. The conductor shall be capable of withstanding the normal handling necessary for manufacture and erection, such as, reeling, unreeling, and pulling through stringing sheaves under sufficient tension to keep the conductor off the ground, etc., without being deformed from a cylindrical form in such a way as to increase radio interference and corona loss.

The make-up and lay of wires shall be such as to produce a conductor essentially free from a tendency to untwist or spring apart when cut. The steel wires shall be performed or post formed so that, when the conductor is cut and the aluminum wires are stripped away from the core as required for splicing, the steel wires can be readily regrouped and easily held in place with one hand to allow a splicing sleeve to be slipped over the steel core wire at the cut end of the conductor.

This forming of the core is required and shall be done in a manner which will not in any way scratch, scrape, remove or otherwise damage the zinc coating of the steel core wires, individually or collectively.

The conductor shall be free from excessive amounts of die grease, metal particles and dirt. The Bidder shall describe in complete detail the method which he proposes to use in normal production to clean the conductor. The effectiveness the cleaning process shall be subject to verification.

Where dissimilar metals are in contact, approved means shall be provided to prevent electro-chemical action and corrosion. Unless otherwise approved, joints and surfaces of copper or copper alloy fittings shall be tinned.

Suspension and tension conductor clamps shall be approved types and shall be as light as possible. Those for aluminum conductor shall preferably be compression type. Suspension and tension clamps shall be designed to avoid any possibility of deforming the stranded conductor and separating the individual strands.

Tension conductor clamps shall not permit slipping of or damage to, or failure of the complete conductor or any part thereof at a load less than 95 percent of the ultimate strength of the conductor.

Clamps and fittings made of steel or malleable iron shall be galvanized. All bolts and nuts shall be as specified and shall be locked in an approved manner.

(c) Tubular bus and fittings

Tubular bus shall be made of first melting aluminum alloy, cold rolled or hard drawn and assembled using corona free fittings. Continuous lengths of bare conductor shall be installed in bus to dampen aolian vibration.

The tubular bus conductor shall have adequate strength to withstand mechanical forces due to short circuit currents and its temperature when carrying full load current shall not exceed 75 deg. C. A safety factor of 2 for normal working loads and 15 with short circuit currents shall be used.

The tubular bus shall include a small drain hole in any low section. Where expansion joints are required they shall be of the thin leaf type. They are required at all potheads and as required on bus bars. Bus supports for main tubular buses shall include on rigid fixed conductor clamp with slide fit on adjacent supports.

All bus support clamps shall be cast of first melting aluminum alloy. Each clamp shall be adjustable for alignment with insulator and furnished with four galvanized steel mounting bolts.

- Bolted type clamps shall be furnished with first melting alloy bolts, nuts and washers finished with anodic coating and lubricated. The clamps for tubing shall have dimensions and section suitable for splicing two pieces of tubing in the clamp.

- Flexible elements of expansion bus support clamps shall be laminated aluminum strap, which has current capacity equivalent to the tube.

Terminal connectors for aluminum shall be of first melting cast aluminum alloy. All terminal pads shall be furnished with stainless steel bolts, nuts and Belliville washers.

The bolted type terminal connectors shall be a multigrip type terminal and furnished with first melting aluminum alloy with bolts, nuts and washers finished with anodic coating and lubricated.

Bolted type connectors listed below shall be furnished with first melting aluminum alloy with bolts, nuts and washers finished with anodic coating and lubricated.

- Angle-Connectors: All angle-connectors shall be of streamlined, bolted type and made of first melting cast aluminum alloy. Tap element sockets shall be deep enough to allow for error in cut-off.

- Couplers: All couplers shall be bolted type and made of first melting cast aluminum alloy.

(d) Overhead ground wire

Overhead shield wore shall be galvanized steel wire, stranded with a cross sectional area of 61.7sqmm and shall comply with BS 183.

Earth wires shall be greased as for conductors and the outer strands shall have a right hand lay.

Each completed shield wire shall be bare and shall be composed of the specified number of wires.

In case of existing substation, the tubular bus and its fittings to be used for extension shall be as nearly as possibly identical with the existing one.

The nominal diameter of individual wires shall have a variation of not more than plus or minus one and an-half (1.5) percent.

Joints or splices may be made in the individual wires prior to drawings to final size or in the finished wire composing the strand. Such joints shall have protection to corrosion equivalent to that of the finished wire itself and shall not decrease the strength of the finished strand below the specified minimum breaking strength. Joints in the individual wires in the finished strand shall be separated by at least 15.2 meters.

All wires in the cable shall lay naturally in their true position in the completed cable, shall tend to remain in position when the cable is cut at any point, and shall permit re-stranding by hand after being forcibly raveled at the end of the cable. The strand shall be free from imperfections and consistent with good commercial practice with a carefully controlled finish completely free from any dirt, loose metal particles, nicks, scratches, abrasions or deformities of any nature.

Each item of material to be furnished by the contractor shall be given the wire manufacturer's routing factory tests.

11.4 Tests

11.4.1 The insulators shall be tested in accordance with IEC or ANSI Standards. Certified copies of the tests shall be submitted for approval to the Employer/Employer's Representative.

(a) Type tests

- Low frequency wet withstand test
- Critical-impulse flashover test
- Impulse withstand test
- Radio-influence voltage test
- Compression strength test
- Thermal shock test

(b) Quality conformance tests

- Visual and dimensional test
- Porosity test
- Galvanizing test
- Cantilever strength test
- Torsional strength test
- Tensile strength test

(c) Routine tests

- Flashover test
- Tension proof test

11.4.2 Bus materials

The following shop tests shall be performed for bus materials. All tests shall be made at the manufacturer's plant by and at the expense of the Contractor. Certified results of test shall be submitted whether or not the inspection is waived. The Employer/Employer's Representative may, at its option, waive part or the whole test.

(a) Aluminum tube

- General inspection
- Chemical composition of aluminum alloy
- Conductivity measurement of aluminum tube
- Dimension and weight measurement
- Certified report of aluminum alloy from the original manufacturer

(b) Bus support clamp and connector

- General inspection
- Dimension measurement
- Chemical composition of aluminum alloy
- Certified report of aluminum alloy from the original manufacturer

(c) Connectors for stranded conductor

- General inspection
- Measurement of dimension
- Compression test
- Certified report of aluminum alloy from the original manufacturer

(d) Miscellaneous hardware

- General inspection

- Measurement of dimension
- Tension test
- Galvanizing test

11.5 Packing and Marking

11.5.1 Insulator

(a) Packaging

The insulators shall be packed in strong wooden boxes with a waterproof lining. These boxes shall provide adequate protection against salt spray, chemical attack and damage that might be encountered in transportation and rough handling during loading, transportation to job site, unloading to temporary storage and ocean transportation.

(b) Marking

In addition to marks required for shipping purposes, each crate and pallet shall be marked with Shipper’s identity and Employer's name and address and quantity and type of contents. Also, the gross, tare and net weights in kilograms shall be stenciled on each pallet.

11.5.2 Bus materials

(a) Packing

The conductor shall be furnished on non-returnable wooden reels, and shall be properly protected to prevent displacement, chafing, distortion, damage from corrosive atmosphere or other damage to the conductor, which might be encountered in shipping, storage or handling. Each layer of conductor shall be separated from the adjacent layer in such a manner as to prevent abrasion or other damage during handling and shipping.

The non-returnable reels shall be made of a strong material suitably strengthened for ocean transport and treated to withstand rotting or any type damage due to ocean atmosphere. The reels shall be capable of withstanding all stress due to braking and string operations. The Employer will accept the use of returnable reels, but any additional costs of such reels will be the responsibility of the Contractor.

(b) Marking

In addition to marks required for shipping purposes, each reel head shall be stenciled to show serial number, type of conductor, length of conductor in meters, the gross, tare, and net weights in kilograms. Each reel shall also be plainly marked to indicate the direction in which is should be rolled to prevent loosening of the conductor on the reel. Those reels from which test samples were taken shall be marked “Tested” with the length of sample conductor removed.


11.6 Guarantee

Any defects in materials or workmanship or other failure to meet requirements of these specifications, which are disclosed prior to the Taking-Over by the Employer, be corrected entirely (including removal and replacement) at the expenses of the Contractor.

Any latent defects not disclosed before date of the Taking-Over but disclosed within guarantee period, materials and/or supplies shall have been placed in use, shall be corrected promptly by and at the expense of the Contractor.

11.7 Wall mounted Split-type Air-Conditioners

General

This specification covers the supply, delivery, field test and installation of Air-Conditioners at Substations.

Equipment to be furnished

Split-type Air-Conditioners shall be furnished with all the accessories to complete the scope of works as given in the price schedule.

Scope of Works

Supply, delivery and installation of the Air-Conditioners shall include but not limited to that:

Civil works like breaking of wall and repairing wherever necessary.

Any support structures and leak proofing compounds required for proper sealing.

Bidder shall provide operation maintenance instruction translated in Nepali font in A4 size paper with good glass frame for each rating. These have to be hung on the wall of the generator house.

Design Requirements

a) Type - Split wall-mounted (Cooling/heating)
b) Minimum Cooling/heating Capacity for

1 Ton	12000 Btu/hr
1.5 Ton	18000 Btu/hr
2 Ton	24000 Btu/hr

Indoor noise level

<	40 db for 1 ton
<	46 db for 1.5 ton
<	51 db for 2 ton

Compressor
Super silent, Power saving
Hermetically sealed
Rotary/reciprocating

Rated Voltage/Frequency
- 230 V, 50 HZ, Single Phase

Fan Speed
- Three Speed with air deflection System

Operation mode with remote control
- Heat/Cool/ Dry/Fan

Air Swing
- To be Present, Automatic

i) Air filter
- Anti –fungal/cleanable

j) Refrigerant
R410A (Non-CFC)

5. Manufacturers

The AC shall be from the following manufacturers:

Mitsubishi

Diakin

Samsung

Or equivalent make / brand

6. Quality Certification: ISO 9001-2000 certified and CE certification.

7. Warranty: 12 months from the date of commissioning.

12. 12KV SWITCHGEAR

12.1 Scope of work:

12.1.1 All the works/material as specified in Bill of Quantity and the scope of work shall be the integral part of the job and all the cost reoccurred in this respect and shall be included in the bid price. So the bidder is requested to visit the site and contact the Owner in case of any items/ works not understood before the bid submitted.

12.1.2 12kV cubicle type Indoor Switchgear Panel shall be an air insulated metal clad switchgear with withdrawal vacuum circuit breaker with the fault interrupting capacity of at least 25 kA at 11kV solidly grounded system. The switchgear shall be arranged in single bus bar. The cubicle shall be of modular design provided with space heaters, with the following modules integrated neatly to form dead front type switchgear capable of extension on the both side, forming a single row, single bus bar switchgear panels.

Breaker Compartment.
Bus bar Compartment
Cable, C.T. and P.T. Compartment
Instrument and Relay Compartment (LV Compartment)

12.1.3 All Switchgear operation shall be performed behind a close door. Additionally it shall even be possible to perform all preparations for work inside the cubicle with full degree of protection.

12.1.4 The use of insulation material shall be reduced to minimum, only ripped insulators with high-anti-tracking characteristics shall be used for necessary conductor supports.

12.1.5 Cubicle front shall be covered by a door with inspection windows for mechanical indication for CB ON/OFF position, spring charged and counter indication of CB operation.

12.1.6 The cubicle shall be of modular design consisting of separate modules for busbar, circuit breaker, cable and low voltage compartment, and instrument component. Each compartment shall have its own pressure relief flap. The fixed contact shall be mounted in bushing moved by circuit breaker carriage.

12.1.7 Earthing to cable feeder and bus bar shall be done via earthing switch manually operated from panel front.

12.1.8 Fixed contacts shall have flat silver plating and contact pressure of male and female contacts during connected position according to the International Standard.

12.1.9 Bus bars and Jumpers shall have made of flat electrolytic bare copper contact with special heat shrinkable sleeves which provide effective insulation between phases or phase to earth, even if bridged by vermin or other conducting body and suitable for rated current


not less than 2000 A. Bus bar shall be latched per panel and easy to replace by standard normal material. Flexible insulation shrouds shall cover the bus bar to Jumper Joints and jumper to stationary contact joints.

12.1.10 Bottom of the cubicle shall be covered with a bottom mica plate through which cables are passed into the panel through the appropriate cable glands.

12.1.11 The proposed switchgear panel shall be extendible.

12.1.12 The proposed switchgear panel shall be suitable for mounting of standard Current and Voltage Transformer according to IEC standard.

12.1.13 It is observed that most of the fault and damages inside the CB is due to the short circuit condition carrier out by crawling animals like rat , lizards etc. So, special attention shall be given during design and fabrication, for preventing them to enter into the chamber.

12.1.14 Panel shall be of enclosure protection of class IP54

12.2. WITHDRAWABLE PART (CARRIAGE)

12.2.1 The chassis shall be made of sheet-steel section and shall carry the switching device, moving mechanism, 4 rolling contact bearings for movement and interlocking mechanism. Movement for carriage shall be done manually and shall be independent from switch room floor.

12.2.2 Moving contacts shall be double flat contact with silver plated contact pieces. The flexible fixing shall allow high tolerance and avoiding overheating.

12.2.3 Connection of auxiliary supply to the fixed part shall be verified via multi-pole plug which shall be included in the interlocking system. For the easy and assured insert of the plug the hose should come from the fixed part and the plug shall be on the withdrawable part.

12.2.4 CB and Isolating Switch Carriage shall have the provision to operate mechanically behind the closed door in Operating and Test Position.

12.2.5 Carriage of the same rating shall be exchangeable. It shall be possible to insert CB with higher current in lower rated cubicle but not vice versa.

12.3 11 KV METALCLAD SWITHGEAR:

12.3.1 Main Equipment Characteristics

12.3.1.1 Insulation:

i. 12kV primary equipment shall be insulated to meet or exceed the following criteria:

Rated Lightning Impulse Withstand Voltage (kVp): 75
Rated Power Frequency Withstand Voltage (kVrms): 28

ii. 12kV cubicles shall be designed to provide phase segregation within the enclosures.

12.3.1.2 Clearances:

i 12kV Primary Equipment clearances between phases and phase to earth shall not be less than as in BS162 or in this specification, whichever is greater.

ii The layout of the equipment shall provide for safe access for operation and maintenance whilst the remaining sections equipment are alive.

iii Minimum clearances in air for the 12kV 'Indoor' Primary Equipment shall not be less than:

Phase to Phase (mm): 127
Phase to Earth (mm): 76.2

iv The busbars shall be insulated by High Grade Phase Insulation. Busbars partitioning shall be done by means of a bushing plate with Cast-Resin Insulators and Cubicles shall be partitioning with earthed sheet metal barriers.

12.3.2.3 Current Carrying Capacity:

i Switchgear 12 kV Busbars and Connections thereto shall be designed to carry current corresponding to Maximum Permissible Overload of the connected equipment without exceeding temperature rise specified in the Relevant Standards.

ii Switchgear 12kV buswork shall be designed to safely withstand with an appropriate margin of the Mechanical and Thermal Effects corresponding to at least the following short circuit currents:

Symmetrical three-phase

(Is) (kA)rms: 25
Peak making Current (kA)p : 63

12.3.2 Circuit Breakers:

12.3.2.1 General

The 12 kV Circuit Breakers shall be Vacuum type, easily withdrawable and housed in a cubicle. It shall consist of three Vacuum Interrupter, three Supports and Operating Mechanism. The Operating Mechanism shall have Motor Charged Spring Operated with provision of hand operated mechanism. With the breaker in close state, spring energy shall be for a "Trip/Close/Trip" Cycle.

12.3.2.2 Main Data:

Type: Metal enclosed, Indoor switch type: Metal enclosed, Indoor switchgear cubicle type with vacuum interrupters.

Nominal Service Voltage (kV)	: 11
Rated Voltage (kV)	: 12
Rated Frequency (Hz)	: 50
Rated Nominal Current (A) :-	
Breaker for Bus Coupling	: 2000A
Feeder Breaker	: 800A
Incomer for Main Power Transformer	: 1250A
Rated Short-Time Breaking Current (asymmetrical) at Rated Voltage, kArms	: 25
Rated Short-Time Making Current at Rated Voltage (KA)p	: 62.5
Rated Operating Mechanism	: Motor-spring operated .
Provision for Manual Operation	:Yes
Bus Bar Rating	2000 A.

12.3.2.3 Technical Requirements:

i The Circuit Breakers shall meet requirements of BS 5311 and IEC 56.

ii Vacuum Interrupter: The Arcing chamber with the two stem connected contacts shall be located between two ceramic insulators. One contact shall be fixed to the housing and the moving contact shall be connected to the housing via vacuum tight bellows. The metal bellows shall enable the moving contact to carry out its strokes. The metal bellows must be able to withstand the movement corresponding to 30,000 make / break operation without failing. The insulators shall be made of metallized aluminum oxide ceramic which permits them to be brazed to metal so that there is no need to use conventional seals. The Vacuum Interrupter shall remain vacuum tight throughout its working life.

iii The Transformer CB shall be capable of interrupting the corresponding 11kV distribution lines in the event of failure of the respective feeder breakers.

iv The Operating Mechanism shall have two Trip Coils and be electrically Trip-Free and Antipumping.

v The Spring Charging Motor, the Closing Coil, the Tripping Coils and all other control devices of all circuit Breakers shall be suitable for 110V d.c Operation.

vi A Manually Operated Mechanism for closing and tripping shall be provided in the breaker cubicle for Maintenance and Emergency Operation. This device shall be so interlocked that while it is operative, the breaker cannot be operated remotely.

vii Each Circuit Breakers shall be equipped with an Operation Counter (to register tripping operations) and position indicator, on the cubicle front.

viii Provision shall be made for Remote alarm/indication of the following status through a pair of NC+NO contacts:

Circuit Breaker "Open".
Circuit Breaker "Closed".
Circuit Breaker "Trip".
Circuit Breaker "Device Mechanism Faulty".
Trip Circuit Healthy.
Circuit Breaker "Failure"

ix The circuit breaker shall be equipped with a local control switch and local remote selector switch auxiliary contacts for remote indication. All contacts shall be wired to terminal block in the breaker cubicle.

x Each of the circuit breakers shall be housed in a free standing indoor type cubicle. This cubicle (and others comprised in the 11kV metal clad switchgear) shall be of standard construction and shall be suitable for attachment of cable connection as described in relevant cubicles. These cubicles shall be equipped with copper earthing busbars of not less than 200Sq.mm.

xi Plugging contact apertures shall be fitted with fully automatic metal safety shutters to close the apertures and prevent access to live part when truck partition is withdrawn and to open when the truck partition is being plugged in. The shutters shall form reasonable dust, drip, fire and insect proof enclosures over the apertures. The respective sets of shutters shall be clearly, boldly and permanently marked 'Busbars' and 'Feeders' respectively.

xii Auxiliary Switches shall be provided as required for Indication, Control, Protection and Interlocking. In addition, a minimum of two Normally Open and two Normally Closed Auxiliary Contacts shall be provided as spare contacts. All available contacts of Auxiliary Switch Assembly shall be wired to the Terminal Blocks on the fixed portion of the equipment of the switches and terminals shall be such as to facilitate future extension.

xiii All auxiliary switches shall have contacts with strong wiping action. the switches shall be located in an accessible position and adequate physical protection shall be provided.

xiv The Circuit Breakers shall be tested in accordance with BS5311 and IEC56 and IEC60 and shall include the following routine tests:

Mechanical operating tests
Power Frequency Voltage withstand tests.
Tests on auxiliary and control circuits

xv The quality assurance of the equipments and their auxiliary shall be based on ISO9001 Standard.

xvi The Minimum Operating Cycle (without maintenance) of Interrupters and Operating Mechanisms shall be suitable for operation over 10Years or 10,000 operations with rated current or 100 operation with rated short circuit current and overall life shall be more than 30,000 operating cycles.

xvii The Vacuum Circuit Breaker installed in the Switchgear shall move into following position in the Circuit Breaker Components:

* Running Position (Run)
  Main Circuit and Control Circuit connected to all circuits.

* Test Position (Test)
  Main circuit separated from the circuit and only Control Circuits are Connected.

* Disconnected Position

As a Control Circuit Connector that would be plugged by hand during the test position both Main and Control circuit are disconnected from the Circuit.

12.4. EARTHING SWITCHES

The Earthing Switch is operated by means of detachable lever from outside the cable compartment. It shall be mechanically interlocked with the CB so that the earthing switch in close position in section of CB truck into the service position is not possible. The operation of the Earthing Switch shall not be possible as long as the CB is not in isolated position.

12.4.1 The 11kV metalclad switchgear shall include earthing switches to facilitate earthing of each cubicle as specified.

12.4.2 Main Data

Rated Voltage kV 12
Rated Current A 1250
Short Circuit Current withstand capability (as specified above)
Bus Bar Rating A = 2000

12.4.3 Technical Requirements:

a. The Earthing Switches shall meet the requirements of BS 5253 and IEC 129.
ii. Auxiliary Switches shall be provided as specified for the Circuit Breakers.
iii. Provision shall be made for padlocking in the Open and Closed position.


iv. Manual control of the switches and position indicator external to the cubicle shall be provided.
v. The Earthing Switch shall be interlocked manually with transformer circuit breakers.

12.5. INTERLOCKING

The following operation shall be taken place only when the under stated interlocking conditions are fulfilled to ensure Personal and Operational Safety.

12.5.1 Transferring the withdrawable part from the Disconnecting Position to the Service Position:

* Control Circuit Plug Inserted
* High Voltage Compartment Door closed.
* Circuit Breaker in OPEN Position.
* Earthing Switch in OPEN Position

12.5.2 Transferring the Withdrawable part from the Service Position to the Disconnected Position.

* Circuit Breaker in OPEN Position.

12.5.3 Operating the Circuit breaker

Withdrawable part in the Interlocked Final Position (Service or Disconnecting position)

12.5.4 Operating the Earth Switch

i. Withdrawable part in the interlocked disconnected position. windows shall be provided to allow visual inspection.

The Switches shall be tested in accordance with BS5253, IEC129 and IEC265 and shall include the following routine tests:
Operating and Mechanical tests
Measurements of the resistance of the main circuit.

12.5.5 Safety Device

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

Cubical with the front plate is pressure tested for the internal arc fault as per PHELA recommendations.
Circuit breaker and the sheet metal enclosures are fully earthed.


12.6. LOW VOLTAGE COMPARTMENT:

The Low Voltage Compartment of the Switchgear shall be located on the top front of the Panel and shall be accessible with a separate door and partitioned against high voltage part. Connection of control and Metering cable is by means of a multiple plug to the withdrawable part possibly at front face of the breaker. Low voltage devices metering and protection equipment shall be mounted flush in the door or on the mounting plate inside.

Wiring inside the cubicle shall be done by 2.5 Sq.mm insulated stranded copper wires for current circuits and 1.5 Sq.mm for voltage circuits.

The following equipments shall be mounted in the low voltage compartment.

* 1 No. Ammeter, Digital Type of class C designation, with selector switch. (for incoming and outgoing circuit breaker)
* 1 No Voltmeter, Digital type, with Voltage Selector switch (for incoming and outgoingcircuit breaker)
* 1 No kVA meter, Digital type of class designation (for incoming and outgoingcircuit breaker)
* 1 No Energy meter 3Phase 4 wire, 3Element, as specified (for incoming and outgoing circuit breakers)
* 1 No Power Factor Meter Digital type 3Ph, 4Wire, 3Element. (for incoming and outgoing circuit breaker)
* Nos Overcurrent Relay Static Type 5A secondary current with (for incoming and outgoing bus coupler circuit breaker)

  - Setting range 5-250% in step of 1% for Overcurrent element
  - have a time multiplier range of 0.025-1 in step of 0.001 for phase fault
  - Setting range 50-3000% in step of 50% for High Set Element

* 1 Earthfault Relay, Static Type, with Secondary Current 5A and with Instantaneous tripping setting range 5-250% (For incoming and outgoing circuit breaker).

  - Setting range 5-250% in step of 1 for Earth fault element
  - have a time multiplier range of 0.025-1 in step of 0.001 for earth fault
  - Setting range 50-3000% in step of 50% for High Set Element

Auxiliary relay and coupling relay if required
Anti-condensation heater (for incoming and outgoing circuit breaker)

12.7 CURRENT TRANSFORMERS:

12.7.1. The 12kV Metalclad Switchgear shall include protection and metering Current Transformers as specified. The Current Transformers shall be Epoxy Resin insulated block type Current Transformers as follows :

	Circuit	Ratio	Accuracy Class	Burden
For Incoming	Core 1 (for Protection)	1200/600/300/5	5P20	30VA
	Core 2 (for Metering)	1200/600//300/5	0.5	30VA
	Core 3 Differential		PS	30VA
For Bus coupler	Core 1 (for Protection)	1200/600/300/5	5P20	30VA
	Core 2 (for Metering)	1200/600/300/5	0.5	30VA
For Outgoing	Core 1 (for Protection)	800/400/200/5	5P20	30VA
	Core 2 (for Metering)	800/400//200/5	0.5	30VA

12.7.2 The current transformer shall comply with the requirements of BS 3938 and IEC 185 shall confirm to the specified insulation requirements and shall withstand without damage the applicable short-circuit current specified. Primary ratio taps shall not be accepted. The ratio given above is tentative one, the final decision shall be taken prior approval of the drawing.

12.7.3 The manufacturer of current transformer shall be the holder of valid ISO 9001 certificate.

12.7.4 Maximum temperature rise at rated primary current shall not exceed 50 degree centigrade.

12.7.5 Accuracy classes for the protection and metering shall not be less than 5P20 and 0.5 respectively. Burden and accuracy class shall be adequate to ensure correct operation of associated protective devices and instruments. Saturation curves shall be provided with C.T. Characteristics.

12.7.6 Each set of secondary windings shall be wired to suitable terminal blocks and earthed at the first control or relay panel to which they are connected. Differential Protection Circuits (involving more than one set. of CT's) shall be earthed at one location only.

12.7.7 The Current Transformers shall be tested in accordance with BS 3938 and IEC 185 and shall include the following Routine Tests :

(i) Verification of terminal markings polarity etc.
(ii) Power frequency tests on primary windings.
(iii) Power frequency tests on secondary windings.
(iv) Overvoltage inter-turn tests.
(v) Determination of ratio error and phase displacement.


12.8. VOLTAGE TRANSFORMERS

12.8.1. The 11kV Metalclad Switchgear shall include Voltage Transformers in incomer as required by the Single Line Diagram as follows:

Type : **Epoxy-resin insulated, single pole with 7.3A Primary side fuses**
Basic Impulse Level : **75kV**
Primary Voltage : **11/ √3 kV**
Secondary Circuit : **110/ √3 V**
Rated burden : **100 VA**
Accuracy classification : **0.5 Class**

12.8.2. The voltage transformers shall comply with the requirements of BS 3941 and IEC 186. Accuracy class for the metering case shall be 0.5 Bidder shall insure whether 100VA is sufficient for the smooth operation.

12.8.3 The voltage transformers and their fuses shall meet the specified insulation requirements and have a rated primary voltage of 11kV with knee of saturation curve not lower than 12kV and ratios per single line diagram.

12.8.4 The voltage transformer shall be provided with high rupturing capacity (HRC) fuses for primary and secondary circuits. The fuses shall be rated for the short circuit levels specified.

12.8.5 The voltage transformers shall be tested in accordance with BS 3941 and IEC 186, and shall include the following routine tests:

Verification of terminal markings.

High voltage power frequency withstand test on primary windings.
High voltage power frequency withstand test on secondary windings.
Tests for accuracy.

12.8.6 The voltage transformer shall be installed at the suitable place in the incoming circuit breaker.

12.9 CONTROL PROTECTION AND INSTRUMENTATION:

12.9.1 This covers the detailed requirements 11kV switchgear panel cubicles, and design, manufacture, transport, installation and commissioning of new 12kV Metal clad VCB switchgear.

12.9.2 The substation will normally be attended and operation will be semi-automatic. Normally closing of circuit breakers shall be manual operation and operation of earthing switches will be manual if it is not mentioned.


12.9.3 Local control facilities adjacent to the equipment shall be provided for maintenance, inspection and emergency operation.

12.9.4 The control system shall be designed to permit the following operating modes:

12.9.4.1 Automatic start/stop operation refers to spring-charged motor for operating mechanism of 11kV VCB.

12.9.4.2 Automatic tripping of 11kV VCB, LV MCB if faults occur in protected lines equipments or circuits.

12.9.5 The control system shall be arranged in such way that it is possible to change between local automatic and local manual control any time.

12.9.6 Solid state modular equipment shall be used wherever possible.

12.9.7 The designs shall be in general conformity with the single line diagrams and layout drawings accompanying this specification.

12.9.8 Under manual control the individual operations shall each be subject to safety interlocks being satisfied.

12.9.9 The control scheme shall be operationally simple, safe, easy to maintain and functionally consistent.
Each module shall have sufficient test points to felicitate fault finding. Control circuits shall be brought out to isolating terminals to permit efficient trouble shooting.

12.9.11 Each cubicle shall be provided with a sufficient point annunciator to identify an alarm condition, including audible alarm, test, acknowledge and reset push buttons.

12.9.12 Control switches for circuit breakers shall be of the discrepancy type. Two independent movements shall be required to initiate an operation. The position of manually operated disconnector shall be indicated by means of discrepancy indicators.

12.9.13 The design shall be such that as to avoid nuisance alarms and shall block those devices which assume alarm conditions when the equipment is under shutdown. Annunciator windows shall be engraved with identification of the alarm condition.

12.9.14.1 Annunciators shall have the following sequence :

Condition	Lamp	Alarm
Normal	Off	Off
Alarm Flashing	On	On
Acknowledge	On	Off
Reset after return		
Normal	Off	Off
Lamp test	On	Off

12.9.14.2 Required signals or alarm systems:

CB Off/On position by green/red lamp

Flag or lamp indication of faults for :

Overcurrent Protection, E/F Protection, DC Supply Failure, CB Failure, MCB tripped, AC supply failure, Interlocking system disturbed, CB driving faults.

12.9.15 The annunciator shall be of solid state type and suitable for operation at 110 V dc and shall be able to withstand IEC 255 class 3 tests without malfunctioning.

12.9.16 Protection required :

i. For incoming & outgoing -**O/C and E/F protection with instantaneous tripping**
ii. For buscoupler panel - **O/C protection**.

12.9.17 Transformer Protection :

Following protection shall be provided for the step-down power transformers in incomer feeders:

12.9.17.1 Transformer Differential

Differential relay shall be provided for the protection of 33/11kV,6/8 & 10/13.3/16.6 MVA transformer.

12.9.17.2 Overcurrent (if applicable)

Backup protection shall be provided in the form of inverse time overcurrent relay connected into the transformer LV neutral connected current transformer.

12.10 FACTORY TESTS:

Factory tests shall include inspection and routine testing of all relays and devices as per BS and IEC publications. Continuity and insulation testing of all devices and wiring and complete control sequences testing shall be performed to the extent feasible in the plant.

All electronic equipment items and the subsystem shall be operated continuously for a minimum of two hundred (200) hrs. prior to shipment in accordance with the approved testing procedures to ensure the operational integrity of each component and of the total system.

Type test reports for each protective relay shall be provided.

Each component of protective equipment shall be tested at the Manufacturer's work or at site to establish its performance characteristics.

12.11 MINIMUM REQUIREMENT FOR SWITCHGEAR

12.11.1 All 11kV feeder and bus coupler cubicles shall house single circuit breaker per pond. Each circuit and feeder shall be equipped with the following devices and equipment Withdrawable module with:

- Hand operated drive mechanism 1 Set
- Auxiliary block with 4NO+ 4NC contacts for position indication 1 No
- Multiple pole lug for control signals 1 No.
- Motor operated spring charging mechanism 1 No.
- Close/trip buttons 1No.
- Trip coil 1No.
- Closing coil 1No.
- Counter indicating number of switching operation 1No.
- Auxiliary block with 11NO + 11NC 1Wi (alarm contact) 1No.
- Auxiliary switch for spring charged indication 1 No.
- Service track for removing of withdraw able module 1 No
- Breaker carriage (if applicable) 2No

Bus Coupler (if applicable)

- Copper busbars, rating shall be 2000A 1 Set
- Epoxy resin insulated block type current transformer as mentioned above in clause 13.7. 2 Nos.
  1st Core : 0.5 class 30 VA (for measurement)
  2nd Core : 5P20 30 VA (for protection)
- Breaker Carriage 1No.

12.11.2 Trunking (Adaptor) Chamber:

Trunking Chamber should have the voltage rating 12 kV and the current rating of bus bar shall not be not less than 2000A. Contractor must verify the overall dimension by inspection at the site for accurate fitting.

12.11.3 Specification of Meter to be installed

Please refer above in the Energy Meter

TECHNICAL DATA SHEET

(Electrical Equipment)

(To be filled in by the Bidder/ Manufacturer)

33kV CIRCUIT BREAKER

S. No	Description	Unit	NEA requirement	Bidders Offer
1	Manufacturer and Country of Origin Model No.			
2	Year of manufacturing experience			
3	Applicable Standard		IEC	
4	Type		VCB Out door	
5	Poles		Three pole	
6	Pole breaking		Three	
7	Rated Voltage			
7.1	Nominal	kV	33	
7.2	Maximum	kV	36	
8	Rated Current			
8.1	Continuous at 45 degree ambient	A	800	
8.2	Rated interrupting current	kA	25	
8.3	Momentary	kA		
9	Frequency	Hz	50	
10	Temperature rise above 45 deg C ambient		As per IEC	
10.1	Contacts	Deg C		
10.2	Terminals	Deg C		
11	Rated short circuit breaking current			
12	Rated short circuit making current			
12.1	Peak	kA		
12.2	RMS symmetrical	kA		
13	Interrupting time at 100% capacity			
13.1	Maximum opening time	ms	60	
13.2	Total interrupting time	ms	60	
14	Closing time	ms		
15	Make time	ms		
16	Maximum current breaking capacity	A		
17	Insulation level			
17.1	Impulse withstand voltage(peak)	kV	170	
17.2	Power frequency withstand voltage	kV	75	
18	Operating Mechanism			
18.1	Type		Spring Loaded	
18.2	Number of mechanism per beaker			
18.3	Single/Three phase auto recloser		Not required	
18.4	Operating voltage of closing and tripping coil	V DC	110	
18.5	Operating voltage range	% of		
	Closing	rated	85-110%	
	Tripping	voltage	70-110%	
18.6	Closing and tripping current	A		
18.7	Spring charging motor rating			
	Capacity	kW		
	Rated voltage	V	110 DC	
18.8	Time required for the motor to charge the spring completely	Sec	<30	
18.9	Space heater and auxiliary equipment			

18.10	Push bottom for local operation	Yes/No	Yes	
18.11	Selection switch for local and remote control	Yes/No	Yes	
19	Operating counter provided	Yes/No	Yes	
20	Space heater provided for cubicle	Yes/No	Yes	
21	Thickness of sheet steel of cubicle	mm	2	
22	Number of auxiliary contacts	No	6No,6NC,6MBB	
23	Operating duty cycle		0-0.3sec-CO-3min-CO	
24	Number of possible operation without maintenance under			
	Rated short circuit breaking current	No		
	Rated Normal Current	No		
25	Porcelain insulator			
25.1	Manufacturer			
25.2	Creepage distance	mm	900	
26	Pad locking provision for local cubicle	Yes/No	Yes	
27	Total weight of the cubicle	kg		
28	ISO 9001 holder	Yes/No	Yes	
29	ISO 9001 certificate submitted	Yes/No	Yes	
30	Type test certificate submitted	Yes/No	Yes	

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DISCONNECTING SWITCH

S. No	Description	Unit	NEA requirement	Bidders Offer
1	Manufacturer and Country of Origin Model No.			
2	Year of manufacturing experience			
3	Applicable Standard		IEC	
4	Type		3pole, single throw, outdoor, center rotating	
5	Frequency	Hz	50	
6	Rated voltage			
	Nominal	kV	33	
	Maximum	kV	36	
7	Rated Current			
7.1	Continuous at 45 deg C ambient	A	800	
7.2	Short time for 3 sec at max kV	kA	25	
7.3.	Peak short time current	kA	32	
8	Temperature rise above 45 deg C ambient at Normal rated current			
8.1	Contacts	deg C		
8.2	Current carrying parts	deg C		
9	Maximum current the switch can safely interrupt			
9.1	Bus/Line charging current	A		
9.1	Potential transformer magnetizing current	A		
10	Clearance			
10.1	Between live parts and ground	mm		
10.2	Between fixed contact and blade in open position	mm		
11	Insulation level			
11.1	Impulse withstand voltage(peak)	kV	170	
11.2	Power frequency withstand voltage (1min,rms)	kV	75	
12	Main contacts			
	Material of fixed contact		Silver coated copper alloy	
	Coating of fixed contact		Silver coated copper alloy	
	Material of moving contacts		Silver coated copper alloy	
	Coating of moving contacts		Silver coated copper alloy	
	Material of the contacts of the earthing switch		Silver coated copper alloy	
	Coating of the contacts of the earthing switch		Silver coated copper alloy	
13	Material of Terminals			
13.1	Coating of terminals			
14	Operating mechanism		Manual operation	
15	Auxiliary Contacts			
15.1	Type	Convertible or fixed	Convertible	
15.2	Continuous current at 110 V DC	A		
15.3	Material		Copper	
15.4	Contacts silver plated	Yes/No	Yes	

16	No of operation switch can withstand without deterioration of contact	No		
17	Type of interlock furnished		Electrical and mechanical	
18	Are the disconnector and the earthing switch mechanically interlocked to each other	Yes/No	Yes	
19	Insulator			
19.1	Manufacturer			
19.2	Type			
19.3	Ref Standard			
19.4	No of units per stack			
19.5	Power frequency withstand voltage			
	Dry	kV		
	Wet	kV		
19.6	Impulse withstand voltage (1min)			
19.7	Creepage distance in Air	mm		
19.8	Tensile strength			
19.9	Cantilever strength			
19.10	Compression strength			
19.11	Torsional strength			
20	Enclosure Protection		IP-55W	
21	Operating mechanism		Manual gang operated	
22	Type of interlock furnished		Manual	
23	Weight of Isolator	kg		
24	ISO 9001 holder	Yes/No	Yes	
25	ISO 9001 certificate submitted	Yes/No	Yes	
26	Type test certificate submitted	Yes/No	Yes	

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CURRENT TRANSFORMER

S. No	Description	Unit	NEA requirement	Bidders Offer
1	Manufacturer and Country of Origin			
	Model No.			
2	Year of manufacturing experience	Years		
3	Applicable Standards		IEC	
4	Type		One phase outdoor, oil immersed	
5	Number of phases	Nos	1	
6	Number of core in each CT	Nos	2	
7	Frequency	Hz	50	
8	Rated primary voltage			
8.1	Nominal	kV	33	
8.2	Maximum	kV	36	
9	Temperature rise above 45deg C ambient at Normal rated current	deg C		
10	Insulation level			
10.1	Impulse withstand voltage	kV	170	
10.2	Power frequency withstand voltage (1min rms)	kV	75	
11	Creepage distance	mm		
12	Short time thermal rating	kA	25	
13	Current rating	A		
	i) For Transformer Protection		400-200-100/5	
	ii) For 33KV Line		1200-600-300/5	
14	Rated VA burden	VA	50	
15	Accuracy class		5P20 for protection and 0.5 for metering	
16	Rated thermal VA burden	VA		
17	Over load factor	%	200	
18	Dimension	cu mm		
19	Weight	kg		
20	ISO 9001 holder	Yes/No	Yes	
21	ISO 9001 certificate submitted	Yes/No	Yes	
22	Type test certificate submitted	Yes/No	Yes	

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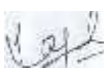

POTENTIAL TRANSFORMER

S. No	Description	Unit	NEA requirement	Bidders Offer
1	Manufacturer and Country of Origin Model No.			
2	Year of manufacturing experience	Years		
3	Applicable Standards		IEC	
4	Type		Outdoor, oil immeresed	
5	Number of phases	No.	1	
6	Frequency	Hz	50	
7	Rated primary voltage			
7.1	Nominal	kV	33/√3	
7.2	Maximum	kV	36	
8	Temperature rise above 45 deg C ambient at Normal rated current			
8.1	With 1.1 times rated primary voltage continuously	deg C		
8.2	With 1.5 times rated voltage for 30 seconds	deg C		
9	Insulation levels			
9.1	Impulse withstand voltage (peak)	kV	170	
9.2	Power frequency withstand voltage (1min rms)	kV	75	
10	Creepage distance	mm	825	
11	Open circuit intermediate voltage	V		
12	Ratings			
12.1	Voltage ratio	kV	33/√3:0.11/√3	
12.2	Rated burden	VA	100	
12.3	Accuracy class		5P and 0.5	
12.4	Over voltage factor			
12.4.1	30 seconds		1.1	
12.4.2	Continuous		1.5	
12.5	Connection			
12.6	Secondary fuse Manufacturer			
	Amp. Ratings	A		
12.7	By pass device for protection provided	Yes/No	Yes	
12.8	Knife switch and fuse on secondary provided	Yes/No	Yes	
13	No of secondary windings	No	2	
14	Dimension	mm		
15	Weight	kg		
16	ISO 9001 holder	Yes/No	Yes	
17	ISO 9001 certificate submitted	Yes/No	Yes	
18	Type test certificate submitted	Yes/No	Yes	

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LIGHTING ARRESTOR

S. No	Description	Unit	NEA requirement	Bidders Offer
1	Manufacturer and Country of Origin Model No.			
2	Year of manufacturing experience	Years		
3	Applicable Standards		IEC	
4	Type		Outdoor, gapless, zinc oxide	
5	Voltage rating of LA	kV	30	
6	Nominal Discharge Current	kA	10	
7	Surge counter with insulating base furnished	Yes/No	Yes	
8	Minimum power frequency spark over voltage	kV		
9	Maximum 1/50 impulse spark over voltage	kV		
10	Maximum front wave spark over voltage	kV		
11	Maximum switch surge spark over voltage	kV		
12	Number of section per pole			
13	Insulation level			
13.1	Impulse withstand voltage (peak)	kV	170	
13.2	Power frequency withstand voltage (1min rms)	kV	75	
14	Creepage distance	mm	825	
15	Earth terminal and accessories provided	Yes/No	Yes	
16	Surge counter	Yes/No	Yes	
17	ISO 9001 holder	Yes/No	Yes	
18	ISO 9001 certificate submitted	Yes/No	Yes	
19	Type test certificate submitted	Yes/No	Yes	

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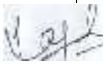
33kV CONTROL AND RELAY PANEL

S. No	Description	Unit	NEA requirement	Bidders Offer
1	Control and relay panel type			
1.1	Manufacturer and Country of origin			
1.2	Year of manufacturing experience	Years		
2	Control switches			
2.1	Manufacturer and Country of origin			
2.2	Type			
2.3	Current Rating	A		
2.4	Catalog Furnished	Yes/No	Yes	
3	Push Botton			
3.1	Manufacturer and Country of origin			
3.2	Type			
3.3	Contact rating continuous	Amp		
	Making current	Amp		
	Breaking current	Amp		
3.4	Catalog Furnished	Yes/No	Yes	
4	Indicating Lamps			
4.1	Manufacturer			
4.2	Voltage ratings	V		
4.3	Wattage	W		
5	Indicating instruments			
5.1	Ammeter			
	Manufacturer and Country of origin			
	Type		Digital	
	Current Range (400-200-100/5 Amp CT operated)	A		
	Accuracy Class		0.5	
	Scale			
	Type of scale			
	Range of indication (400-200-100/5 Amp CT operated)	A	0-100 0-200 0-400	
	Lineal/ Non linear			
	Overloaded range	%	1.5	
	VA burden			
	Catalog furnished	Yes/No	Yes	
	Transducer operated	Yes/No		
6	Voltmeter			
	Manufacturer and Country of origin			
	Type		Static	
	Accuracy class		0.5	
	Scale			
	Range of indication	kV	0-36	
	Linear/Non linear			
	Over scale range	%	1.1	
	VA burden	VA		
	Catalog furnished	Yes/No	Yes	
	Transducer operated	Yes/No	Yes	
7	Apparent power meter (kVA)			
	Manufacturer and Country of origin			
	Type		digital	
	Rated voltage	kV	33/√3:0.11/√3	

	Rated current	A	400-200-100/5	
	Current range (Transducer operated)	mA		
	Accuracy class		0.5	
	Scale	MVA		
	Type of scale			
	Range of indication		0-10	
	Linear/Non linear			
	VA burden			
	Current coil	VA		
	Voltage coil	VA		
	Catalog furnished	Yes/No	Yes	
	Transducer operated	Yes/No	Yes	
8	kWH Meter		NEA shall provide	
	Manufacturer and Country of origin			
	Type		TOD (static)	
	Applicable standard		IEC	
	Accuracy class		0.2	
	Import Export meter provided	Yes/No	Yes	
	Rated voltage	kV	33/√3:0.11/√3	
	Rated current	A	400-200-100/5	
	VA burden			
	Current coil	VA		
	Voltage coil	VA		
	Impulse contact provided 1pulse 100kW	Yes/No	Yes	
	Reverse rotation locking mechanism provided	Yes/No	Yes	
9	Power factor meter			
	Manufacturer and Country of origin			
	Type		Digital	
	Accuracy class		0.5	
10	Annunciators			
	Manufacturer and Country of origin			
	Type			
	Manufacturer's type designation			
	Catalog furnished	Yes/No	Yes	
	Number of inputs (annunciator/event)			
	Number of active points	Nos	24	
	Number of rows		4	
	Number of column		6	
	Type of mounting		Flush	
	Replacement of individual inscription plates and lamps from front panel possible	Yes/No	Yes	
	Sequence of operation as per specification	Yes/No	Yes	
11	Protective Relays			
11.1	Phase Over Current Relay			
	Manufacturer and Country of origin			
	Type		Static Non directional	
	Manufacturer's type designation			
	Applicable standards		IEC	
	Triple pole or single pole		Single*3	
	Current setting range	% of rated current	5-250%	

	Operating time at 10 times current settings (for TDS=1)	sec	3
	Reset time	ms	
	Characteristics		IDMT (Standard inverse)
	Instantaneous unit provided	Yes/No	Yes
	Current setting range	% of rated current	500-2000%
	Operating range		
	No Contacts		
	Insulation test as per IEC	Yes/ No	Yes
	Indication		
	Hand reset flags provided	Yes/No	Yes
	Light emitting diode provided	Yes/No	Yes
	Auxiliary DC supply	V	110
	Technical Literature submitted	Yes/No	Yes
	Test Certificate submitted	Yes/No	Yes
11.2	Earth fault relay		
	Manufacturer and Country of origin		
	Type		Static/Non directional
	Manufacturer's type designation		
	Applicable standard		IEC
	Triple pole or single pole		Single
	Continuous overload capacity	x In	
	Current setting range	% of rated current	5-250%
	operating time at 10 times current setting (for TDS=1)	sec	3
	Characteristics		IDMT (Standard inverse)
	Instantaneous unit provided	Yes/No	Yes
	Current setting range	% of rated current	500-2000%
	Operating range		
	No Contacts		
	Insulation test as per IEC	Yes/ No	Yes
	Indication		
	Hand reset flags provided	Yes/No	Yes
	Light emitting diode provided	Yes/No	Yes
	Auxiliary DC supply	V	110
	Technical Literature submitted	Yes/No	Yes
	Test certificate submitted	Yes/No	Yes
11.3	Directional Over current Relay		Not required
	Manufacturer and Country of origin		
	Type		Static/ directional
	Manufacturer's type designation		
	Applicable standard		IEC
	Triple pole or single pole		Single*3
	Current setting range	% of rated current	50-200%
	operating time at 10 times current setting	sec	3
	Reset time	ms	
	Characteristics		IDMT (Standard inverse)
	Instantaneous unit provided	Yes/No	Yes

	Current setting range	% of rated current	200-1600%	
	Operating range			
	Insulation test as per IEC	Yes/ No	Yes	
	Indication			
	Hand reset flags provided	Yes/No	Yes	
	Light emitting diode provided	Yes/No	Yes	
	Auxiliary DC supply	V	110	
	Technical Literature submitted	Yes/No	Yes	
	Test certificate submitted	Yes/No	Yes	
11.4	Directional Earth Fault Relay		Not Required	
	Manufacturer and Country of origin			
	Type		Static/ directional	
	Manufacturer's type designation			
	Applicable standard		IEC	
	Triple pole or single pole		Single	
	Continuous overload capacity	xIn		
	operating time at 10 times current setting	sec	3	
	Characteristics		IDMT (Standard inverse)	
	Instantaneous unit provided	Yes/No	Yes	
	Current setting range	% of rated current	200-1600%	
	Operating range			
	Insulation test as per IEC	Yes/ No	Yes	
	Indication			
	Hand reset flags provided	Yes/No	Yes	
	Light emitting diode provided	Yes/No	Yes	
	Auxiliary DC supply	V	110	
	Technical Literature submitted	Yes/No	Yes	
	Test certificate submitted	Yes/No	Yes	
11.5	Differential Relay			
	Manufacturer and Country of origin			
	Standard reference			
	Type			
	Voltage rating	V	110	
	Type of Mounting		Flush	
	Operating time setting	ms	<30	
	Sensitivity setting		10-50%xIn	
	Bias setting			
	CT ratio Compensating range			
	Burden for Current Circuit	VA		
	DC Burden	VA		
	Tripping	A		
	Making Current	A		
	Closing load (At 110V DC)	A		
	Ambient Temperature Range	Deg C		
	Auxiliary DC supply	V	110	
	Technical Literature submitted	Yes/No	Yes	
	Test certificate submitted	Yes/No	Yes	
11.6	Auxiliary Tripping and Lockout Relay			
	Manufacturer and Country of origin			
	Type			
	Manufacturer's type designation			
	Applicable standard		IEC	




	Operating Time	ms	<15	
	Does the lockout relay reset by the manually operated or electrically operated reset device			
	Is the cut off contact provided to interrupt the operating coil	Yes/No	Yes	
	Contact rating at 125V DC	A		
	Auxiliary DC supply	V	110	
	Technical Literature submitted	Yes/No	Yes	
	Test certificate submitted	Yes/No	Yes	
11.7	Break Fail Lockout Relay, 86K			
	DC Voltage Rating	V	110	
	Nos. of electrically separate No and NC Contacts			
11.8	Break Failure Lockout Relay BF			
	DC Voltage Rating	V	110	
	Nos. of electrically separate No and NC Contacts			
	Technical Literature submitted	Yes/No	Yes	
	Test certificate submitted	Yes/No	Yes	
12	Construction of Control and Relay Panel			
	Type		Simplex	
	Manufacturer's type designation			
	Applicable Standard			
	Control panel furnished as per specification	Yes/No	Yes	
	Enclosure protection class	IP	IP54	
	Thickness of sheet metal used			
	Front and rear portion	mm	>3	
	Side top and bottom cover	mm	>2	
	All instruments, meters, relays and control switches flush or semi flush type		Flush	
	Ground Bus			
	Material		Copper	
	Size	mm x mm		
	Internal Wiring			
	Type of Insulation			
	Voltage Grade of Wires	V	600	
	Cross Section of Wires	sq.mm	2.5 min	
	Current Circuit			
	Voltage and auxiliary circuit			
	Over all dimension of control board	cu mm		
	Shipping data			
	Size of large package	mm x mm x mm		
	Weight of heaviest package	kg		
	ISO 9001 holder	Yes/No	Yes	
	ISO 9001 certificate submitted	Yes/No	Yes	

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Distribution Board

S. No	Description	Unit	NEA requirement	Bidders Offer
1	Construction of AC DB			
	Type		Simplex/Duplex	
	Manufacturer's Type designation			
	Applicable Standard			
	Control Panel furnished as per specification	Yes/No	Yes	
	Enclosure Protection Class	IP	IP54	
	Thickness of sheet metal used	mm	>2	
	All instruments, meters, relays and control switches flush or semi flush		Flush	
	Bus			
	Material		Copper	
	Size	mm x mm		
	Rating	A	400A	
	Instruments/Equipments mounted			
	Voltmeter	V	0-400V	
	Ammeter	A	0-200A	
	Control switches			
	MCCB			
	Type		DP	
	Manufacturer			
	Current rating	A	400A	
	Internal wiring			
	Type of insulation			
	Voltage grade of wires	V	600	
	Cross section of wires	sq.mm		
	Current circuit	sq.mm		
	Voltage &auxiliary circuit			
	Number of feeders	Nos		
	MCB used	Yes/No	Yes	
	Type	SP/DP	SP/DP	
	Ratings	A		
	Overall Dimension	mm x mm x mm		
	Shipping data			
	Size of large package			
	Weight of the heaviest package	kg		
	Delivery of equipment in months following award of contract	Months		
	Technical literature/ drawings submitted	Yes/No	Yes	
	ISO 9001 holder	Yes/No	Yes	
	ISO 9001 certificate submitted	Yes/No	Yes	

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CONTROL CABLES

S. No	Description	Unit	NEA requirement	Bidders Offer
1	Manufacturer and country of origin			
2	Manufacturer's type designation			
3	Type			
4	Applicable Standards		IEC	
5	Voltage ratings			
	Suitable for max. system voltage	V	1000	
	Voltage grade of the cables	V	600	
	Rated voltage between each conductor and screen	V		
	Rated voltage between two conductors	V		
6	Conductor material		Copper	
7	Conductor			
	Cross section of wires	sq.mm		
	Nos & dia of each core in cable			
	Overall jacket of thickness			
8	Insulating material		Polyethylene	
9	Overall jacket material		PVC	
10	Net weight of the cable	kg/m		
11	Standard drum length	m		
12	Continuous current at 45 deg C			
	in ground			
	in duct			
13	Electrical parameters			
	Resistance	Ohm		
	Reactance	Ohm		
14	Technical literature submitted	Yes/No	Yes	
15	Type test certificate submitted	Yes/No	Yes	
16	Delivery of equipment in months following	Months		

	award of contract ISO 9001 holder ISO 9001 certificate submitted	Yes/No Yes/No	Yes Yes	

Signed & Stamp:

As Representative for:

Address:

Date

LV POWER CABLES

S. No	Description	Unit	NEA requirement	Bidders Offer
1	Manufacturer and country of origin			
2	Manufacturer's type designation			
3	Type			
4	Applicable Standards		IEC	
5	Voltage ratings			
	Suitable for max. system voltage	V	1000	
	Voltage grade of the cables	V	600	
	Rated voltage between each conductor and screen	V		
	Type of system earthing		Solidly grounded	
6	Conductor material		Copper	
	Cross section of wires	sq.mm		
	Nos & dia of wires of each conductor			
	Insulating material and thickness		Polyethylene	
	Overall jacket material/thickness		PVC	
	Overall cable diameter			
7	Continuous current			
	in ground	A		
	in duct	A		
8	Electrical parameters			
	Resistance	Ohm		
	Reactance	Ohm		
9	Net weight of the cable	kg/m		
10	Technical literature submitted	Yes/No	Yes	
11	Type test certificate submitted	Yes/No	Yes	
12	Delivery of equipment in months following award of contract	Months		
	ISO 9001 holder	Yes/No	Yes	
	ISO 9001 certificate submitted	Yes/No	Yes	

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Address:

Date

HV XLPE POWER CABLE

S. No	Description	Unit	NEA requirement	Bidders Offer
1	Manufacturer and country of origin			
2	Manufacturer's type designation			
3	Type			
4	Applicable Standards		IEC	
5	Voltage ratings			
	Suitable for max. system voltage	kV	12	
	Rated voltage between each conductor and screen	kV	12	
	Type of system earthing		Solidly grounded	
6	Conductor material		Copper for 12 kV	
	Cross section of wires	sq.mm.	400	
	Nos & dia of wires of each conductor			
	Insulating material and thickness		XL Polyethylene	
	Overall jacket material/thickness		PVC	
	Overall cable diameter	mm		
7	Continuous current			
	in ground	A		
	in duct	A		
8	Electrical parameters			
	Resistance	Ohm		
	Reactance	Ohm		
9	Net weight of the cable	kg/m		
10	Technical literature submitted	Yes/No	Yes	
11	Type test certificate submitted	Yes/No	Yes	
12	Delivery of equipment in months following award of contract	Months		
	ISO 9001 holder	Yes/No	Yes	
	ISO 9001 certificate submitted	Yes/No	Yes	

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GROUNDING SYSTEM

S. No	Description	Unit	NEA requirement	Bidders Offer
1	Main ground grid conductor material		Copper	
2	Main ground grid conductor size	sq.mm		
3	Depth of buried main ground conductor			
4	Material of riser		Copper	
	Cross section of riser conductor	sq.mm	100	
5	Type of joint above and below ground level			
6	Ground electrode			
	Material		Copper clad steel	
	Diameter	mm	16	
	Length	m	as per IEEE 80	
7	Fench grounding included			
8	Cross section of conductor rise for fench ground	sq.mm		
9	Fench separately grounded by electrode	Yes/No	Yes	
10	Calculation for grounding grid length and conductor size furnished	Yes/No	Yes	
11	Earthing systen designed for	ohm	<1	

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Date

MISCELLANEOUS MATERIALS

S. No	Description	Unit	NEA requirement	Bidders Offer
A	Strain bus and fittings			
1	Manufacturer and country of origin			
2	Nominal sectional area			
3	Nos and Size of wires			
	Aluminum			
	Steel			
4	Overall diameter	mm x mm x mm		
	Steel core			
	Complete conductor			
5	Continuous current at 45 deg C	A		
6	Ultimate tensile strength			
7	Short circuit current 1 sec			
8	Resistance	ohm		
9	Weight	kg		
B	Fittings			
1	Manufacturer and country of origin			
2	Material			
C	Suspension and tension insulators			
1	Manufacturer and country of origin			
2	Manufacturer's type designation			
3	Applicable standard			
4	Size			
	Diameter	mm	254	
	Height	mm	146	
5	No of units per string	No	11	
6	Combined electrical and mechanical failing load	kg	12000	
7	Creepage distance per unit	mm	292	
8	Impulse withstand voltage	kV	120	
9	Dry power frequency withstand voltage	kV	78	
10	Wet power frequency withstand test	kv	45	
11	puncture voltage	kV	120	
12	Technical literature submitted	Yes/No	Yes	
13	Type test certificate submitted	Yes/No	Yes	
D	Post insulator			
1	Manufacturer and country of origin			
2	Manufacturer's type designation			
3	Applicable standard			
4	Rated system voltage	kV	33	
5	Maximum rated voltage	kV	36	
6	Unit size (Diameter)	mm		
7	Unit size (length)	mm		
8	Creepage distance	mm	>900	
9	Insulation level			
	Impulse withstand voltage	kV	170	
	Power frequency withstand voltage (1 min rms)	kV	95	
10	Failing load (bending)	kg		
11	Failing load (torsion)	kg-m		

12	Technical literature submitted	Yes/No	Yes	
13	Type test certificate submitted	Yes/No	Yes	
E	ACSR Conductor			
1	Manufacturer and country of origin			
2	manufacturer's type designation			
3	Applicable standard			
4	Unit size(dia x No of strands)			
5	Overall cross sectional area			
6	Technical literature submitted	Yes/No	Yes	
7	Type test certificate submitted	Yes/No	Yes	
F	Earth Wires			
1	Manufacturer and country of origin			
2	manufacturer's type designation			
3	Applicable standard			
4	Unit size(dia x No of strands)			
5	Overall cross sectional area			
6	Technical literature submitted	Yes/No	Yes	
7	Type test certificate submitted	Yes/No	Yes	

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Address:

Date

12kV VACUUM CIRCUIT BREAKER

S. No	Description	Unit	NEA requirement	Bidders Offer
1	Manufacturer and country of origin			
2	Year of manufacturing experience			
3	Manufacturer's designation as per submitted catalogue			
4	Applicable standard	IEC		
5	Type	3 Phase , Indoor		
6	Rated Voltage			
6.1	Nominal	kV	11	
6.2	Maximum	kV	12	
7	Rated Current			
7.1	Continuous at 45 degree ambient			
	Incomer	A	1250	
	Outgoing	A	800	
	Trunking chamber	A	2000	
	Busbar/Bus Coupler	A	2000	
7.2	Short time for 1 sec at max. kV	kA	25	
	Momentary	kA		
8	Frequency	Hz	50	
9	Rated short circuit breaking current	kA		
10				
10.1	Peak	kA	62.5	
10.2	RMS Symmetrical	kA		
11	Interrupting time at 100% capacity			
11.1	Maximum Opening time	ms		
11.2	Total interrupting time	ms	60	
12	Closing time	ms		
13	Make time	ms	120	
14	Maximum capacitive current breaking capacity (rms)	A		
15	Insulation level			
15.1	Impulse withstand voltage (peak)	kV	75	
15.2	Power frequency withstand voltage	kV	28	
16	Vacuum chamber			
	Make time			
	Rating	A		
17	Operating mechanism			
17.1	Type		Spring Operated	
17.2	Operating voltage of closing and tripping coil	V DC	110	
17.3	Operating voltage range			
	Closing time	% of rated voltage	85-110%	
	Tripping		70-110%	
17.4	Closing and tripping current	A		
17.5	Spring charging motor rating			
	Capacity	kW		
	Rated voltage	V	400	
	Frequency	Hz	50	
	Phase	No	3 Phase	
17.6	Time required by motor to charge the spring completely	sec		
17.7	Push buttom for local/ remote control	Yes/No	Yes	

17.8	Selection switch for local/remote control	Yes/No	Yes	
18	Current transformer			
	Nos of core (incoming and outgoing)		3 and 2	
	Ratio/class/burden	A	1200/600/300/5, 800/400/200/5	
	Metering	VA	0.5, 30 VA	
	Protection	VA	5P20,30	
	Differential	VA	PS, 30	
18.2	Potential Transformer			
	Type		-	
	Rated Voltage			
	-Primary	kV	11/√3	
	-Secondary	kV	0.11/√3	
	Rated burden	VA	100	
	Accuracy class		0.5	
	Insulation level			
	-Impulse withstand voltage	kV	75	
	-Power frequency withstand voltage	kV	28	
	Fuse (HV/LV)			
	Continuous rating	A		
	Symmetric faults rating	kA		
19	Indicating Instruments			
19.1	Ammeter			
i	Manufacturer and country of origin			
ii	Type		digital	
iii	Current range (400-200-100/1 Amp CT operated)			
iv	Accuracy class		0.5	
v	Scale			
	Range of indication (400-200-100/1A CT operated)	A		
	Linear/Nonlinear			
	Overload range	%	1.5	
vi	VA Burden	VA	30	
	Is manufacturer ISO holder	Yes/No	Yes	
19.2	Voltmeter			
i	Manufacturer and country of origin			
ii	Type		digital	
iii	Accuracy class		0.5	
iv	Scale			
	Range of indication	kV	0-15	
v	VA Burden			
	Is manufacturer ISO holder	Yes/No	Yes	
19.3	Apparent Power meter			
i	Manufacturer and country of origin			
	Type			
	Rated voltage	kV	11√3:0.11√3	
	Rated Current	A	400-200-100/5	
	Accuracy class		0.5	
	Range of indication	MVA	0-15 or 10	
	VA burden			
	Current coil	VA		
	Voltage coil			
	Is manufacturer ISO holder	Yes/No	Yes	


19.4	KWh Meter			
i	Manufacturer and country of origin			
ii	Type		Static 3-phase, 4 wire	
iii	Accuracy class		0.2/0.5	
iv	Rated voltage	kV	11√3:0.11√3	
v	Rated Current	A	400-200-100/5	
vi	VA burden			
	Current coil	VA		
	Voltage coil			
vii	Reverse rotation locking mechanism provided	Yes/No	Yes	
	Is manufacturer ISO holder	Yes/No	Yes	
19.5	Annunciators			
	Manufacturer and country of origin			
	Type			
	Number of active points	No	4	
	Type of mounting		Flush	
	Replacement of individual inscription plates and lamps from front panel possible	Yes/No	Yes	
	Sequence of operation as per specification	Yes/No	Yes	
20	Protective Relay			
20.1	Over current relay			
iv	Manufacturer and country of origin			
ii	Type		Static Non-directional	
iii	Manufacturer's type designation			
iv	Applicable standard			
v	No of poles		Three	
vi	current setting range	% of rated current	20-200%	
vii	Operating time at 10 times current setting (for TDS=1)	sec	3	
viii	Reset time	ms		
ix	Characteristics		IDMT (standard inverse)	
x	Instantaneous unit provided	Yes/No	Yes	
	Current setting range	% of rated current		
	Operating range			
	No Contacts		-	
xi	Insulation test according to IEC	Yes/No	Yes	
xii	Indication			
	Hand reset flags provided	Yes/No	Yes	
	Light emitting diode provided	Yes/No	Yes	
xiii	Auxiliary DC supply	V	110	
xiv	Technical literature provided	Yes/No	Yes	
20.2	Earth fault relay			
i	Manufacturer and country of origin			
ii	Type		Static/Non-directional	
iii	Applicable standard		IEC	
iv	Continuous overload capacity	xIn		
v	Current setting range	% of In	10-80%	

vi	Operating time at 10 times current setting	sec	3	
vii	Characteristics		IDMT (standard inverse)	
viii	Instantaneous unit provided	Yes/No	Yes	
	Current setting range	% of In	200-1600%	
	Operating range			
	No Contacts			
ix	Insulation test according to IEC	Yes/No	Yes	
x	Indication			
	Hand reset flags provided	Yes/No	Yes	
	Light emitting diode provided	Yes/No	Yes	
xi	auxiliary DC supply	V	110	
xii	Is Manufacturer ISO 9001 holder?	Yes/No	Yes	
xiii	Technical literature submitted	Yes/No	Yes	
xiv	Type test certificate submitted	Yes/No	Yes	
20.3	Auxiliary Tripping and Lockout Relay			
i	Manufacturer and country of origin			
ii	Type			
iii	Manufacturer's type designation			
iv	Applicable standard			
v	Operating time	ms	<15	
vi	Contact rating at 125V Dc	A		
21	Earthing switch			
	Type		Integrated	
	Rating			
	Interlocking	Yes/No	Yes	
22	Surge Arrestor			
	Type		ZNo	
	Rating	kA	9kV,10kA	
23	Space heater provided for cubicle	Yes/No	Yes/rating	
24	Operating duty cycle		0-0.3sec-co-3min-co	
25	Number of possible operation without maintenance under:			
	Rated short circuit braking current	No	100	
	Rated Normal current	No	10000	
26	Clearances			
26.1	Phase to phase	mm	127	
26.2	Phase to earth	mm	76.2	
27	Padlocking provision for cubicle	Yes/No	Yes	
28	Total weight of the circuit breaker	kg		
29	Mechanical Dimension (LXWXH)	mmxmmxmm		
30	Delivery of equipment in months following award of contract (Allowing time for approval of drawing)			
31	Type test certificate submitted	Yes/No	Yes	
32	Has manufacturer exported units	Yes/No	Yes	
33	Technical literature submitted	Yes/No	Yes	
34	ISO 9001 holder	Yes/No	Yes	
35	ISO 9001 certificate submitted	Yes/No	Yes	

Signed & Stamp:
As Representative for:
Address:
Date


110 V BATTERY

DESCRIPTION	UNIT	NEA requirement	Bidder offer
1. Manufacturer and Country of Origin			
2. Manufacturing experience	years		
3. Type of battery		MFVRLA	
4. Applicable standards		IEC	
5. Number of cells	No.		
6. Number of units	No.		
7. Number of cells in a unit	No.		
8. Nominal voltage rating	V	110	
9. Nominal capacity at 27^0C at 10 h discharge time to cell end voltage 1.75	AH	240	
10. Ampere capacity at 27^0C at 15 min discharge time to cell end voltage 1.75	A		
11. Battery construction (type)			
12. Type of plates			
a) Positive (flat or tubular)			
b) Negative			
13. Type of rack - Rack dimensions			
14. Float charging voltage	V		
15. Equalizing charging voltage	V		
16. Internal resistance of one cell	ohm		
17. Short circuit current withstand capacity	A		
18. Float charging current	A		
19. Charging current of a fully discharged battery at 8 hour charging rate	A		
20. End voltage of each cell	V		
21. Charging efficiency of the battery	%		
22. Max. duration in month, the battery can be kept	month		

without charging			
23. Battery life (guaranteed value)	years		
24. Rack interconnection furnished?		Yes	
25. Delivery of equipment in months following award of contract (allowing time for approval of drawings)	month		
Type test certificate submitted	Yes/No		
Has manufacturer exported units	Yes/No		
Technical literature submitted	Yes/No		
ISO 9001 holder	Yes/No	Yes	
ISO 9001 certificate submitted	Yes/No	Yes	

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110 V BATTERY CHARGERS

DESCRIPTION	UNIT	NEA requirement	Bidder offer
1. Manufacturer and Country of Origin			
2. Manufacturing experience	years		
3. Type of charger		constant voltage	
4. Applicable standard		IEC	
5. Output rating	A		
6. Range of DC voltage variation	±V		
7. Maximum AC input	kVA		
8. Input Voltage / phase	V	400 V, 3 ph	
9. Ripple	%	< 2%	
10. Efficiency of charger at 100 % output	%		
11. Temperature rise above ambient of 40 degree C			
a) Solid state elements	^{0}C		
b) Wound elements	^{0}C		
12.Voltage regulation	%		
13. Float voltage adjustment			
14. Equalizing voltage adjustment			
15. Auto equalizing charge provided?	Yes/No	Yes	
16. Timer for equalizing charge provided?	Yes/No	Yes	
17. End switching to limit equipment	type		
18. Manual over-ride switch for selection of float/equalizing charge provided?	Yes/No	Yes	
19. Delivery of equipment in months following award of contract (allowing time for approval of drawings)	month		

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Date

SPECIFICATION OF CIVIL & BUILDING WORKS

1. SITE WORKS

Work Included

Furnishing all materials equipment and labor and performing all operations required for the clearing stripping, Filling and compacting of substation areas and constructing access roads so indicated on the drawings, specified herein and as evidently necessary to complete to work as given in the price schedule.

1.2 Clearing and Stripping

1.2.1 General

Clearing shall include cutting, leveling , removal and disposal with lead of 100 m, as specified of all trees, bushes down timber, debris, posts, fences, indicted structures and other obstructions from the areas to be occupied by permanent works of the contract and as indicated on the drawings specified herein and directed by the Owner/Engineer. Areas so indicated shall be stripped of 20 cm thick topsoil. Topsoil approved by the Owner/Engineer shall be stockpiled for use in the finish grading and seeding work. Stockpiled topsoil shall be free from trash, vegetation, or other debris.

1.2.2 Protection

The Contractor shall be responsible for prevention of damage to structures and other objects, which are not included in the clearing work. No objects of any kind outside the indicated limits of the work shall be removed or damaged. Existing utilities which are not specifically included in the work shall be protected by the contractor. The contractor shall be responsible for employment of safe methods of demolition and clearing.

1.2.3 Payment

Payment for the contract item “Clearing and stripping” will made at the lump sum price as bid therefore in the schedule which shall include full compensation for all costs incurred in performing the clearing and stripping, including but not limited to removal and disposal of bushes, splash, roots and debris and stripping, stockpiling and disposal of topsoil or unsuitable earth material within lead of 100 meters.

1.3 Compacted Fill for Site Grading

1.3.1 The contractor shall provide and compact select borrow material within the limits of the work to the lines, grades and elevations to be specified by the Owner/Engineer. In general, the new substation sites and access roads will be elevated by approximately one meter from the existing ground level. The contractor shall provide details of filling for approval of the owner.

1.3.2 Common Fill

The contractor may use fill materials available from cut areas in the switchyard if suitable and approved by the owner. This materials shall be well-graded bank-run gravel, relatively free from clay, loan on vegetables matter and with no stones over 10 cm in maximum dimensions, or materials of equivalent strength and characteristics. Representative samples from proposed borrow sources shall be submitted to the Owner/Engineer for approval of the borrow source. Approval of borrow source shall both mean automatic approval of Owner/Engineer. If Owner/Nepal Electricity Authority rejects any material the Contractor shall remove it from site without any extra cost to the Owner.

1.3.3 The Contractor shall, at his option, use areas approved by the Owner/Engineer for production of select borrow or at his own expense, make arrangements for obtaining select borrow at other sources with prior approval of the Owner/Nepal Electricity Authority.

1.3.4 Unless otherwise specified y the Owner/Engineer, compacting shall be to the following sensitizes at optimum moisture contents as determined by ASTMD-1557, Method D.

a) Fill location and required density

1)	Under building and yard foundation	95 percent
2)	Sub-base for roadways	90 percent
3)	Gravel roadways top 400mm	95 percent
4)	All other locations	90 percent

b) It is Contractor's responsibility to select his method for attaining the required compaction and obtain approval of the Owner/Engineer for the proposed method. Should the method of compaction prove unsatisfactory, it is the Contractor's responsibility to take remedial measures and obtain the approval of the Owner/Engineer for the changes made. For the compaction of fill, 2 tom vibrating roller is preferable.

c) The Owner/Engineer reserves the right to have compaction tests performed by an independent laboratory, with all testing costs borne by the Contractor. Any additional compaction or replacement of fill required to meet the specified density, as evidence by the tests, shall be done by at the expense of the Contractor.

d) Failure of the compacted fill to reach the required density as evidence by these tests, is cause of rejection by the Owner of the work in the affected area(s). Unless the Contractor can rework and compact the fill to the required density, he shall remove the fill in the areas affected. Subsequently the Contractor shall replace the removal fill with material which he can compact to the required density.


e) Compaction shall be carried out in layer wise, each layer not exceeding 300 mm loose thickness.

1.3.5 Measurement for payment for the contract item, "Site Grading " Shall be the number of cubic meters of site grading, filled of bankrun gravel furnished and placed in accordance with the Specifications, as shown on drawings, or as directed by the Owner/Engineer. The measurement and the payment shall be for compacted volume.

1.3.6 Payment for the contract item, : Site Grading" will be made at the unit price for cubic meter. Bid therefore in the price schedules which unit price shall include full compensation for all costs incurred in furnishing all materials and all other operations related to fill including but not limited to:

a) Obtaining materials to job site from source, to temporary stockpiles and/or points or final disposition.

b) Transporting, materials to job site from source, to temporary stockpiles and/or points or final disposition.

c) Leveling the top surface to the finish grade.

1.4 Crushes Stone Substation Yard Surfacing

1.4.1 The Contractor shall furnish, delivery, deposited and spread crushes stone on the switchyard area. The crushes stone shall be crushes granite, gneiss or equal, 25mm size and shall be hard, durable and seamless, spread and bladed dense but not compacted. The Contractors shall spread the crushes stone on previously properly prepared sub surfaces. The cover shall be 150mm thick.

1.4.2 Measurement for payment for contractor item. Crushes Stone for Substation Yard surfacing, shall be at the number of square meters of crushes stone surface of crushed stone furnished and placed in accordance with Specification, as shown on deducting area cover by permanent structure and fixtures.

1.4.3 Payment for the contract item "Crushed Stone for Substation Surfacing" will be made at the unit price per square meter therefore in the Schedule, which unit price shall include full compensation for all costs incurred in furnishing all materials and all other operation related to the fill including but not be limited to:

a) Obtaining materials from owner/Engineer approved source.

b) Transporting materials to job site from source, to temporary stockpiles and/or to points of final disposition.

1.5 Site Drainage

1.5.1 The Contractor shall design and furnish all construction works for collection and disposing storm water all around the switchyard site into the soak pit drain or nearby channel.

1.5.2 Grading

Location and its direction of the elevations shall be as per approved drawings.

1.5.3 Drainage channel materials

a) All concrete drains must be built to tall

Excavating must give allowance to formwork which shall be refilled with proper compaction.

b) Concrete pipes

Concrete pipes shall be Np-3 class or equivalent in required size. Closed pipes shall be used at road crossing, the perforated type pipes shall be used for switchyard area. 150 mm dia. Perforated pipe shall be made of asbestos cement. 250 mm and 200mm dia. Perforated pipe shall be made of R.C.C hume pipe Np-2 class or equivalent. Those pipes shall be protected with screened gravel of 25mm-40mm size.

1.5.4 Construction

Excavating, trenching and backfilling for drainage channels shall be done after all other underground utilized are installed but before road sub grade is prepared.

a) Trench Excavation

Trenches for pipe shall excavated to a sufficient depth and width to enable to pipe and any specified joint bedding, hunching etc. to be accommodated.

b) Bedding and laying of pipes

Immediately following excavation of trenches, pipes shall be laid. Pipe shall be laid so that each one is in contact with the bed throughout the length of its barrel.

c) Jointing of pipes

Length of each pipes shall be commercially available joints to be constructed in the fields shall be factory made collar jointed with jute packing and cement sand mortar 1:3. And the joint location shall be covered by 30cm thick concrete (1:2:4).

d) Backfilling

After 48 hours of pipe jointing, the trenches shall be backfilled with excavated materials. IF excavated materials is not suitable then the contractor shall replace it by select borrow. Backfilling shall be done in layer wise, each layer not exceeding 15 cm.

1.5.5 Open channel type drainage

Excavation and backfilling for this type of drainage shall be done as specified herein.

The surface shall be made as smooth as possible with plaster work. Side and base shall be constructed in stone masonry wall 360 mm thick and cement sand mortar to be used shall be 1:5 ratio by volume.

1.5.6 Payment for the contract item “Drainage” will be made at lump sum bid price. Therefore in the schedule the bid price shall include full compensation for all costs incurred in furnishing all materials, equipment labor and other operations related to the scope of work.

1.6 Laying of underground cable

Contractor shall furnish all construction work for under grounding of 12 kV cables from substation outgoing cable exit point to nearest take off poles.

This work shall include excavation, sand filling from the top and backfilling. All work shall be done according to the standard practice.

Cost of “12 kV power cable and accessories: in the Price Schedule shall include the cost of laying of cable with required materials as described above.

1.7 Cable Trenches

1.7.1 General

Concrete cable trenches of adequate size shall be designed and constructed in accordance with the drawings and as directed by the Owner/Engineer. Trenches shall be designed with floor drains to assure proper drainage and shall be equipped with floor drains to assure proper drainage and shall be equipped with removable iron covers. At road crossing R.C.C. Hume pipe - NP3 of sufficient size shall be provided. The detailed design shall be approved by the Owner.

1.7.2 Payment

Payment for the contract item, cable trenches, will be made at the unit price per meter bid. Therefore, in the schedule the unit price shall include full compensation for all costs incurred in furnishing all materials, equipment and labor and all other operations related to cable trench, design and construction, including but not be limited to:

a) Performing detail designs and preparation of construction drawings

b) Supplying transporting all materials to job site.

c) Excavating and backfilling for the cable trenches.

d) Construction the cable trenches with floor drains, reinforced concrete wall, base and removable cover.

1.8 Access Road

Asphalts Payment

General

This specification covers all construction works for 4 meters wide drive-way road within Owner's premises.

Grading

Finish grade of roads and packing area shall be as directed by Owner.

Pavement Materials

Sub-base

Sub-base shall be a non-plastic, sandy granular material with a C. B. R value greater than 15. It shall be free of deleterious materials and subjected to the Owner's approval. Thickness of sub-base course shall be 30 cm compacted.

Base Course

Base shall be crushed aggregate with a CBR value greater than 80. It shall be free of deleterious material and subjected to the Owner's approval. Thickness of base course shall be 15 cm compacted.

It shall conform to following gradation:.

Sieve Size	Percentage Passing
1.5 ”/2	100
¾”	90-100
3/8”	50-80
No. 4	35-55
No. 30	10-30
No. 200	2-9

Wearing Course

Wearing course shall be asphalt concrete mixture.

Asphalt Concrete Mixture

Asphalt concrete shall be a mixture of mineral aggregate and paving asphalt mixed at a central mixing plant. It s components shall be specified herein.

Paving asphalt shall be a stream refined asphalt produce from crude asphaltic petroleum or mixture of refined liquid asphalt and refined solid asphalt. It shall be homogeneous and free from water and residues of coal, coat tar or paraffin oil. It shall have a penetration grade of 85-1000 when tested according to ASTM D-5.

Aggregate for asphalt concrete shall be a composition of coarse aggregate fine aggregate. Both shall be clean and durable.

Composition of Grading

The grading of the combined aggregates and the percentage of asphalt shall be as follows:

Percentages shown are based on weight of dry aggregates.

Sieve Size	Percentage Passing	
	Minimum	Maximum.
¾”	100	
½”	95	100
3/8”	72	88
No.4	46	60
No.8	28	42
No.30	15	27
No. 50	10	20
No.200	4	7
Asphalt content (%)	4.8	6.0

Payment

The unit price bid in the price schedule shall include the cost of design, all labor all material, civil construction works, etc.

Payment for the contract item “ Asphalt Road” will be made at the unit price per sq. meter of finished blacktop surface bid therefore in the price schedule, which unit price shall include fill compensations for all costs incurred in grading, furnishing all material, equipment labor and all other operations including earthwork and excavations.


1.9 Stone Masonry for Protection

The Contractor shall design and construct stone masonry wall to protect the different level of switchyard, control building, road and other places as directed by the Owner.

The stone shall be placed with uncoursed close joints to the lines and grades as designed. The rubble stone shall be placed with 1:3 cement mortar. After completion of masonry wall, it shall be cured with water for more than 10 hours.

Weep-holes with poly vinyl chloride (PVC) pipes of 5 cm in diameter shall be made in each 4 sq. m of slope surface of the masonry wall. The upper surface of the masonry wall shall be finished smooth with concrete.

Payment: Measurement for payment of "Stone Masonry Wall" works shall be made for the number of cubic meters measured as provided at the unit price specified in the Price Schedule. The unit price shall include all labor tools and equipment materials including furnishing, transporting and placing the materials, excavating, backfilling, installation of PVC pipes and all other costs necessary for the performance and completion of the works.

1.10 Switchyard and Boundary Fencing

A barbed fence shall be constructed around Owner's premises as shown on the drawings.

The work include under this item entails the complete furnishing and installation of all galvanized wire fencing, posts, and appurtenances, complete and in finished condition, including the furnishing of all labour, materials, plant, tools and equipment required for the work.

The contractor shall erect the boundary fence strictly conforming to this specification. Concrete work shall be in accordance with the details in the item of these specifications concerning concrete work.

Payment

The unit price bid in the Price Schedule shall include the cost of all labor and all materials.

Measurement for payment shall be made on the basis of running meter of actual quantities performed and be made at the unit price bid therefore in the price schedule, which shall include earth excavation, backfill and all other related works.

1.11 Entrance Gate


One entrance gate for main entrance to the Owner's premises and another one for the switchyard shall be erected. The iron gates shall be 4.5x1.5 (wxh) m. the Contractor shall submit the design for the approval of Owner.

Excavation, backfilling, pilling (if necessary) for installations of gate posts are included and the gate shall be painted according to the direction of the Owner. Measurement for payment shall be made on the basis of actual quantities performed and made at the unit price bid therein.

Payment shall be made on the basis of lump sum price and be made at the unit price bid therefore in the Price Schedule.

2. CONCRETE FOUNDATION AND TRENCHES

Work Included

Furnishing all materials, equipment and labor and perform all operations required for the design and construction of all the concrete foundations for equipment and other structures, oil containment and cable trenches, as specified herein and as evidently necessary to complete the work.

2.2 Foundation Design

2.2.1 General

The Contractor shall design all foundations specified on the bid drawings. The design shall be based on assumed soil parameters. Upon completion of the detail soil test, actual soil conditions shall be investigated and shown to be in compliance with the assumed condition.

2.2.2 Submittals

The Contractor shall submit design calculations, detail drawings and reinforcement steel schedules to the Owner/Engineer for review and comment before construction commences, Review of the foundation design by the Owner/Engineer in no way relieves the Contractor of his responsibility for an adequate foundation design, even though this Specification sets forth the basis foundation design criteria. Upon receiving the Owner's /Engineer comments, the Contractor shall submit to the Owner/ Engineer final drawings of all foundation details, including reinforcement steel schedules on drawing sheet sizes for record file.

2.2.3 Design Load

The structure design loads are defined on the structure outline drawings and the loads used to design the foundation shall be actual working loads applied to the foundations by the equipment and structures. The foundations shall be designed to resist all vertical


and lateral forces, uplift forces and overturning moments with a minimum factor of safety of 1.5.

2.2.4 Bearing Loads

The Contractor shall used an allowable soil bearing pressure of 1.0kg/cm2 for the design of the foundation for the purpose of bidding, but this is only reference value. After award of contract the Contractor shall carry out detail soil test and detail design of foundation based on the soil test result. There may be variation in the volume of work in final design compared to the bidding design, for which the Contractor will not get any extra payment.

2.2.5 Uplift and Overturning Loads

The uplift and overturning resistance of concrete spread footing shall be assumed as the weight of a volume of earth in the form of an inverted frustum of cone or pyramid. The cone of pyramid height shall be 30cm less than the depth from finish grade to the top of the concrete mat, the base area shall be the top area of the mat and the top area shall be determined by the intersection of planes starting at the mat edges and sloping outward at a 20 degree cone angle from the vertical and the horizontal plane 30 cm below finish grade.

2.2.6 Unit weight for overturning resistance

The following unit weight shall be used for design:

a) Soil …….. 12,000kg/m3

b) Concrete…… 16,00kg/m3

2.2.7 Payment

No separate or direct payment will be made to the Contractor for design works. All costs incurred in connection therewith shall be included in the lump sum bid price for the construction of various works.

2.3 Soil Test

2.3.1 Ground bearing tests

The contractor shall carry out soil tests to determine the ground bearing capacity by means of a Standard Penetrations Test and Auger Boring and tests shall be performed in accordance with the following Specifications.

a) The Contractor shall perform soil investigation work according to the approved plan and details of tests. Report on test results including various data collected during the investigation works and Contractor’s recommendations, on which the design will be based, shall be approved Owner/Engineer.

b) Sub surface investigation for soil strength of foundation for structures and equipment shall conform to the following requirements.

Number of boring shall be at least 2 borings at the locations specified below:

- One at take-off structure foundation
- One at transformers foundation

c) Thin-walled tube soil sampling in accordance with ASTM D-1587-63 T shall b made at every meter for the first three meter of depth.

d) Standard penetration tests in accordance with ASTM-D-1586-64T shall be made at every meter for the first three meter of depth and every two meters fort he further depth after this-walled tube soil samples have been taken.

e) Every undisturbed sample collected from thin-walled tube shall be subject to the following series of test.

- Natural moisture content
- Atterberg limits
- Sieve analysis
- Unit weight
- Specific gravity determination
- Unconfined compression tests.

f) Accurate log of all soil strata penetration resistance test unconfined compressive strength, soil classification, ground water table and other tests result shall be recorded in the reports submitted.

The Contractor shall provide all necessary equipment, materials and personnel to prepare conduct and report the tests.

2.3.2 Payment

Payment for the contract item: Soil Testing will be made at the lump sum price bid. Therefore, in the schedule, the price shall include compensation for all costs incurred in furnishing all materials and labor and other operations related to soil testing.

2.4 Excavation and Backfill

2.4.1 The contractor shall excavate earth, rock, stumps and all the other materials encountered as required for construction of the foundations, oil containments and trenches and drainage pipes. The Contractor shall place all suitable excavated materials in backfill or in graded embankment in the immediate area at structures. Materials found to be unsuitable for foundation backfill or grading shall be wasted and disposed of at Contractor own expense, and shall be backfilled with select borrowing material.


2.4.2 Excavation shall be maintained in a clean, safe and sound condition until completion of the foundation construction and shall be dike to prevent flooding by surface runoff. Suitable pumping equipment shall be provided and used to dewater excavation so that all installation work and backfilling is performed in the dry state. Any previously prepared foundation bearing surface that is softened by water runoff of otherwise contaminated before placement of the structure foundation shall be excavated and replaced at the Contractor's expenses.

2.4.3 In those excavation where the base is unstable. Lies below groundwater level, or has been over excavated, the Contractor shall furnished and place a layer of crushed stone, or selected backfill, or borrow to stabilize the base for placement of foundation.

2.4.4 Backfill shall be place in not greater than 20cm lifts before compaction. Each lift shall be thoroughly compacted before the following lift is placed, Pneumatic or equivalent tempers shall be used on cohesive materials: vibratory compactors shall be used on non-cohesive materials. Compaction shall achieve a density at least equal to that of the surrounding undisturbed earth. Large stones or rock fragments may be used in the backfill provided they do not interfere with proper compaction. Particles larger than 25 cm shall be placed not nearer than 0.5 m of the structure and at least 1.0m below ground surface.

2.4.5 Rock particles larger than 10 cm shall not be in contact with the concrete.

2.4.6 Upon the completion of excavation a 10 cm thick layer of boulder or selected borrow shall be provided at the base of each foundation.

2.4.7 Payment

No separate or direct payment will be made to the Contractor for excavation and backfill. All costs incurred in connection therewith shall be included in the lump sum bid prices for the construction of the various foundation types.

2.5 Foundation Construction

2.5.1 General requirement

All materials and labor required to remove and replace at his expense any materials incorporated in the work that do not conform to these Specifications.

a) The Contractor will be required to remove and replace at his expenses any materials incorporated in the work that do not conform to these Specifications.

b) The Contractors shall furnish without extra cost all materials the Owner/Engineer may required for testing. The cost of the tests shall be borne by the Contractor.

2.5.2 Measurement

Measurement for payment for the contract item: Concrete foundation, shall be on the basis of the actual number of each type of foundation constructed by the Contractor.

2.5.3 Reference to standard specifications

Standard referred to in these specifications are as follows.

a) ASTM refers to the latest edition of publications of American Society for Testing and Materials.

b) ACI refers to the latest edition of publications of American Concrete Institute.

2.5.4 Measurement Standard

Measurement standards referred to in these Specifications, gallons shall be understood to be U.S gallons.

a) Gallons – whenever used in these Specifications, gallons shall be understood to be U.S gallons.

b) Bag- Wherever used in these Specifications, bag will be understood to mean 50 kg bags of Portland cement.

2.5.5 Concrete

The Contractor shall design and test concrete mixes which have a 28 days specified compressive strength of 210kg/sq.cm.

a) At least on month prior to the placement of any concrete, the Contractor shall test cylinders for each trial mix under both field-cured and laborated cured conditions. The test cylinders shall be made and tested in accordance with the applicable standards. Also for every new batch of cement purchased one set of test cylinders shall be taken before two weeks of using that cement.

b) The concrete mixes be of such proportions as to produce a plastic and workable mix which will not separate during placing and will finish sell without using excessive quantities of mixing water.

c) After the test results are known for the test cylinders, the Contractor shall submit test result to Owner/Engineer then Owner/Engineer will notify the Contractor of the acceptable design mixes.

d) When placing concrete in hot weather, the recommendations of the American Concrete Institute's publication "Recommended, Practice for Hot Weather Concreting"(ACI 605) shall be followed in so far and the Owner/Engineer nay direct. The use of set retarders will be at the Owner/Engineer's discretion. For concrete placed during extremely hot weather, the aggregate shall be collected by frequent water spraying in such a manner as to utilize the cooling effect of evaporation. Concrete with a temperature of 30 deg. C high before placement will be rejected and shall be wasted at the Contractor's expense.

2.5.6 Cement

In locations where conditions do not required high sulfate resistance, cement shall conform to the requirements of ASTM C150 type 1.

a) In locations where, in the opinion of the Owner/Engineer, the conditions required the use of high sulfate resistance cement, conforming to the requirements of ASTM C150 type V shall be used without any extra cost to the Owner.

b) The aggregates shall consist of clean, natural materials or, subject to the approval of the Owner/Engineer, manufactured aggregate may be used.

c) Aggregates shall be separated into sand and coarse aggregate before being used. No pit or crusher run materials will be permitted without prior approval of the Owner/Engineer.

d) Natural fine aggregate or sand grading shall be within the following limits and the fitness modules shall be between 2.5 and 2.8.02

Sieve Size	Amount finer than each Laboratory
U.S. Std.	Sieve, Weight Percent
3/8” (9.5mm)	100
# 4 (4.75mm)	95 to 100
# 8 (2.36mm)	80 to 10
# 16 (1.16mm)	50 to 85
# 30 (600micron)	25 to 60
# 50 (300 micron)	10 to 30
# 100 (100 micron)	2 to 10

c) Natural coarse aggregate grading shall be within the following limits, depending upon the nominal size of the coarse aggregate.

U. S Standard Sieve	Nominal 1-1/2”	Nominal ¾” (19mm)
2” (50.8mm)	100	
1-1/2” (25-38mm)	95-100	
1” (25mm)		100
¾” (19mm)	35-70	90-100
3/8” (9.5mm)	10-30	20-55
No. 4 (4.75mm)	0-5	0-10

2.5.7 Slump

All the concrete shall have a maximum slump of 102 mm and minimum slump of 75 mm at the time of placing. The water-cement ratio shall be determined by consideration of the specified strength, the water reducing admixtures, the slump required for proper placement, air entraining requirements, the available and maximum allowable aggregate size and its specific gravity the fitness modulus of the fine aggregate and its specific gravity and the amount of water carried on the aggregates. The slumps and maximum sizes of aggregate as well as the computation of trail mixes shall be as described in the American concrete Institute Recommended Practice of Selecting Proportions for Concrete (ACI 613) The minimum amount of cement per cubic meter of concrete using 8mm aggregate, shall be 6 bags (300kg) for a concrete design strength of 210kg/sq. cm. But if 210 kg/cm^2 strength of 28 days concrete cannot be achieved with this cement content the more cement shall be used for which the Contractor will not get nay extra payment. The proportion of all materials in the concrete shall be subjected to approval by the Owner/Engineer. The Contractor shall provide all plant and equipment necessary to determine and control the actual proportion of materials entering the batch.

a) In calculating the total water in any mix. The amount of water carried on the aggregate shall be included, the water on the aggregate shall be determined periodically by test and the amount of free water on the aggregate subtracted from the water added to the mix. In all cases the amount of water to be used shall be the minimum amount required to produce a plastic mixture of the strength specified and of the required density, uniformity and workability. The consistency of any mix shall be that required for the specific placing conditions and methods of placements.

b) Water used in mixing and curing concrete shall not more than 1,000 parts per million chlorides no more than 1,3000 parts per million sulfates, shall not have a turbidity count greater than 2,000 parts per million and shall also be free of objectionable quantities of oil and organic materials.

2.5.8 Storage of materials

Cement and aggregate shall be stored at the site of the work in such manner as to payment deterioration or instruction of foreign matter. Special care shall be taken in storing cement to keep it thoroughly dry at all times.

a) Cement that has become caked in storage in still usable only if, when pressed between the thumb and fingers, it powders readily. Otherwise, its use will not be permitted.

b) When reinforcing steel is delivered to the job in advance of the Contractor's requirements, the Contractor shall provide suitable protection in order to prevent excessive rust developing on the reinforcing steel. It will be Contractor's responsibility to remove excessive rust.

c) Before starting the foundation construction all screened aggregates and sand shall be collected and stockpiled near site. So that it is free from clay, dust and other foreign materials.


2.5.9 Concrete mixing

Before any concrete mixing is begun all equipment for mixing, transporting and placing the concrete shall be cleaned of all dirt and debris. All dirt and debris shall also be removed from the places to be occupied by the concrete.

a) All mechanical equipment shall be checked before starting a concrete placement to as certain whether or not is in good operation condition and not shall be tuned-up, repaired or replaces to the satisfaction of the Owner/Engineer.

b) When a foundation location is ready for concrete placement, the Contractor shall inform Owner/Engineer at least 24 hrs. before concrete placing time so that Owner/Engineer may inspect to assure that the excavation is free of water, mud any debris : then the bottom surface of the excavation is a well leveled and properly compacted crushes stone sub-base; that the reinforcing steel is properly secured in place; and that the form-work is properly braced.

c) Rock surface shall be as flat as possible and projecting ridges shall be leveled off before the concrete is placed or space between the ridges shall have been filled with concrete to form a horizontal surface.

d) The Contractor shall ensure that all materials that is to be embedded in the concrete has been placed before the concrete is places. The contractor shall be responsible for the accurate location of all embedded materials. Any work in accurately or improperly set shall be relocated and rest reset at the Contractor's expense.

e) All batching components of the concrete shall be accurately measured. Measuring on a weight basis is preferred however measuring on a volume basis will be allowed as long as careful controls are maintained. Weight measurements shall be made using standards batching equipment for large quantities and wheelbarrow scales for small quantities. Volume measurements shall be made in batching boxes. The batching boxes shall be as large as is practical.

f) The batch mixer shall be rotated at a speed recommended by the manufacturer and mixing shall be continued for at least one and one half (1-1/2) minutes after all materials are in the mixes, unless the size of the batch is over 1.2 cu. M. when additional mixing time shall be required as advised by the Owner/Engineer. A mechanically operated batch mixer shall be used for concrete mixing.

g) The retempering of concrete, which has partially hardened, that ism remixing with or without additional cement, aggregate or water, will not be permitted.

h) Concrete shall be conveyed from the mixer to the place of final deposit within 30 minutes by methods which will prevent the segregation or loss of the materials. After 30 minutes of mixing the mixed concrete shall be rejected and replaced by fresh concrete at contractors own expense.

i) Equipments for chuting, pumping and pneumatically conveying concrete shall be of such size and design as to insured a practically continuous flow of concrete at the delivery end without separation of the materials. The chutes shall never be on


a slope that is steeper than two vertical to three horizontal. Conveying equipment shall not any aluminum parts the come in contact with the concrete.

j) When the Concrete is to be placed on hard rock or other concrete, after the existing surface has been properly cleaned and otherwise prepared the existing surface is to be wetted until it is saturated. The first batch of concrete places shall be as required. The grout shall be evenly spread on the water-saturated surface and then normal concrete shall be deposited continuously and as rapidly as practicable.

k) The concreting shall be carried on at such a rate that the concrete is at all times plastic and flows readily into the spaces between the bars and so that each layer properly mixes with its predecessor. Successive layers shall be places within 15 minutes of the proceeding layer.

l) When placing concrete with free drops over 2 meters, sufficient numbers of hoppers and trunk must be provided of a size to allow for proper placing. The trunk sections shall reach within 500mm of the bottom of the placement.

m) The concrete shall be consolidated during and after depositing by vibration, the concrete shall be thoroughly worked around reinforcement and embedded items and into corners of forms.

n) All concrete must be consolidated by means of internal vibration expect where the Owner/Engineer has given written permission to use some other method of consolidation. The type and make of vibrator must have a speed of at least 6000 vibrations per minute (VPM) when the machine is being supplied, furnish efficient transformers, compressors, etc. of approved type to operate all vibrators at the voltage, pressure etc. specified by the manufacture.

o) The Contractor shall always have at least two vibrators in operating condition at the location of the concrete placement.

p) Vibrators shall not be used to transport concrete inside the forms.

2.5.10 The Contractors shall make at least one set of concrete compressive strength test cylinders each day or for each 100 cubic meters of concrete, or as directed by the Owner/Engineer. There shall be three cylinders to a set and the cylinders shall be made in accordance with ASTM C31. Only one cylinder shall be made from any batch containing less than ½ cubic meters of concrete.

a) The Contractors shall delivery cylinders to a location designated by the Owner/Engineer where they will be tested in accordance with ASTM C39. Two of the cylinder will be tested at 28 days. If the 28-days test cylinder shall be discarded. If the 28 days tests indicated a compressive strength of less than 210 kg/sq.cm. the remaining cylinder will be tested at 90 days. The cost of the tests will be borne by the Contractor.

b) If the 90 days compressive strength indicates a compressive strength of less than 210kg/sq.cm. the Owner/Engineer will determine what remedial measures are necessary and the Contractors shall perform the remedial measures at his own expenses. The remedial measurements may include, but are not limited to, the


replacement of the entire foundation, The Contractor shall also pay for any additional concrete tests including core drilling and the repairs or replacements which may result from same, which the Owner/Engineer deems necessary strength.

2.5.11 Concrete formwork

Forms shall be used, wherever necessary to confine the concrete for structures and shape it to the required lines OR to insure contamination of the concrete by materials caving or sloughing from adjacent surfaces lest by excavation.

a) Forms shall be provided with tie rods and clamps to have sufficient strength to withstand the pressure resulting from placement and vibration of the concrete and shall be maintained rigidly in position. Forms shall be sufficiently tight to prevent loss of mortar from the concrete. Molding strips shall be places in the corners of forms so as to produce chamfered edges on permanently exposed concrete surfaces. All exposed surfaces shall be formed with plywood or steel sheathing. Unexposed surfaces may be formed with any materials of adequate strength and tightness to hold the plastic concrete in proper position and prevent the loss of mortar.

b) If plywood or steel forms are not available, the Contractor may substitute wood planking provided exposed surfaces are remove to remove ridges.

c) Before concrete is places, the surfaces of all forms shall be coated with a form oil that effectively prevents sticking and will not stain the concrete surfaces. For steel forms, form oil shall consist of refined mineral oil. For steel forms, form oil consist or refined mineral oil. For steel forms, from oil shall consist of refined mineral oil compound.

d) Forms shall be removed only after 48 hours of concreting or when the strength of the concrete is such that form removal will not result in cracking, spalling, or breaking of edges of surfaces, or other damage to the concrete. Any concrete damages by forms shall be repaired immediately.

2.5.12 Concrete finishing and curing

a) The expose top surface of all concrete foundation piers shall be wood floated and steel troweled and shall be slightly sloped to prevent the accumulation of water.

b) Immediately after the removal of forms, the holes left by form tie rod fastener shall be filled with mortar and all damaged or defective concrete shall be repaired or removed and replaced to the satisfaction of the Owner/Engineer. Improperly consolidated concrete shall be removed by chipping and the clipped openings or recesses shall be of such depth and shape are required to insure that the patching materials placed in the openings or recesses will be thoroughly keyed and bonded to the concrete. “dry pack” mortar shall be used for filling relatively deep chipped recesses with small surface dimensions. Concrete will be required for the replacement of defective concrete where surface dimension of the shipped openings or recesses are relatively large. The depth of chipped recesses for concrete patches shall extend at least 25 mm beyond the nearest reinforcing steel.


c) To insure proper curing, all concrete shall be kept moist for a period of least ten (10) days. Burlap or/and equivalent materials or a curing compound shall be applied over exposed concrete surfaces, the burlap shall be kept moist at all times.

2.5.13 Membrane curing compound

Membrane curing compound shall be applied uniformly by spray, leaving no pinholes or gaps, at a rate not to exceed 4.91 square meters per liter. The curing compound shall be applied after finishing operations are completed and surface moisture has disappeared. If forms are removed prior to 7 days placing the concrete, the uncovered surfaces shall be coated with the curing compound as specified herein.

a) Foundations shall not be backfilled before they have been inspected by Owner/Engineer to see that they are free from surface defects and voids, or that the defects and voids have been properly repaired,

b) The foundations shall not be subjected to any loads in addition to those existing at the time of placing of the foundation concrete until the curing period has elapsed.

2.5.14 Payment

No separate or direct payment will be made to the Contractor for concrete. All costs incurred in connection therewith shall be included in the lump sum bid price for the construction of the various foundation types and trenches.

2.5.15 Torsteel reinforcing bar

All torsteel reinforcing bar shall conform to the requirement of BS 1144 or equivalent and shall fabricated in accordance with the “Manual of Standard Practice” of the concrete Reinforcing Steel Institute.

a) Mill scale rust, oil and mud shall be removed from reinforcing steel by firm rubbing with burlap or equivalent treatment before the reinforcing steel is placed.

b) The minimum center-to-center distance between parallel bars shall be two and one-half (2-1/2) times the diameter of the bars. In no case shall be clear spacing between bars be less than 25 mm not less than one -one third (1-1/3) times the nominal maximum size of coarse aggregate.

c) All reinforcing steel shall have a protective concrete cover of not less than:

1) 80mm - on the bottom of footing and on any surface of concrete that will be exposed to salt water.

2) 50mm - concrete exposed to weather or ground

d) Reinforcing steel hall be accurately located and shall be secured in position by the use of annealed iron, no less than No. 16 gauge and shall be supported in a


manner that will keep the reinforcement away from the exposed concrete surfaces. Concrete blocks shall be used to support the reinforcing steel in the foundation mat: broken stones or wooden blocks shall not be used to supporting the reinforcing steel.

No separate or direct payment will be made to the Contractor for concrete Reinforcement Steel. All costs incurred in connection therewith shall be included in the lump sum bid price for the construction of the various foundation types.

2.5.16 Grouting

Grouting for seating structural steel members and equipment on foundations shall be non-shrink (not-setting) Portland cement mortal grout or a suitable commercially available grout, at the Contractor's option. Grouting shall be done under pressure by means of an expanding agent or by means of static head. Propositioning and missing of grout shall conform to the following:

a) Mortal grout containing aluminum powder as an expansive agent mixture of 1 part cement and 2 parts sand, by weight, with a water cement ratio not exceeding 0.55, the quantity of aluminum powder used shall be approximately 0.005 percent of the weight of cement, the actual quantity to be determined from tests with materials to be used, and at the temperature and under the conditions of a placement. Aluminum powder shall be blended with cement in proportions of one part powder 10-50 parts cement, by weight and the blend shall be sprinkled over the dry batch. After all ingredients are added, the batch shall be missed 3 minutes. Grout, which has not been placed within 45 minutes, shall be wasted.

b) In lieu of use of an expensive agent. Settlement shall be reduced by extending the missing period or by delaying final mixture to minimize the interval between time to placement and initial set and placement the under static header pressure. The motor grout shall be mixture of one part cement and 2.5 parts sand, with a water cement ratio of approximately 0.50, slump shall be the minimum necessary to enable placement.

No separate or direct payment will be made to the Contractor for Grouting. All costs incurred in connection therewith shall be included in the lump sum bid price for the construction of the various foundation types.

2.5.17 Payment

Payment for the contract item, Concrete foundation, will be made at the unit price per foundation type bid in the Schedule, which unit price shall include full compensation for all costs incurred in furnishing all materials, equipment and labor and all costs incurred in furnishing all materials, equipment and labor and all other operations related to concrete Foundation design and construction, including but not limited to:

a) Performing detail foundation design and preparation of construction drawings including bar-bending schedule.


b) Supplying and transporting

c) Excavation, dewatering, providing 10cm thick soiling layer as under Article 2.4.6 of this section, providing 5cm thick (1:3:6) lean concrete layer and back filling for the foundations.

d) Constructing the foundation including form work setting, reinforcement bar cutting bending and fixing.

e) Grouting for base plates

f) Concrete testing

3. BUILDING WORKS

3.1 General

This specification is intended to cover the complete provision and erection of control building and furnishing if the indoor facilities for the project including all design, supervision, materials, equipment, labor and services necessary for or incidental to the construction of control building.

3.2 Scope of work

3.2.1 The Contractor shall perform the design, construction works, furnishing and delivering of the equipment, materials and all accessories for the control building as listed below:

a) Excavation and Backfilling

b) Concrete Work

c) Flooring

d) Stone Masonry work

e) Plaster and Punning Work

f) Glass and Glazing

g) Doors and Windows with iron grills

h) Water Proofing

i) Painting

j) Plumbing, Drainage and Sanitary fitting

k) Cable Trench

l) Ventilation and Fan

m) Fire fighting

n) Ileat Insulation

3.2.2 All the works for the control building shall be subject to approval of Owner/Engineer. Owner /Engineer shall have the right to required the Contractor to make any changes on designs, construction works, materials and equipment to make the structures conform to the specification without and additional cost.

3.2.3 The Contractor shall prepare the design drawings including all facilities based on the attached conceptual drawings and submit the design drawings to Owner/Engineer for approval.

3.2.4 Bearing Loads

The Contractor shall used an allowable soil bearing pressure of 1.0kg/cm2 for the design of foundation for bidding purpose. But this is only reference value. After award of contract, the Contract shall carry out details soil test and detail design of foundation shall based on the soil test result. There may be variation in the volume of work in final design compared to the bidding for which the contractor will not get any extra payment.

3.2.5 The design live load for all floor slab not be less than 600/kg/m2 and 100kg/m2 for roof slab.

3.3 Codes and standards

The latest editions of Codes, Specification and Standards listed below, but referred to thereafter by basis designation only from a part of this Specification to the extent indicated by the references thereof.

In the event of conflicts or discrepancies between this specification and the referenced codes, Specification or Standards, the more stringent applicable requirement shall govern.

a) American National Standard Institute (ANSI) Standards

b) American Society for Testing and Materials (ASTM) Standards

c) American Concrete Institute

d) Concrete Reinforcing Steel Institute

e) National Fire Protection Association (NFPA) Publications

f) Federal Specification

g) Flat Glass Marketing Association (FGMA) Publication

It is the intent of this specification to establish acceptable standards or quality and performance. Minor deviations in details due to manufacturer's standards shop process will be considered for acceptance provided that, in the opinion of the Owner/Engineer, the proposed substitutions are equal in quality and performance to the specified materials. All deviations shall be called out in writing in the proposal and shall be specially indicated on the shop drawings. The Contractor will not get any extra payment for increase/decrease of work volume due to such deviations.

3.4 Excavation and Backfilling

The detail Specification for the excavation and backfilling work shall be as per Article 2.4 of Section VI.

3.5 Concrete Work

The detail Specification for the concrete work shall be as per Article 2.5 of Section VI.

Concreting in control building shall be done in foundation, tie beams, floor slab, steps, column, beam and roof slab as per approved drawings.

3.6 Flooring

3.6.1 Scope of Work

Perform all flooring work required as per drawings and as specified herein.

3.6.2 Reference

All work and materials shall be in accordance with American Standards, ASTM, or equivalent.

3.6.3 Materials

a) Sand shall be coarse, clean sharp sand, free from clay, loan or other impurities. Sand shall be uniformly graded from coarse to fine and shall conform ASTM or equivalent.

b) Portland Cement

Portland cement shall be as per STM (150 TYPE) or equivalent. Only one brand of cement shall be used in the work.

c) Gravel

Gravel shall be well graded hard, fresh and conform to ASTM or equivalent.

d) Water

Water shall be clean fresh and free from injurious amount of oils, acids, alkalies and organic matter.

3.6.4 Construction

a) Preparation of earth

The earth is properly rammed and leveled by rammer, before gravel soiling water is sprinkled during ramming

b) Gravel Soiling

Above the rammed earth well graded gravel is layed and coarse sand is spreaded over the gravel bed. Water is sprinkled and compaction is done properly. The top surface is properly leveled and compacted before concrete laying.

c) Concrete laying

Concrete work shall be one as specified under article 2.6 in Section VII.

The flooring shall consist of (for each square meter)

- Concrete mix: 300kg/m3 thickness 0.15m with 2% water proofing compound.
- Steel bar 8kg
- Graveled layer 0.1 thick

3.6.5 Tiles

Terrazo tiles shall be installed in control room, 11kV switchgear room, toilet and battery room. Terrazo tiles shall be precast tiles with an average weight of 5.6 kg. The tiles shall be 30 cm x 30 cm and wall base units of grade 1 according to American Standard or equivalent.

High-density ceramic tiles shall be placed on the walls of battery room and bathroom upto a height of 1.75 m from the floor.

3.7 Stone Masonry Work

3.7.1 Materials

a) Stone units shall be sound, free from defects that would impair its strength or affects its service ability.

b) Cement shall be ordinary Portland as per ASTM C150 Type 1 or equivalent.

c) Sand shall be clean, fine, sharp gramules, free from foreign or deleterious matter.

d) Water shall be clean and free from acid, alkalis, oil or organic matter.

The Contractor should submit samples or cement sand and lime for Owner/Engineers approval.

3.7.2 Mortar Mixture

The type of mortar mixture for stone masonry shall be 1 part, P.C : 5 part sand

3.7.3 Stone masonry laying

a) Lay stone masonry in accurately spaced courses, level, plumb and true to line.

b) Soak stone units in clean water for one hour before laying. Units shall be damped when laid.

c) Lay stone in running bond with joints approximately 10mm wide.

d) When stone masonry wall cross the recessed floor cable trenches provide and install cast-in-situ concrete Lintels of sufficient size and strength to support and carry masonry walls across the trench sprays.

e) Reinforced all masonry walls with cast-in-situ reinforced concrete formed flush with the masonry surfaces for cement plaster-finish.


f) Provide concrete pilasters and horizontal tie for every 9 square meters of masonry wall surface, plus at all corners and door jambs.

g) Size of wall

1) All the peripheric wall shall be constructed in 360 mm thickness.

2) All the partition wall shall be constructed in 240mm and 110mm thickness. But the latter one shall be constructed at less than 3.0m span only.

3.7.4 Curing

Spray masonry surfaces with water twice daily for a period 10 days, or until the surface receives a plaster finish.

3.7.5 Protection

Where exposed to weather, protect top of masonry with water tied materials in such a way that it will protect the completed work. Masonry wall shall set for 48 hours before any load is applied on the completed work.

3.8 Plaster and Punning Work

Plaster

3.8.1.1 Materials

Shall conform to the respective Specifications and other requirements specified below:

a) Sand:

Sand shall be coarse, clean sharp sand, free from clay, loam or other impurities. Sand shall be uniformly graded from coarse to fine.

b) Protland Cement

Portland cement shall be as per ASTM C 150 Type 1 or equivalent. Only one brand of cement shall be used in the work.

c) Water shall be clean, fresh and free from injurious amount of oils, acids, alkalies and organic matter.

3.8.1.2 Construction

a) Thickness of plaster

Thickness of plaster from the face of the plaster base to the finish plaster surface shall be 2.0 cm.

b) Preparation of plastering

Concrete surfaces shall be thoroughly cleaned and free of paint, efflorescence, oil, grease, acids, and other loose or foreign matter prior to application of base coats.

No plaster work shall be applied on masonry work less than 2 weeks old.

c) Mixing of plaster

Plaster shall be mixed in mechanical mixers where hand mixing is approved for small quantities. Caked, or lamped materials shall not be used. Each batch shall be proportioned by volume, accurately measured by manual or mechanical devices, and thoroughly mixed with the minimum amount of water unit uniform in color and consistency. Retermpering will not be permitted and plaster that has begun to stiffen shall be discarded. Mortal 90 minutes after mixing shall be rejected for the plastering work.

d) Proportions

These are to differenced into 2 TYPES:

1) 1PC: 3 SAND

2) 1 PC: 4 Sand

Type (1) is to be used on all external walls, ceiling and floors.

Type (2) is to be used everywhere else.

All concrete works and inside and outside walls shall be plastered.

e) Plastering

Plaster shall be done in two coating, both shall be proportioned as mentioned in (Article D) above but sand to be used in the finish coating shall be of the finest grade.

The first coating shall be applied with a spatter-dash, which is to be done by forcibly throwing the wet mix on the surface and making no attempt to level it.

The second coating will be applied after the first coating has hardened.

After this, a wet soaked sponge shall be rubbed on the finish surface.

3.9 Door and Window

3.9.1 The contractor shall furnished and install doors and windows. The Contractor shall prepare and submit drawings of doors and windows to Owner/Engineer for approval, prior to the execution of the erection work floor level.

Wooden doors and Windows

Timber shall be the sal wood. The timber shall be of the best quantity well seasoned and free from sap, knots, wraps, cracks and other defects. All wood work shall be planes and neatly and truly finished to the exact dimensions. All joints shall be neat and strong truly and accurately fitted and glued before being fitted together.

3.9.2 Carpentry

3.9.2.1 Materials

Lumber shall be subjected to Owner's/Engineer's approval

a) Salwood

1) Sized and Pattern

Lumber shall be surfaced four sides, and worked according to patterns as are indicated or specified on the drawings. Expose members for transparent finish shall be attached for compatibility of grain and color between adjoining members; for paint finish, is not required. The size of frame of panel shall not be less than 40mm x 100mm and the size of frame of shall not be less than 75mm x 120 mm unless mentioned specifically otherwise.

2) Moisture Content

At the time of delivery, the moisture content shall not be exceed 15% for material of 2.5 cm or less in thickness, and shall not exceed 19% for material over 2.5 cm in thickness.

b) Teak Plywood

All interior plywood for transparent finish shall be of equal and uniform of color and graining, such as for door panels. Hardwood plywood shall be of premium grade. Plywood for paint finish matching for compatibility is not required

c) Veneers

Veneers on wood doors, panels and other exposed wood work shall be 4 mm thick.

d) Fasteners

Only galvanized fasteners will be used.

e) Glue

Fully waterproof throughout, such as “herein” or equal.

f) Putty

Shall conform to American Standards or equivalent.

3.9.2.2 Construction

a) Fastening for exposed members

Other than two positioning nails per sub-assembly of plywood no exposed nails shall be used. All exposed members are to glued using either pressure of electric wood welder. All traces of access glue shall be removed. Top shall be fastened to sub-or web frames with concealed clips, screws, glue blocks or similar bidden fastenings. Exposed ends shall be lock mitered and glued to face plates.

b) Edge Treatment

Visible edge shall be banded with lumber edging, glued under [pressure with no nails allowed. Species shall match the face veneers of plywood, but may be of any species on particleboard.

c) Size of door

Unless and otherwise specified, the size of door panel shall not be less than 1.0 x 2.30m (w x h).

3.9.2.3 Hardware

Hardware’s such as hinges, cylinder locks, handles and door closers shall be stainless steel of excellent quality. Samples of hardware’s shall be submitted to Owner/Engineer for approval. Cylinder locks and door closers shall be installed with the doors and windows according to the instructions of Owner/Engineer. Master key for all locks shall be provided.

3.10 Water Proofing

This section covers all the construction work for disposing the rain water from the roof. To dispose rain water from roof there will be 10cm average thickness of 1:2:5 concrete for the slope of roof. A layer of tarflet shall be provided as vapor barrier course between RCC slab and slop concrete. At top of slope concrete (After hear insulation layer) the waterproofing layer shall be self-adhesive bitumen/polyethylene (tarfelt) membrane of thickness about 1.5-2.0 mm capable of bridging any shrinkage cracks in concrete.

The area to be applied must be dry and swept free from dust.

Prime all surfaces with primer and apply the membrane when the primer is tacky. All lap joints must have an overlap of 75mm rolled firmly against each other. The membrane has to turn up to the roof parapet, counter flashed by a metal sheet all in accordance to drawings and manufactures instructions.

The type and made of the membrane must first be submitted for approval by the Owner/Engineer.

a) A layer of 30mm round stone chipping of 2-5 mm size shall be provided with bituminous bonding, to achieve water proofing.

b) 100mm dia. G.I rain water down spout pipe shall be installed at least 4 corners of roof and it shall be connected to the manhole (40 x 40 x 60 cm) at bottom, from each of the manhole 100 mm. of polyethylene pipe shall be used to connect to the switchyard drainage line.

3.11 Heat Insulation

The section covers the treatment of heat insulation at roof.

Heat insulation layer shall be 33 mm thick expanded polystyrene sheets which shall be installed above slop concrete layer with hot bitumen setting bed.

3.12 Plumbing, Drainage and Sanitary Fittings

3.12.1 General

The Contractors shall furnish, install and test the complete indoor Potable Water service Water , Plumbing, Storm Drainage and Sanitary Sewer Systems. The pipe line outside the Owner’s premises shall be the responsibility of the Owner.

All necessary incidentals such as sanitary fittings, wash bowl water closet, equipment supports, flushing system, excavation and backfill, the Contractor shall supply disposal of surplus dirt and rubbish.

The Contractor shall furnish satisfactory functioning installations. All items of labor, material or equipment not pacifically mentioned herein, but incidental to required for a complete installation and proper operation of the above mentioned systems, shall be included.

The Contractor shall furnish and install 1.0 cubic meter capacity PVC water tank on roof and suitable pump to pump the water from an under ground water storage tank comprising of a similar 2 cu.m PVC tank to be installed underground by the Contractor.

3.12.2 Standards

The work shall be carried out in accordance with Codes National Plumbing code. S. U. Department of commerce, unless otherwise indicated.

3.12.3 Workmanship

The installation shall be made in neat, orderly and workmanship manner, conforming in every way to the accepted standards of the best commercial practice.

3.12.4 Design Requirements

The plumbing and drainage of all the buildings shall be as per the National Standard Plumbing code.

For the potable and service water supply to the building and over storage tank of 1 cubic m storage capacity will have to be provided by the Contractor. The tank will be mounted on the roof. The water distribution inside the building will be taken from this overhead tank.

The design of the plumbing system shall be developed by the Contractor. Floor drains, drain form washbasin and drain from the equipment shall be run separately from sanitary sewer and connected to the outdoor switchyard water drainage system.

Sanitary sewer drain from the building will be connected to the septic tank (1.0m x 2.5m x 1.5m) and out let from septic tank connected to the soak pit (1.0 m dia. And 3.0m deep). Overflow from the soak pit shall be connected to the switchyard drainage system.

a) Septic tank shall be constructed in double compartment in 240 mm thick stone masonry wall with 1:4 cement concrete 1:2:4 in 20mm thickness. The septic tank shall be provided with removable RCC slab cover.

b) Soak pit shall be constructed in honey-combed stone wall of 240 mm thick with 1:4 cement sand mortar.

c) Sewage pipe shall be heavy quality cast iron and not less than 100 mm dia. In size.

d) Drain pipe to connect drainage system form soak pit shall be used of 100mm dia. Of polyethylene pipe of heavy quality.

e) All the water supply pipe shall be heavy quality of galvanized steel pipe required size.

3.13 Cable Trench

3.13.1 The details design of the cable trench shall be responsibility of the Contractor. All designs and details shall be subjected to approval of the Owner/Engineer.

3.13.2 Type of Cable Trench

3.13.3 Type of cable trench

Cable trench shall be reinforced concrete trench with one or more layer of hot dip galvanized light gauge shape steel tray. The cover of trench shall be min. 6mm thick checkered plate with steel frame and shall be galvanized.

3.14 Paint

3.14.1 General

All surfaces shall be painted except the following:

a) Exterior

Roofing, paving, concrete, nonferrous metals, glass, pre –finished items.

b) Interior:

Glass, ore-finished surface, nonferrous metals, stainless steel, attic surfaces.

3.14.2 Materials

A list of the painting materials and their color which are to applied the specified surfaces shall be submitted to the Owner/Engineer for approval.

3.14.3 Paint Application

The finished surface shall be free form runs, drops, ridges, waves, pales, brush marks, and variations in color, texture and finish. The hiding shall be complete and coat shall be so applied as to produce film of uniform thickness. Special attention shall be given to insure that all surfaces including edges, corners, crevices, wells and rivets receive a film thickness equivalent to that of adjacent painted surfaces.

Adjacent areas and installations shall be protected by the use of drops cloths or other approved precautionary measures.

Metal or wood surface adjacent to surface to receive water-thinned paints shall be primed and/or touched up prior to the application of water-thinned paints. The first coat on plaster shall include such repeated touching up of suction spots or overall applications of primer sealer as necessary to produce a uniform color and gloss. The first coat on both faces of wood doors shall be applied at essentially the same time.

a) Coating Progress

Sufficient time shall elapse between successive coats to permit proper drying. This period shall be modified as necessary to suit adverse weather conditions.

Oil base or olcoresinous solvent type paints shall be considered dry for recoating when the paints feels firm, does not deform or feel sticky under moderate pressure of the thumb, and the application of another coat of paint does not cause lifting or less of adhesion of the undercoat.


Coating shall be as follows:

1) All interior and exterior plastered surfaces:

- First coat: 1 coat of Alkali Resistance Primer
- Second Coat: 2 coat of weather shield Exterior wall finish in water [roof snowcem paint.

2) Gloss finish work:

- First Coat: 1 coat of Wood Primer
- Second coat: 2 coat of synthetic super gloss

3) Interior transparent finish wood:

- First Coat: 1 coat of Wood Primer
- Second coat: 2 coat of Teal oil.

4) Metal surface:

- First Coat: 1 coat of Metal Primer Chromate
- Second coat: 2 coats of Aluminum Paint

b) Storage, mining and thinning

At time of application, paint shall show no signs of hard setting, excessive skinning, levering or other deterioration. Paint shall be thoroughly stirred, strained and kept at a uniform consistency during applications.

Where necessary to suit conditions of surface, temperature weather, and method of application, package pint may be thinned immediately prior to application in accordance with the manufacture's directions, but not excess of 0.5 liter of suitable thinner per 4 liter. The use of thinner for any reason shall not relieve Contractor from obtaining complete hiding.

Samples shall be clearly identified by designated name, specification number batch number, project contract number, intended use, and quantity involved. At the discretion of the Owner/Engineer samples may be tested before approval, or materials may be approved for use based on the test reports furnished. In the later case the samples will be retained by the Owner/Engineer for possible future testing should the materials appear to be defective during or after application.

3.15 Glass and Glazing

a) Sheet glass to be used for door and windows shall be 6 mm thick, tinted glass except as otherwise specified. It shall be of the best quality, free of unevenness, stain or bubbles, and materials appear to be defective during or after application.

b) Glazing compounds shall be of suitable type approved for the application.

The use of no-skimming compounds, non-resilient type of performed sealers, and performed impregnated type gasket will not be permitted. Metals sash putty will not be permitted.

c) Channel glazing compound shall be equal in performance to, but nor limited to the following.

1) Non-drying, knife grade polybutene sealant.

d) One-part acrylic terpolymer sealant.

e) Shop painted items

Surfaces of fabricated and assembled items that are finish painted by the manufacture or specified to finish painted under other sections of the Specification are exempted from the following schedule requirements for surface preparation and painting shop primed items shall receive surface preparation and finish painting as required by the section.

f) Colors and tints, including shades of stain, shall match the respective color specimens selected by the Owner/Engineer.

Stains shall conform in shade to manufactures standard color. Undercoat shall vary slightly form the color of the next coat.

g) Surface preparation and pretreatment

Cleaning and pretreatment of surface prior to painting shall be accomplished in accordance with the detailed requirements specified.

h) Cleaning

Clots and cotton waste that might constitute of fire hazard shall be placed in closed metal containers or destroyed at the end of each day. Upon completion of the work, staging, scaffolding and containers shall be removed from the site or destroyed in as approved manner.

3.16 Ventilation and Fans

Rooms shall be provided with ceiling fans and suitable exhaust fans shall be installed din the battery room and toilet.

3.17 Fire Fighting System


3.17.1 The Contractor shall supply and install all fire fighting system for control building and switchyard.

3.17.2 The contractor shall supply two sets of portable type of 10 1b CO2 fire extinguishers for control rooms/switchgear room and one (1) set of wheeled cart type shall be provided with the fire extinguisher. The extinguisher shall be especially suitable to rooms with electrical equipment.

3.18 Electrification work

3.18.1 Supply and fixing of all electrical work shall be performed in accordance to the Clause-13 Lighting System in Vol-II –Section I Specification of Electrical Equipment.

3.18.2 Payment

Payment for the contract item: Electrification work will be made at the lump sum price bid. Therefore, in the schedule, the price shall include compensation for all costs incurred in furnishing all materials and labor and other operations related to electrification work.

3.19 Supply and installation of furniture and indoor facilities

3.19.2 Furniture and indoor facilities as listed below shall be supplied under the item “Supply and installation of furniture and indoor facilities as per specification”. Payment for this item shall be in lump sum basis (in lot).

3.20 Payment

The payment to the Control Building shall be made per unit basis as per the Price Schedule.

INSPECTION, TESTING AND COMMISSIONING

1.1 SCOPE OF WORK

The whole of the Works supplied under the Contract shall be subject to inspections and tests by the Employer or their Representatives during manufacture, erection and after completion. The inspections and tests shall include, but not be limited to, the requirements of this section of the Specifications.

The Contractor shall provide all costs, appliances, apparatus, supervision, labor and services necessary to carry out all tests, unless specifically stated otherwise.

The Contractor shall furnish the detailed schedule of his commissioning plan at least one month prior to the scheduled date. The schedule shall include the commissioning procedures, testing sequences and details of special testing equipment, tests and commissioning record formats, information about relevant standards etc.

The scope of the commissioning program includes the site testing and putting into successful operation of all the equipment supplied under the Contract, for 33kV, 11kV, AC & DC plants and all secondary voltages systems. Testing of energy meters and certification of their accuracy shall also be included.

1.2 OBJECTIVES

The objectives of commissioning work, prior to the successful energization of Plant at full voltage and connection to the system, are the following:

- Confirm the integrity (correctness) of installation.
- Confirm the integrity of insulation, connections and phasing.
- Ensure proof of equipment characteristics.
- Review workmanship.
- Confirm the correct implementation of the design.
- Check equipment ratings.
- Check settings and operation of protective relays.
- Check and measure resistivity of earthing grid and earthing system.
- Confirm the proper functioning of SCADA system.

1.3 QUALITY ASSURANCE, INSPECTION AND TESTING

To assure that the supply and services under the scope of this Contract whether manufactured or performed within the Contractor's works or at his subcontractor's premises or at the Site or at any other place of work, are in accordance with the Specifications, the Contractor shall adopt suitable quality assurance program to control such activities at all points necessary. Such program shall be outlined by the Contractor and shall be finally accepted by the Employer after discussions before the award of the Contract. A quality assurance program of the Contractor shall generally cover, but not be limited to the following:


(a) His organization structure for the management and implementation of the proposed quality assurance program.
(b) Documentation control system.

(c) Qualification data for bidder's key personnel.

(d) The procedure for purchases of materials, parts, components, and selection of sub-contractors' services including vendor analysis, source inspection, incoming raw materials inspection, and verification of materials purchases.

(e) System for shop manufacturing including process controls and fabrication and assembly controls.

(f) Control of non-conforming items and system for corrective actions.
(g) Control of calibration and testing of measuring and testing equipment.
(h) Inspection and test procedure for manufacture.
(i) System for indication and appraisal of inspection status.
(j) System for quality audits.
(k) System for authorizing release of manufactured products to the Employer.
(l) System for maintenance of records.
(m) System for handling storage and delivery.
(n) A quality plan detailing out the specific quality control procedure adopting for controlling the quality characteristics relevant to each item of supply.

The quality plan shall be mutually discussed and approved by the Employer after incorporating necessary corrections by the Contractor as may be required.

- Quality Assurance Documents

The Contractor shall be required to submit all the Quality Assurance Documents as stipulated in the Quality Plan at the time of Employer's inspection of material/equipment.

The Employer, through his duly authorized representatives, reserves the right to carry out Quality Audit and Quality Surveillance of the systems and the procedures of the Contractor's and the subcontractor's Quality Management and Control Activities.

- Inspection, Testing and Inspection Certificates

The Employer shall have the right to re-inspect at his expenses, any material though it would have been previously inspected and approved by him at the Contractor's works before, and if, after the same are inspected at Site following the latter, material is found defective, then the Contractor shall bear the cost of this inspection and reinstatement according to specification.

1.4 TESTS AT MANUFACTURERS WORKS

1.4.1 General

Where no specific test is specified, then the various items of materials and equipment shall be tested in accordance with the relevant British, IEC, or American Standards. Where no


appropriate standard is available, tests shall be carried out in accordance with the maker's standard practice, which shall be subject to the Employer's approval.

At least fourteen days' prior notice, in writing or by tele-fax, shall be given to the Employer of the readiness of the plant for test or inspection and every facility shall be provided by the Contractor and sub-Contractor (s) to enable the Employer or their Representative to carry out the inspections and witness the tests. This includes progress, test rig and packing inspections also.

Inspection of equipment will not be carried out unless the Employer has approved copies of the relevant sub-orders, drawings and test procedures. No equipment shall be packed, prepared for shipment, or dismantled for the purpose of packing for shipment, unless it has been satisfactorily inspected, or inspection has been waived by the Employer.

Functional electrical and mechanical tests shall be carried out on the completed plant after assembly in the Works. The extent and method of recording the results shall be agreed by the Employer in sufficient time to enable the tests to be satisfactorily witnessed or to make any changes to the proposed program of tests. All instruments and apparatus used in the performance of the tests shall be subject to the approval of the Employer and, if required by the Employer, shall be calibrated to an agreed standard at a laboratory of national standing to be nominated by the Contractor and approved by the Employer. The costs of carrying out such calibration shall be borne by the Contractor in all cases.

The costs of making/performing any test shall be borne by the Contractor. This shall apply to tests performed at the site or elsewhere.
After receiving the prior information about the completion of manufacturing at the factory, the Employer will depute his personnel to the Contractor's factory to witness the fabrication, assembly and testing of any or all parts of major equipment. The number of the Employer's personnel and equipment to be witnessed will be as listed below. The duration of such visits shall be as per inspection/testing requirements.

12 kV Switchgear	1 persons, 1 visit
33 kV Circuit Breaker	1 person, 1 visit
33 kV Control & Relay Panel	1 persons, 1 visit
Disconnecting Switch & LA	1 persons, 1 visit
Instrument Transformers	1 persons, 1 visit
Battery & battery Charger	1 persons, 1 visit

1.4.2 Test Certificates

Within30 days of the completion of any test, triplicate sets of all principal test records, test certificates and performance curves shall be supplied to the Employer.


These test records, certificates and performance curves shall be supplied for all tests, whether or not they have been witnessed by the Employer or his representative. The information given on such test certificates and curves shall be sufficient to identify the material or equipment to which the certificate refers and should also bear the Contract reference title. Specified requirements shall be shown on each certificate for comparison with actual test results.

When all equipment has been tested, test certificates of all factory and site tests shall be compiled by the Contractor into volumes and bound in an approved form complete with index. Two copies of each volume shall be supplied to the Consultant and five copies to the Employer.

1.4.3 Type Tests

Type tests are required to prove the general design of the equipment and the Contractor may submit certificates of such design tests, which have been carried out on identical equipment. Notwithstanding any provision in BS, IEC or ANSI Standards, the Employer shall have the right to accept such certificates in lieu of the specified type tests or to reject them.

The type tests prescribed shall be carried out at the Contractor's cost in all cases, where either such certificates are not available or are rejected by the Employer.

1.5 RESPONSIBILITIES

To ensure that the test jurisdiction and transfer of responsibilities is regulated by strict safety and handover procedures, the Contractor agrees the interface with the Employer to establish and implement handover procedures consistent with the terms of these Specifications.

The Employer shall retain full jurisdiction over all commissioning activities, which may affect the operation of the existing system. In these circumstances and when so requested, shall provide technical advices and assistances.

The Contractor shall be responsible for technical guidance and assistance in establishing the scope and method of tests, witnessing of the testing, assessment of results, and re-negotiation of the changes in test schedules which may be necessary as a result of other circumstances, such as delays in the delivery, possible equipment failures.

1.6 SAFETY PROCEDURES

The Contractor shall share the responsibility for safety procedures with the Employer. The Contractor shall establish and implement a work permit and tagging system and associated safety procedures (subject to the review of Employer) for all equipment, systems and areas not covered by the Employer’s safety procedures.

The Employer will assume responsibility for the establishment and implementation of tagging, safety and work permit procedures for the protection of personnel and equipment, as soon as equipment and systems are connected to or are energizeable from the existing system.


1.7 TRAINING OF THE EMPLOYER'S STAFF

The Contractor shall plan for the Employer's staffs' participation, either continuously or on a regularly recurring basis, in the commissioning work and:

Allow the Employer's staffs to become familiar with the operating and maintenance aspects of the new equipment supplied by him,

Maintain a continuing assessment with the Employer of the precautions required in or possible consequences of, initial energization of equipment, Allow for the above two necessary objectives in the preparation of schedules.

The Contractor shall station at site, at least, one technical expert for a minimum of six months continuously after commissioning to rectify any problems, as well as train the Employer's attending staffs. If required, the length of his stay shall be extended as per requirement, which shall be at the Employer's discretion.

1.8 COMMISSIONING STAFF

The Contractor shall provide commissioning personnel including skilled and unskilled labor as required. Submit a list with names, experience and proposed duration of the stay of key personnel on site, consistent with the construction schedule, along with the commissioning program.

Ensure that only staffs assigned to commissioning fulfills that duty for the duration of the assignment.

Ensure that commissioning staffs have authorization, and the competence, to undertake minor repairs or to make temporary redesigns and to reconnect systems to meet the specified system performance to preclude delays in energization and putting into commercial service of any part of the works.

1.9 TEST EQUIPMENT

The Contractor shall ensure that all instruments, tools and other equipment required for testing and commissioning are available on site, ensure that the test equipment is of satisfactory quality and condition and, where necessary, is calibrated by an approved authority or standard.

Make arrangements for the provision of power supplies for testing with necessary vector configuration, voltage and current rating.

1.10 COMMISSIONING PROGRAM

Prepare a commissioning program for approval by the Employer and for incorporation into the Project master construction program. Allocate adequate time in this program to permit full commissioning of all components.

Carry out all testing during normal working hours as far as practicable. Tests, which involve existing apparatus and system outages, may be carried out outside normal working hours. Give the Employer sufficient notice to allow for the necessary outage arrangements to be made in conformity with the testing program.

Note that no tests listed in the agreed program will be waived except upon the instructions or consent of the Employer in writing.

1.10.1 Test Procedures

The following basic tests, in addition to others, shall be carried out:

- Measurement of insulation resistance.
- AC withstand voltage test

1.10.2 Requirements for Field Tests

The field tests shall be carried out in presence of Employer under the following conditions:

AC withstand test voltages for conductors and outdoor equipment shall be normal operation voltage of the transmission line and, withstand voltage test shall be carried out for ten (10) minutes by the normal voltage mentioned above. The field tests shall be carried out by the Contractor after adjustment of all the equipment have been completed.

Expandable and lead wires and other materials required for the field tests shall be arranged by the Contractor. The Contractor shall be responsible for providing all measuring instruments, test equipment and tools required for the tests.

Preparation of the test record sheets and test reports shall be the responsibility of the Contractor and the results of the field tests shall be submitted by the Contractor for Employer’s approval.

Measurement of insulation resistance of the equipment shall be performed by at least 1000 V meggar.

After completion of the measurement of insulation resistance mentioned above, ac withstand voltage test shall be performed by the normal operation voltage of the existing power system in accordance with the following procedure:

- 11 and 33 kV Main Circuit: The 11 kV and 33 kV circuit breakers and disconnecting switches, except for circuit breakers receiving power for the test from the existing power system through a transmission line, shall be closed, succeeding, normal operation voltage shall be charged on the equipment and bus conductors for ten (10) minutes for ac withstand voltage test. The indication value of meters mounted on the board during the ac withstand voltage test shall be recorded on the test record sheets prepared by the Contractor.


Submit test procedures, consisting of detailed test methods and samples of the related test record forms, for all equipment to be tested, to the Employer for approval along with the commissioning program. Strictly adhere to these procedures for the commissioning tests.

1.10.3 Records

Maintain an up-to-date record of all commissioning activities on site.

Record the results of the tests clearly on forms and formats approved by the Employer and with clear references to the equipment and items tested, so that the record can be used as the basis for maintenance tests, in future. Submit the required number of site test records to the Employer as soon as possible after completion of the tests.

Record the details of the test equipment and instruments used in the test sheets, in those cases where the instrument or equipment characteristics can have a bearing on the test results.

1.10.4 "As-Built" Drawings

Keep an ongoing record of all changes on a master set of drawings. Produce and supply a minimum of five complete sets of marked-up "As Constructed/As-Built" drawings before leaving the Site. Correct and re-issue the original drawings as soon as possible as per this specification.

1.10.5 Test Methods

Carry out all necessary tests for commissioning the substations. The following clauses detail the tests which are considered to represent the minimum required in addition to those specified under the appropriate IEC Publications, other approved standards and the manufacturer's instructions for each item of equipment.

Strictly adhere to the methods of testing approved by the Employer.

A) Site and Commissioning Tests for Main and Auxiliary Equipment

General Checks:

Make a general check of all main and auxiliary equipment. Include a check of the completeness, correctness and condition of ground connections, labeling, arcing ring, paint surfaces, cables, wiring, pipe-work, valves, blanking plates and all other auxiliary and ancillary items.

Check for oil and gas leaks and that insulators are clean and free from external damage. Check that loose items, which are to be handed over to the Employer, e.g., blanking plates, tools, spares, etc. are in order and are correctly stored or handed over.

Circuit Breaker Tests


Check and set pressure switches settings when required. Also test mechanical operating systems.

Carry out contact resistance tests. In the case of multi-interrupter circuit breakers, perform resistance tests at each interrupter or pair of interrupters as well as through the series of interrupters on each pole.

Test local and remote trip/close operation and perform circuit breaker and auxiliary contact timing tests on all circuit breakers.

Control/ Relay Panels, energy meters and Switchboards

Carry out general testing and inspection, as referred to above. The Contractor shall also carry following tests: a) Carrier signal testing b) protective relay testing c) Instrument transformers testing c) Phase correcting testing. Functionally test and perform the timing tests on circuit breakers and AC and DC circuits, associated with stand-by auxiliary supplies and stand-by generating sets, particularly where automatic operation is defined.

Carry out insulation measurement tests of secondary circuits with a 1000 V DC meggar before and after high voltage testing.

Check shutters, interlocking, earth procedures and the inter-changeability of components.

Carry out a high voltage 50 Hz dielectric test on each bus at 75% of the specified value for the equivalent factory test.

Disconnecting Switch and Earth Switches

Test all disconnecting switch and earth switches operationally to confirm contact pressures, contact resistance, simultaneous-operation of all phases and the ease of operation.

Check the local and remote indications and the operation of auxiliary contacts. Check the earthing mat at the operating positions and check the availability of connecting points for maintenance earthing arrangements.

Test the earth switches and maintenance earthing devices to confirm the opening and closing sequences and check the ground mat connections, indications and manual locking devices.

Lightning Arresters

Inspect and verify the condition and satisfactory mounting of the arresters and their earth connections, electrodes and operation counters. Note the counter readings.

Busbars and Connections

Test flexible bus bars and connections to ensure that the correct tensions, sags and clearances will be maintained over the range of environmental conditions and loads


without stress to other equipment. If dynamometers are used to check the sags and tensions, check them before and after use.

Check rigid bus bars and connections to ensure that the bus bars will not cause overloading of the supporting insulators under load conditions and under the range of climatic variations applicable to the Site. Ensure that expansion and contraction of the equipment is fully accommodated by flexible connections.

Test conductivity on selected connections and joints.

Perform high voltage DC tests on all HV cables and isolated phase bus bars at 75% of the specified value for the equivalent factory test. Carry out with at least 1000 V DC meggar the insulation measurement test, before and after high voltage tests.

Batteries and Battery Charging Equipment

Test the insulation to earth of the complete DC system. Test the batteries and chargers to confirm the charger ratings, adjustment, alarm systems and battery capacity for the specified length of time at maximum expected loading. Record the specific gravity and cell voltages of the batteries during the initial charge and when fully charged and maintain proper regular records until the battery is taken over by the Employer.

Interlocking: Check all interlocking arrangements, both electrical and mechanical.

B) Earthing System

Carry out the tests and measurements in accordance with IEEE Standard 80. Test the effectiveness of the bonding and earthing and make conductivity tests on selected joints on the main earthing system and at the connections to equipment and structures. Check the precautions taken to avoid corrosion attack on the earthing system.

Measure the resistance of the earthing system to the remote earth indicating method and equipment used. Separate test probes of minimum 300 to 600 meters length to effectively test the earthing system. Perform earthing resistance measurements with the transmission line earth wires disconnected from the grounding grid.

C) Area Lighting

Check all lighting circuits including the operation of relevant photoelectric cells and remote/local commands. Measure the lighting levels throughout the substation on horizontal surface 800 mm above ground level and on all vertical surfaces of transformers, marshaling kiosks, etc. Measure the lighting levels in the area surrounding the substation up to 20 m from the fence.

D) Particular Constraints and Special Tests

The Contractor shall be prepared to cooperate with any special tests requested by the Employer.