NEPAL ELECTRICITY AUTHORITY

(An Undertaking of Government of Nepal)

PROJECT MANAGEMENT DIRECTORATE

Distribution System Augmentation and Expansion Project

BIDDING DOCUMENT
FOR
Rural Electrification and Distribution Network Improvement of Tanahu District
(Design, Supply and Install)

Single-Stage, Two-Envelope
Bidding Procedure

Issued on:	**…….**
Invitation for Bids No.:	**ICB-PMD-DSAEP-074/75-01-Tanahu**
ICB No.:	**ICB-PMD-DSAEP-074/75-01-Tanahu**
Employer:	**Nepal Electricity Authority**
Country:	**Nepal**

VOLUME II OF III

JULY 2018

Distribution System Augmentation and Expansion Project
Project Management Directorate
Nepal Electricity Authority
Chandragiri Municipality Ward No. – 7
Matatirtha, Kathmandu
Phone No: +977 1 5164122/5164111

TABLE OF CONTENTS

VOLUME II OF III: SPECIFICATIONS AND STANDARDS

VOLUME IIA OF III: 33/11 kV Substation Construction Works

VOLUME IIB OF III: Line and Distribution Transformer Construction Works

VOLUME – IIA OF III

SECTION – 1

SPECIFICATION OF CIVIL AND BUILDING WORKS

FOR

33/11kV SUBSTATION CONSTRUCTION WORKS

Table of Contents

1. Site Works

1.1 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 100m, 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 20cm 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 include 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. These 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 The surplus earth generated from foundation work shall be disposed away from levelling area boundary at low lying areas within 2Km lead. The surplus earth if disposed within substation main boundary, the same shall be spread in uniform layers and compacted with suitable compacting equipment to achieve 95% compaction at O.M.C.

1.3.5 The thickness of fill material under the foundations shall be such that the maximum pressure from the footing, transferred through the fill material and distributed onto the original undisturbed soil will not exceed the allowable soil bearing pressure of the original undisturbed soil. For expansive soils, the fill materials and other protections etc. to be used under the foundation is to be got approved by the NEA/Consultant.

1.3.6 Unless otherwise specified by the Owner/Engineer, compacting shall be to the following sensitizes at optimum moisture contents as determined by Indian standard Codes.

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. If 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 ton 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. Layer wise compaction tests must be done. 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.

1.3.7 Measurement for payment for the contract item, "Site Grading " Shall be the number of cubic meters of site grading, filled of bank run 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.

1.3.8 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 and Antiweed Treatment.

The work shall consist of surfacing course, composed of crushed rock, spread uniformly on the whole switchyard and control building area and as shown on the approved drawings in two layers in accordance with lines, grades, cross-section and as directed by the Employer.

The Contractor shall furnish, deliver, deposit and spread crushed stone on the switchyard and control building area. The crushed stone shall be crushed granite, gnesis or equal, 25mm to 60mm size and bladed dense but not compacted. The Contractor shall spread crushed stone over already properly prepared sub-surfaces. The thickness of crush rock surfacing shall be 150mm thick.

Chemical Compound:

Chemical compounds used to prevent the growth of grass and weeds shall be as approved by the Employer. The concentration of applied solution shall be double of the manufacturer's recommendation.

Construction Method

The preparation of the area to spread crushed rock surfacing shall be done in such a way as to clear of all grass, weeds, roots and all other objectionable materials.

a. Prior to shaping and compacting, the first spraying of chemical compound shall be carried out uniformly by hand pouring. The compaction shall be performed by mechanical compactor.
b. The first application of surfacing shall be spread uniformly with a layer of 1/2 inches (13mm) size aggregate approximately 40mm thick.
c. After the first application of surfacing has been applied, the third spraying of chemical compound shall be taken on the layer of 1/2 inches (13mm) size aggregate. However, the chemical compound shall be re-sprayed in case of rain during spraying.
d. The aggregate for the second application of surfacing shall be composed of one part of 1 inch (25mm) size aggregate and two parts of 2 inches (50mm) size aggregate by loose volume and shall be mixed on the switchyard area before spreading. The thickness of the second application shall be 60mm to furnish a total thickness of 100mm of surfacing.

e. After spreading of second surfacing, the fourth spraying of chemical compound shall be applied throughout the whole area of surfacing. As in previous sprayings, the application of chemical compound shall be re-taken in case of rain during spray. The thickness of the third course surfacing shall be 50mm to furnish a total thickness of 150mmof the surfacing.

Payment

Measurements for payment for Contract item "Crushed Rock Surfacing" shall be on square meters of crushed stone furnished and placed in accordance with Specifications, as shown on the drawings or as directed by the Employer and shall be measured net by deducting area covered by permanent structure and fixtures.

Payment for the Contract item "Crushed Rock Surfacing" will be made at the unit price per square meter bid. Therefore, in the Price Schedule, unit price shall include full compensation for

all costs incurred in furnishing all materials and all other operations related to the fill including but not limited to:

(a) Obtaining materials from the Employer's approved source

(b) Transporting materials to job site from source, to temporary stockpiles and/or to point of final disposition

(c) Placing and spreading material

1.5 Site Drainage

Preparation of overall drainage layout, design, drawing and providing rain water drainage system within the switchyard fencing under the present scope including connection at one or more points to the outfall point located outside the substation boundary wall is in the scope of contractor. Invert level of drainage system at outfall point shall be decided in such a way that the water can easily be discharged outside the substation boundary wall. In case outfall point is more than 50M away from boundary wall, only 50 metre drain outside the boundary wall is in the scope of contractor. Outfall point shall be got approved from NEA/Consultant before commencement of construction. While designing the drainage system following points shall taken care of:

(a) The surface of the switchyard shall be sloped to prevent accumulation of water.

(b) Drain shall be constructed at suitable locations in such a way that switchyard is not flooded and roads are not affected with ponding of surface water. In the switchyard maximum spacing between two drains shall not be more than 100 meter. It will be ensured that no area is left undrained.

(c) Open surface drains having 300mm bottom width and 300mm depth at starting point of drain shall be provided. The depth of drain shall be measured with respect to finished ground level of switch yard i.e. from bottom of switch yard stone filling.

(d) Longitudinal slope shall not be less than 1 in 1000.

(e) Open surface drains shall be constructed with brick masonry or concrete blocks. As per design of contractor. PCC (1:2:4) shall be laid over 40mm thick layer of PCC 1:4:8 (1 cement: 4coarse sand: 8 stone aggregate 20mm nominal size.)

(f) The side wall of the drains shall be 25 mm above the gravel level to prevent falling of gravel into drain. Groove of 125 mm width shall be provided at 2000 mm spacing with suitable mild steel grating.

(g) The maximum velocity for pipe drains and open drains shall be limited to 2.4m/sec and 1.8m/sec respectively. However, minimum non-silting velocity of 0.6m/sec shall be ensured.

(h) Pipe drains shall be provided in areas of switchyard where movement of crane will be necessary in operating phase of the substation.

(i) For pipe drains, concrete pipe of class NP2 shall be used. However, for road crossings etc. higher strength pipe of class NP3 shall be provided. For rail crossings, RCC pipes of class NP4 shall be provided. For design of RCC pipes for drains and culverts, relevant British standard codes (B S Codes)/ equivalent International Standards. Shall be followed.

(j) Two Nos. of portable pumps of 5 hp capacity for drainage of water shall be provided by the Contractor.

(k) Pipe drains shall be connected through manholes at an interval of max. 30m.

(l) If the invert level of outfall point is above the last drain point in the substation boundary, sump of suitable size has to be constructed with in the substation

boundary.

(m) The drainage scheme and associated drawings shall be got approved from NEA/Consultant before commencement of construction.

1.6 Laying of underground cable

Contractor shall furnish all construction work for under grounding of 12 kV cables from sub-station 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.

e) Base and removable cover.

1.8 Access Road

1.8.1 **Asphalts Pavement**

1.8.1.1 General

This specification covers all construction works for 4 meters wide drive-way road within Owner's premises.

1.8.1.2 Grading

Finish grade of roads and packing area shall be as directed by Owner.

1.8.2 **Pavement Materials**

1.8.2.1 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.

1.8.2.2 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

1.8.2.3 Wearing Course

Wearing course shall be asphalt concrete mixture.

1.8.3 **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 / indian standared.

Aggregate for asphalt concrete shall be a composition of coarse aggregate fine aggregate. Both shall be clean and durable.

1.8.4 **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

1.8.5 **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 concrete road

Road Inside the boundary wall: The sub-grade shall be prepared by providing suitable longitudinal & transvers slopes. The sub grades shall be well compacted (95 % of dry density/proctor density). Over prepared sub-grade, 300mm thick (minimum) consolidated water bound macadam in three layers each of 100 mm thick shall be laid below pavement (3.75 m wide) and shoulders(1.3 m wide each on either side of road) width. A 100 mm thick RCC layer with reinforcement of 8 mm @ 300 mm centre to centre in both directions (to be centrally placed) shall be provided as pavement of road over WBM layer. Suitable side drain of PCC (1:2:4) &cross drainage work through RCC Hume pipes encased in concrete (1:2:4) at the interval of about 100 meter road length shall also be provided with the approach road. Suitable modifications of turnings for transportations of Transformers & other equipment's shall also be carried out. For which excavation/ cutting shall be paid in item earthwork in excavation of BPS.

1.10 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 1:5 cement mortar. After completion of masonry wall, it shall be cured with water for more than 10 days.

Weep-holes with poly vinyl chloride (PVC) pipes of 15 cm in diameter shall be made in each 4 sq. m of slope surface of the masonry wall. Backside of poly vinyl chloride (PVC) pipes appropriate filter material must be provided. The upper surface of the masonry wall shall be finished smooth with concrete. Front side of masonry wall shall be finished with pointing works.

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.

1.11 Switchyard and Boundary Fencing

1.11.1 General

Work covered under this clause comprises of design, drawing, supply, fabrication, erection, painting or galvanization as specified etc of switch yard Fencing and gate, construction of foundation of steel posts and toe wall .While providing switch yard fencing and gate, Following points may be taken care of :

1.11.2 Areas requiring Fencing

Fencing shall be provided for complete switchyard as per approved layout drawing. Separate gate shall be provided for men and equipment.

Internal fence surrounding the various equipments (if) mounted on ground or a height lower than 2.5m. Necessary gates shall be provided for each area so surrounded.

1.11.3 Product materials

The minimum requirements are as follows:

Chain link fence fabric (galvanization) in accordance to relevant British standard codes (B S Codes)/ equivalent International Standards.

1.11.4 Posts

The posts shall be of medium M.S. tubes of 50mm diameter conforming to grade as per relevant international /BS standard. The tubes shall also conform relevant British standard codes (B S Codes)/ equivalent International Standards. The length of tubular post shall be 2600 mm.

An M.S. base plate of size 160 X 160 X 6mm thick shall be welded with the tubular post. The post shall be provided on the top with M S plate.

The tubular post shall be welded with 8 number of M S flat of size 50 x 6mm – 75mm long at suitable locations. Two number of 13.5 mm diameter holes on each cleats shall be provided to bolt the fence fabric panel. The cleats shall be welded at equal spacing in such a way that 4 numbers of cleats are on one side and remaining 4 cleats are on the opposite side of the post. The cleats on the corner posts shall be welded in such a way that it suits the site requirement.

The whole assembly of tubular post shall be hot dip galvanized. The zinc coating shall be minimum 610 gram per sq. meter. The purity of zinc shall be 99.95% as per relevant BS.

1.11.5 Fence Fabric & Fence Panel

Chain link fencing shall be made of 3.15 mm diameter wire with 75 X 75 mm mesh size. Fence fabric shall be galvanized. Chain link fencing shall be fabricated in the form of panel 1300 X 2928 mm. An M.S. flat of at least 50x6 mm size shall be welded all-round fence fabric to form a panel. Four pairs of 13.5mm diameter holes on the vertical M S flat matching the spacing of holes in cleats fixed with pipe shall be provided to fix the fence panel with the tubular posts. A washer shall also be provided below each nut. The contractor, for fixing the panels, shall supply the 12mm diameter bolts including nuts and washers. All nuts, bolts and washers shall be hot dip galvanized.

The fence panel shall be provided with two or more coats of approved standard Zinc paint over approved standard steel primer.

1.11.5.1 Installation

Fence shall be installed along the switchyard line as shown in the approved drawings.

Post holes shall be excavated by approved method.

All posts shall be 3.0m apart measured parallel to ground surface.

Posts shall be set in 1:2:4 Plain Cement Concrete block of minimum 0.40x0.40x1.2m depth. 75mm thick plain cement concrete 1:3:6 shall be provided below concrete blocks. Posts shall be braced and held in plumb position and true alignment and elevation until concrete has set.

Fence fabric shall not be installed until concrete has cured a minimum of 7 days.

Fence fabric panel shall be fixed to the post at 4 nos. MS flat each of 50x6, 75 long through 2 nos. of bolts (12mm diameter) on each flat.

1.11.5.2 Gate

The gate shall be made of medium duty M.S. pipe conforming to relevant I.S. with welded joints. The main frame (outer frame) of the gate shall be made of 40mm dia pipe and vertical pipes of 15mm dia @ 125mm spacing (maximum) shall be welded with the main frame. Two number of 1.25 mm thick and 125 mm wide MS plates (Horizontal) @ 500 mm centre to centre distance shall be welded on each gate leaf. Gate leaves shall be fixed with a vertical post of 2700 mm long two steel channels-150 welded together.A 8 mm thick 200X 200 mm size MS plate shall be welded at the bottom of channel frame.

The gates shall be fabricated with welded joints to achieve rigid connections. The gate frames shall be painted with one coat of approved steel primer and two coats of synthetic enamel paint.

The gates shall be provided with suitable locking arrangement welded on 4 mm thick MS plate on the gate leaf.

The main gate shall be 5.0m wide and shall be of double leaf type (as shown in the drawing). Next to the main gate, a men gate (1.25m wide single leaf) shall also be provided.

Steel roller shall be provided with the gate.

Gate shall be installed in location as shown in approved G.A. drawing.

The vertical post of gate shall be embedded in PCC foundation of 500 X500X1250 mm deep size.

1.12 Steel Gate (Main entry)

A steel gate of 2.1 m high and 5m wide along with 1.5 m wide main gate shall be provided at entry location of substation. The gate shall be supported on steel columns. The steel support columns shall be encased with suitable RCC foundations. Suitable wheel mounting arrangement shall be provided at the bottom of gate for smooth opening of gate. All steel works shall be provided with two coats of synthetic enamel paint over a coat of steel primer of approved make.

The item shall be measured and paid on Lump sum basis.

2. Foundation Design

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 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.

2.3 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 2.0.

2.4 Bearing Loads

The Contractor shall use 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.

2.5 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.

2.6 Unit weight for overturning resistance

The following unit weight shall be used for design:

a) Soil …….. 12,000kg/m3

b) Concrete…… 16,00kg/m3

2.7 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.

2.8 Soil Test

2.8.1 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 4 borings at the locations specified below:

- One at take-off structure foundation
- One at transformers foundation
- One at control building location.
- One at Staff quarter location.

Thin-walled tube soil sampling in accordance with ASTM D-1587-63 T/ Indian standard shall be made at every meter for the first three meter of depth.

Standard penetration tests in accordance with ASTM-D-1586-64T/ Indian standard 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.

Every undisturbed sample collected from thin-walled tube shall be subject to the following series of test. The following laboratory tests shall be carried out

a) Visual and Engineering Classification

b) Atterberg limits Tests.

c) Natural moisture content, Optimum moisture content, bulk density and specific gravity.

d) Grain size distribution analysis.

e) Swell pressure and free swell index determination.

f) California bearing ratio.

g) Consolidated drained test with pore pressure measurement.

Chemical tests on soil and water to determine the carbonates, sulphates, nitrates, chlorides, Ph value, and organic matter and any other chemical harmful to the concrete foundation.

In case rock is encountered, the soil test required for rock as per relevant British standard codes (B S Codes)/ equivalent International Standards including following tests shall also be conducted.

(i) UCC test.

(ii) Point load index test.

2.8.2 Payment

Payment for the contract item. Soil Testing, will be made at the lump sup 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.

2.9 Excavation and Backfill

2.9.1 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.

2.9.2 Work covered under this clause comprises the site clearance, survey work/setting out and making profiles (preparation of plot plan, setting up Bench Mark and taking spot levels at 05m x 05 m interval, preparation of contour plan with contour interval of 0.50 m), Earth work in Excavation & filling in specified area with all lifts and leads and earth work in filling with borrowed earth with all leads and lifts (Borrow areas including payment of royalty for borrowed earth shall be arranged by the contractor at his own cost). During detailed engineering stage, the contractor will prepare the leveling proposal for optimum leveling and submit to NEA/Consultant for approval. Contractor shall submit the hard copy and editable soft copy of leveling proposal (leveling quantity calculation in Excel form and leveling drawing in Auto-CAD file) to NEA/Consultant for approval.

2.9.3 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.

2.9.4 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.

2.9.5 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.

2.9.6 Rock particles larger than 10 cm shall not be in contact with the concrete.

2.9.7 Upon the completion of excavation a 10 cm thick layer of boulder or selected borrow shall be provided at the base of each foundation.

2.9.8 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.

2.10 Foundation Works

2.10.1 General Requirement

The design of the foundation for all the substation steel structures, electro-mechanical equipment, and control buildings to be constructed shall be the responsibility of the Contractor. All designs and details shall be subject to the approval of Employer. Approval of designs by Employer in no way relieves the Contractor of responsibility for an inadequate foundation design.

2.10.2 Design loads

Foundations shall be designed for 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, overturning moments and any other forces with a minimum factor of safety of 2.0.

2.10.3 Bearing loads

The Contractor shall use an ultimate soil bearing pressure of 2.0kg/sq.cm 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 tests and detail design of foundations based on the soil test results. There may be variation in the volume of work in final design as compared to the bidding design, for which the Contractor will not get any extra payment.

2.10.4 Uplift and overturning loads

The uplift and overturning resistance of concrete spread footings shall be assumed as the weight of a volume of earth in the form of an inverted frustum of a cone or pyramid. The cone or pyramid height shall be 30 cm 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 200 cone angle from the vertical and the horizontal plane 30 cm below finish grade.

2.10.5 Unit weights for overturning resistance

The following unit weights shall be used for design:

a) Soil 1,200kg/m3

b) Concrete 1,600kg/m3

2.10.6 Detail Calculation

Detail calculations for each type of foundation shall be submitted to the Employer for approval. Such details shall show the following requirements:

1. Calculation of loads acting on foundation under different conditions.
2. Calculated safety factor for each type of stability and condition.
3. Maximum stresses in concrete and in steel reinforcement at any critical section.

2.10.7 Line and Grade

The Contractor shall provide all lines and grades or elevation of the ground at each footing and set the necessary stakes that are required for the work and will be held responsible for their accuracy. Employer may check lines and levels set by the Contractor from time to time, but the responsibility for their accuracy shall rest entirely on the Contractor.

2.10.8 Detail Drawings

Details of each type of foundation submitted for Employer's approval shall be as shown on the approved design drawings and shall conform to the requirements described hereafter. No change shall be made without the written approval of Employer. The detail drawings shall at least include:

1. Detail dimensions of foundation.

2. Detail dimensions of anchor bolts, template settings etc in the foundations.

3. Details of placing of all reinforcing steel which shall conform to the Building Code Requirements for Reinforced Concrete (ACI 318) and the Manual of Standard Practice of Detailing Reinforced Concrete Structure (ACI 315) unless otherwise as specified herein.

4. Details of type, size and length of each reinforcing steel including details of bar bending schedule.

2.11 Earth Works

2.11.1 Excavation

Excavation shall conform to the dimensions and elevations as shown on the approved drawings. The general cut slope shall not be steeper than 1: 1.5; however, where the Contractor shall not excavate the slope to satisfy the condition above, temporary supports to the sides of excavations shall be required by means of timbering, sheet piling or shoring.

When foundations rest on an excavated surface other than rock, special care shall be taken not to disturb the bottom of the excavation. When subsoil for foundations become mucky on top due to construction operation or any other reason, such subsoil shall be removed and replaced by one or more layers of compacted sand or compacted crushed rock, as directed by the Employer.

Excavated materials, suitable for use as backfill, shall be deposited by the Contractor in storage piles at the area approved by the Employer. However, surplus excavated materials shall also be hauled and transported to the disposal area designated by the Employer.

2.11.2 Dewatering

This specification covers the general requirements of dewatering excavations in general. All excavations shall be kept free of water. Grading in the vicinity of excavations shall be controlled to prevent surface water running into excavated areas.

The Contractor shall remove, by pumping or other means approved by the Employer, any water inclusive of rainwater and subsoil water accumulated in excavation and keep all excavations/trenches free of water required for further work.

The Employer shall approve the method of pumping; but in any case, the pumping arrangement shall be such that there shall be no movement of subsoil or blowing -in due to differential head of water during pumping. Pumping arrangements shall be adequate to ensure no delays in construction.

When there is a continuous inflow of water and quantum of water to be handled is considered, in the opinion of the Employer, as large, well point system (dewatering), single stage or multistage shall be adopted. The Contractor shall submit to the Employer his scheme of well point system including the stages, the spacing number and diameter of well-points, headers, etc., and the number, capacity and location of pumps for approval.

2.11.2.1 Payment

No separate or direct payment will be made to the Contractor for dewatering of foundation works. All costs incurred in connection therewith

shall be included in the unit bid prices for the construction of the various foundations and other civil works.

2.11.3 Timber shoring

This specification covers the general requirements of timber shoring for open excavations for structure foundations.

Close timbering shall be done by completely covering the sides of the pits generally with short, upright members called polling boards. These shall be of minimum 250mm x 400mm sections or as directed by the Employer.

The boards shall generally be placed in position vertically side by side without any gap on each side of the excavation and shall be secured by horizontal walling of strong wood at maximum 1.2 meters spacing, strutted with bellies or as directed by the Employer. The length of the belly struts shall depend on the excavation and supported by vertical walling, which in turn shall be suitably strutted. The lowest boards supporting the sides of the trench or pit shall remain exposed, so as to render the earth liable to slip out.

Timber shoring shall be 'close' or 'open' type, depending on the nature of soil and the depth of pit. The type of timbering shall be as approved by the Employer. It shall be the responsibility of the Contractor to take all necessary steps to prevent the sides of excavations, pits, etc., from collapsing.

Timber shoring may be required to keep the sides of excavations vertical to ensure safety of adjoining structures, or to limit the slope of excavations, or due to space restrictions or for other reasons. Such shoring shall be carried out, except in an emergency, only under instructions from the Employer.

2.11.3.1 Payment

No separate payment will be made to the Contractor for timber shoring. All costs incurred in connection therewith shall be included in the unit bid prices for the construction of the various foundation types and other civil works.

2.11.4 Backfill

The Contractor shall place and compact the backfill materials to the lines, grades and dimensions to be shown on the approved drawings. The materials to be used for backfill, the amount thereof and the manner of depositing the materials shall be approved by the Employer.

2.11.4.1 Payment

No separate or direct payment will be made to the Contractor for earthwork in foundations. All costs incurred in connections therewith shall be included in the unit/lump sum bid prices for the construction of various foundations, etc.

2.12 Concrete Works

Concrete work shall mean and include all and every concrete works, for the civil works. The Contractor shall perform the concrete work in strict conformity to the Specification and as directed by the Employer and shall inform Employer, at least 24 hours in advance, of the times and places which he intends to place concrete.

2.12.1 Composition of Concrete

General Mix Composition

The concrete shall be composed of cement, fine aggregate, coarse aggregate, water and admixtures as specified. All materials shall be well mixed and brought to the proper consistency. The mix proportions shall be as follows:

Minimum compressive strength (28 days)	210 kg/cm2
Minimum cement content	300 kg/m3
Maximum water cement ratio	0.55
Maximum slump	10 cm.

The detailed concrete mix design shall be submitted to the Employer for approval on the basis of producing concrete, having suitable workability, consistency, density, impermeability, durability, and required strength with concrete compressive strength test records. If 210 kg/sq.cm. strength of 28 days, cannot be achieved with the above cement content, more cement shall be used for which the Contractor will not receive any extra payment.

2.12.2 Consistency

The detailed mix proportions shall be submitted to the Employer for approval to secure concrete of the proper consistency and to adjust for any variation in the moisture content or grading of the aggregate as they enter the mixer. Addition of water to compensate for stiffening of the concrete before placing will not be permitted. Uniformity in concrete consistency from batch to batch will be required.

2.12.3 Soling Layer

Soling layer of mixed gravel or pebble of 10 cm thickness shall be used under lean concrete layer of all foundations.

2.12.4 Lean Concrete

Lean concrete of minimum 5 cm. thickness shall be used under all foundations with the ratio of cement: fine aggregate: coarse aggregate equal to 1:3:5 (by volume).

2.12.5 Cement

2.12.5.1 Quality

The Contractor shall furnish normal Portland cement in fifty (50) kg net-weight sacks.

The cement for the civil work shall conform to the requirements of "Portland cement, Type I" designated in ASTM C150 or Indian Standard. Where conditions require the use of high sulphate resistance cement, cement conforming to the requirements of ASTM CISO Type V or Indian standard/NS shall be used without any cost to Employer.

2.12.6 Coarse Aggregate

2.12.6.1 Quantity

Coarse aggregate shall conform to the requirements of ASTM C 33 or Indian Standard and shall be either natural gravel or manufactured coarse aggregate. Coarse aggregate shall consist of well shaped clean, hard, dense, durable rock fragments and shall not contain wood chips and any other impurities.

2.12.6.2 Grading

Coarse aggregate shall be graded for each maximum size within the standard limits specified as follows:

ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR COARSE AGGREGATES AS PER IS 383

3.	**Coarse Aggregates**										
i)	Physical Tests										
	a) Determination of particles size	a. IS Sieve Designation	**%age passing for Single-Sized Aggregate of nominal size**					**Percentage Passing for grades Aggregate of nominal size**			
			40 mm	**20 mm**	**16 mm**	**12.5 mm**	**10 mm**	**40 mm**	**20 mm**	**16 mm**	**12.5 mm**
		63 mm	100	-	-	-	-	-	-	-	-
		40 mm	85 to 100	100	-	-	-	95 to 100	100	-	-
		20 mm	0 to 20	85 to 100	100	-	-	30 to 70	95 to 100	100	100
		16 mm	-	-	85 to 100	100	-	-	-	90-100	-
		12.5 mm	-	-	-	85 to 100	100	-	-	-	90 to 100
		10 mm	0 to 5	0 to 20	0 to 30	0 to 45	85 to 100	10 to 35	25 to 55	30 to 70	40 to 85
		4.75 mm	-	0 to 5	0 to 5	0 to 10	0 to 20	0 to 5	0 to 10	0 to 10	0 to 10
		2.36 mm	-	-	-	-	0 to 5	-	-	-	-
	b. Flakiness index		Not to exceed 25%								
	c. Crushing Value		Not to exceed 45%								
	d. Presence of deletrious material		Total presence of deleterious materials not to exceed 5%								
	e. Hardness		Abrasion value not more than 40%, Impact value not more than 30%								
	f. Soundness test (for concrete work subject to frost action)		12% when tested with sodium sulphate and 18% when tested with magnesium sulphate								

2.12.7 Fine Aggregate

2.12.7.1 Quality

Fine aggregate shall conform to the requirements of ASTM C33 or Indian Standard and shall be natural sand or manufactured sand. It shall consist of clean, hard, dense and durable rock particles, free from injurious amounts of dust, silt, stone powder, pieces of thin stone, alkali, organic matter and other impurities.

2.12.7.2 Grading

The fine aggregate as batched shall be well graded, and when tested shall conform to the following limits:

4.	**Fine aggregates**				
i)	Physical Tests	IS Sieve Designation	Percentage passing for graded aggregate of nominal size		
	a) Determination of particle size		F.A. Zone I	F.A. Zone II	F.A. Zone III
		10 mm	**100**	**100**	**100**
		4.75 mm	**90-100**	**90-100**	**90-100**

		2.36 mm	**60-95**	**75-100**	**85-100**
		1.18 mm	**30-70**	**55-90**	**75-100**
		600 microns	**15-34**	**35-59**	**60-79**
		300 microns	**5 to 20**	**8 to 30**	**12 to 40**
		150 microns	**0-10**	**0-10**	0-10
	b) Silt content		**Not to exceed 8%**	**Not to exceed 8%**	**Not to exceed 8%**
	c) Presence of deleterious material	**Total presence of deleterious materials shall not exceed 5%**			
	d) Soundness Applicable to concrete work subject to frost action	**12% when tested with sodium sulphate and 15% when tested with magnesium sulphate**			

ACCEPTANCE CRITERIA AND PERMISSIBLE LIMITS FOR FINE AGGREGATES AS PER IS 383

2.12.8 Admixture

The Contractor shall use admixture, if required, listed below in order to improve the quality of concrete or mortar such as workability and finish ability and water tightness.

Air -entraining agent - ASTM C260 or equivalent.

Water -reducing and set retarding agent - ASTM C494 or equivalent.

Plasticizer

The cost of the material and all costs incidental to their use shall be included in the unit price bid in the Price Schedule for concrete in which the materials are used.

2.12.9 Batching and Mixing

The Contractor shall provide equipment and shall maintain and operate the equipment to produce the required quality of concrete.

When any mixer produces unsatisfactory results, the Employer may direct the Contractor to increase the mixing time or repair the mixing blades, and the Contractor shall promptly carry out the directions of the Employer.

The order of feeding the materials into the mixer shall be subject to approval of the Employer. If concrete is to be mixed by hand, it shall be subject to approval of the Employer.

2.12.10 Placing of Concrete.

2.12.10.1 General Conditions

Prior to placing concrete, the Contractor shall submit to the Employer for approval the mixed proportion, the characteristics of each materials of concrete, the concrete placing schedule, placing equipment, and method of execution of work. No concrete shall be placed until all formwork, treatment of surface, placing of reinforcement and other parts to be embedded have been inspected and approved by the Employer.

For each lot of concreting works, an authorization letter of concrete placing (pour card/check list) shall be prepared and submitted, which will be authorized by the Employer after having inspection of prerequisite of general conditions of concrete placing.

Placing of concrete shall not be permitted under the following conditions, unless specifically approved by the Employer.

1. When it rains.
2. When illumination is imperfect for night work.
3. When vibrator is not working.
4. When the Employer orders to stop.
5. One nos. of diesel/petrol operating vibrator must be at site.

2.12.10.2 Preparation for Placing

Treatment of foundation surfaces:

All surfaces of foundation upon or against which the concrete is to be placed shall be cleaned and moistened thoroughly before the placing. When concrete is placed upon or against earth foundations, the Contractor shall, in accordance with the direction of the Employer, remove all objectionable substances such as standing water, flowing water, fragments of wood.

Treatment of surfaces of construction joints:

Prior to placing the concrete upon or against the hardened concrete, the surface of the construction joints shall be cleaned, moistened and removed of all defect or loose concrete, and unsound foreign materials.

Transporting and Conveying:

The concrete which has elapsed more than 60 minutes after being discharged from the mixer and/or in which slump loss exceeds 3.0 cm as it is delivered to the site for placing, shall be disposed off at the place designated by the Employer. All such wasted concrete shall be borne to the Contractor's account. Concrete shall be placed with a vertical drop not greater than 1.0 m except where suitable equipment is provided to prevent segregation or where specifically authorized.

Concrete, which has segregated during transportation, shall be re-mixed. Re-tempering of concrete shall not be permitted.

Placing:

After the surface of unformed construction joint has been cleaned and the placing of concrete has been approved by the Employer in accordance with the provisions of the preceding Sub -articles, surface of unformed construction joint shall be covered with a layer of mortar approximately 1.5 cm thick. The Contractor shall place concrete upon the fresh mortar before it begins to set. The mortar shall be of richer cement content than the concrete without coarse aggregate. The cost of the mortar shall be included in the unit bid price for the foundation lot.

Concrete shall be deposited in all cases, as nearly as practicable, directly in its final position and shall not be caused to flow such that it will permit lateral movement or cause segregation of the coarse aggregate, mortar or water from the concrete mass.

2.12.11 Consolidation:

Immediately after placing, every layer of concrete shall be consolidated to the maximum practicable density so that it closes snugly against all surfaces of reinforcement bars and embedded fixtures and against all corners of the forms. Consolidation of concrete shall be done by electric or

pneumatic power -driven, immersion -type vibrators or other approved means.

2.12.12 Concrete Construction Tolerance:

Variations in alignment, grade and dimension of the structures from the established alignment, grade and dimensions shall be remedied or removed and replaced by the Contractor at his own expense as directed by the Employer.

2.12.13 Repair of Concrete:

The Contractor shall repair at his own expense the imperfections of concrete surfaces and the irregularities which do not meet the specified dimensions. Repairing work shall be performed and completed within 24 hours after the removal of forms, in accordance with the direction of the Employer.

2.12.14 Curing:

Prior to placing concrete, the Contractor shall obtain Employer's approval in respect of the method to protect and cure concrete and the facilities the proposes to use. After concrete has been placed, it shall be protected and cured strictly in accordance with the method approved by the Employer.

All costs for the curing of concrete shall be included in the unit price bid for foundation lot.

2.12.15 Forms:

General Conditions:

Forms shall be used, wherever necessary, to confine and shape the concrete to the required lines, and as directed by the Employer. Forms shall have sufficient strength to withstand the pressure resulting from placing and vibrating of the concrete, and shall be maintained rigidly in positions. Metal props must be used for support. For switchyard equipment foundation new metal forms must be used. Forms shall be new and sufficiently tight by using Nuts and bolts to prevent loss of mortar from the concrete. Each form shall be so prepared that each section may be removed individually without injuring the concrete.

The costs of all labor and materials for forms and for any necessary treatment of coating of forms shall be included in the unit price bid for foundation lot, for which the forms are to be used. No separate payment will be made for form.

Removal of Forms:

Forms shall not be removed without the approval of the Employer. As a rule, the forms shall be removed at the following minimum times after concrete has been placed:

Side forms of column and walls 2 days (48 Hours)

Supporting forms of floors and beams	28 days

2.12.16 Anchor bolts Setting and Grouting:

Anchor bolts setting in foundations of gantry and equipment structures shall be done by using steel template. Setting of Anchor bolts shall be done prior to the foundation concrete.

Grouting for seating structural steel members and equipment on foundations shall be non-shrink (not-setting) Portland cement mortar 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 a static head. Proportioning and mixing of grout shall conform to the following:

2.12.16.1 Mortar 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 placement. Aluminum powder shall be blended with cement in proportions of one-part powder to 50 parts cement, by weight, and the blend shall be sprinkled over the dry batch. After all ingredients are added, the batch shall be mixed for 3 minutes. Grout, which has not been placed within 45 minutes, shall be wasted /rejected.

2.12.16.2 In lieu of use of an expansive agent, settlement shall be reduced by extending the mixing period or by delaying final mixture to minimize the interval between time of placement and initial set and placement the under static header pressure. The mortar grout shall be a mixture of one-part cement and 2.5 parts sand, with a minimum necessary, to enable placement.

2.12.16.3 Payment:

No separate or direct payment will be made to the Contractor for Anchor Bolts Setting and Grouting. All costs incurred in connection therewith shall be included in the unit bid price for the construction of various foundation types.

2.12.17 Tests:

The Contractor shall make all necessary tests for determining the mixed proportions of each type of concrete, including tests of aggregates, so as to produce the concrete specified above.

In order to control the quality of concrete to be placed, the Contractor shall perform the following field tests:

2.12.17.1 Slump Test:

A slump test will be made from each of the first three batches mixed each day. An additional slump test will be made for each additional 40 cubic meters of concrete placed in any one day. Slump will be determined in accordance with ASTM C 143/Indian standard.

2.12.17.2 Compression Test:

Three sets of three concrete compression test cubes/ cylinders will be made each day when concrete is placed or as directed by the Employer. One set of each group will be tested at an age of 7 days and the other set will be tested at an age of 28 days. The third set will be an extra set to be tested only if needed. If the compressive strength indicates a compressive strength of less than 210 kg/sq.cm. Employer will determine what remedial measures are necessary and the Contractor shall perform these remedial measures at his own expense.

Concrete test cubes/cylinders will be made, cured, and stored in accordance with ASTM C31/Indian standard. Concrete cubes/cylinders will be tested in accordance with ASTM C39/Indian Standard.

No separate or direct payment will be made to the Contractor for tests. All costs for the tests shall be included in the unit bid price for the construction of various foundation types.

2.12.18 Steel Reinforcement Works

The Contractor shall place all the reinforcement bars in the concrete structures as shown on the approved drawings, bar bending schedules and as directed by the Employer. The reinforcement bars shall be furnished by the Contractor.

2.12.18.1 Quality:

The reinforcement bars used for the concrete structure shall be torsteel reinforcing bars and dimensions, shapes, tensile strength, yield point, elongation and other properties, shall conform to BS 1144/ Indian Standard or NS.

2.12.18.2 Placing:

Reinforcement bars shall be accurately placed and special care shall be exercised to prevent the reinforcement bars from being displaced during the placement of concrete. Intersecting points and splices of the reinforcement bars shall be fixed by using suitable clips or annealed wires. The reinforcement bars in structures shall be placed and supported by use of concrete blocks, metal spacers, metal hangers or other satisfactory devices to ensure required coverage between the reinforcement bars and the surface of concrete. Drawings of bar lists/schedule shall be submitted to the Employer for approval. The cost of binding wires, cutting and placing of steel bars shall be included in the unit price bid for foundation lot.

2.12.18.3 Payment

No separate or direct payment will be made to the Contractor for Concrete Reinforcing Steel in foundations. All costs incurred in connection therewith shall be included in the unit bid price for the construction of the various foundation types.

2.13 Measurement for payment:

Measurement for payment for the Contract item, "Concrete Foundation" shall be on the basis of the actual unit/lump sum of each type of foundation constructed by the Contractor.

Payment for the Contract item "Concrete Foundations" will be made at the unit/lump sum price per foundation type bid. Therefore, in the Price Schedule, such unit/lump sum price shall include full compensation for all costs incurred in furnishing all materials, including reinforcement bars, equipment and labor and all other operations related to Concrete Foundation design and construction, including but not limited to:

a) Performing detail foundation designs and preparation of construction drawing including bar-bending schedule

b) Supplying and transporting all foundation materials to job site

c) Excavating, dewatering, form works, providing 10cm thick soiling layer, providing 5cm thick (1:3:5) lean concrete layer, and backfilling for the foundations and all other related operations.

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) Heat 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 require 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 use 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 be 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 2.11 of Section VI.

3.5 Concrete Work

The detail Specification for the concrete work shall be as per Article 2.12 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 Brick Masonry Work

3.6.1 Materials

(a) Brick units shall be first class, sound, well burned, and free from defects that would impair its strength or affect its service-ability. Bricks having minimum 75 Kg/cm2 compressive strength can only used for masonry work. Contractor shall ascertain himself at site regarding the availability of bricks of minimum 75 kg/cm2 compressive strength before submitting his offer. The contractor may use concrete blocks of equivalent.
(b) Cement shall be ordinary Portland as per ASTM C150 Type I or equivalent/Indian Standard.
(c) Sand shall be clean, fine, sharp granules, 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 with lab test reports of cement, sandand lime for Employer's approval.

Mortar Mixtures

The type of mortar mixture for brick masonry shall be 1:4 in ratio.

Brick Masonry Laying

(a) Lay brick masonry in accurately spaced courses, level, plumb and true to line.

(b) Soak brick units in clean water for one hour before laying. Units shall be damped when laid.

(c) Lay brick in running bond with joints approximately 10mm wide.

(d) When brick masonry walls 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) Reinforce 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) The entire periphery wall shall be constructed in 360mm thickness.

(2) The entire partition wall shall be constructed in 240mm and 110mm thickness. But the latter one shall be constructed at less than 2.0 m span only.

3.6.2 Curing

Spray masonry surfaces with water thrice daily for a period of 10 days, or until the surface receives a plaster finish.

3.6.3 Protection

Where exposed to weather, protect top of masonry with water tied material 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.

3.6.4 Payment

Payment for the Contract item " Brick Masonry Works " will be made at the unit/ lump sum price bid. Therefore, in the Price Schedule, the unit price shall include full compensation for all costs incurred in furnishing all materials, labor and other operations related to brick masonry in foundation and superstructure wall.

3.7 Flooring

3.7.1 Scope of Work

Perform all flooring work required as per drawings and as specified herein.

3.7.2 Reference

All work and materials shall be in accordance with American Standards, ASTM, or equivalent.

3.7.3 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.

3.7.4 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 laid and coarse sand is spread 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

3.7.5 Tiles

Terrazzo/mosaic tiles shall be installed in control room, 11kV switchgear room, toilet and battery room. Terrazzo/mosaic tiles shall be precast tiles with an average weight of 2.9 kg. The tiles shall be 25 cm x 25 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 up to a height of 1.75 m from the floor.

3.8 Stone Masonry Work

3.8.1 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 granules, 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.

3.8.2 Mortar Mixture

The type of mortar mixture for stone masonry shall be 1 part, P.C: 5 part sand.

3.8.3 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 peripheral 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.

3.8.4 Curing

Spray masonry surfaces with water thrice daily for a period 10 days, or until the surface receives a plaster finish.

3.8.5 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.

3.9 Plaster and Punning Work

3.9.1 Plaster 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) Portland 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.

3.9.2 Plaster 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.

3.10 Door and Window

3.10.1 The contractor shall furnish 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.

3.10.2 Carpentry

3.10.2.1 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/Indian standards or equivalent.

3.10.2.2 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 be 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).

3.10.2.3 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.

3.11 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 heat 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.

3.12 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.

3.13 Illumination

The Contractor shall design and provide illumination system for the control building according to the requirements. The Contractor's designed drawings shall be submitted to the Employer for approval.

3.14 Water supply and sanitary system

The control building shall have an adequate water supply system as approved by the Employer. An underground R.C.C. water tank (min. thickness 150mm) shall be provided of inner dimensions 3m * 2m * 2m. A rooftop stainless steel water tank of at least 1,000-liter shall be provided. One heavy-duty water-pump of 1 H.P capacity shall be used for pumping water from underground-tank to roof-tank. The underground tank shall be connected to the public water-supply system at the main gate by a ½" GI pipe.

All plumbing works shall be concealed and performed with ½" & 1" GI pipes or CPVC pipes, fitting to the approval of the Employer. Two ½" tap points for external use shall be provided outside the control building as directed by the Employer.

3.14.1 Standards

The works shall be carried out in accordance with the latest revision of relevant standards.

3.15 Sanitary Fixtures

The Contractor shall provide sanitary fixtures for control building (bathroom, toilet and kitchen) using products of high quality ISO certified products. Employer shall approve the type, size color, etc.

3.15.1 Standards

The work shall be carried out in accordance with the latest revision of relevant standards.

3.15.2 Workmanship

The installation shall be made in neat, orderly and workmanlike manner, conforming in every way to the accepted standards of the best commercial practice.

3.15.3 Payment:

Payment for the Contract item "Water Supply and Plumbing & Sanitary Fixtures" will be made at the Lot. Therefore, in the Price Schedule, the lot price shall include full compensation for all costs incurred in furnishing all materials, labor and other operations related to Water Supply & Plumbing and Sanitary fixtures.

3.16 Plumbing, Drainage and Sanitary Fittings

3.16.1 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 require 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 stainless steel water tank on roof and suitable pump to pump the water from an underground water storage tank comprising of a similar 2 cu.m PVC tank to be installed underground by the Contractor.

3.16.2 Standards

The work shall be carried out in accordance with Codes National Plumbing code. S. U. Department of commerce, unless otherwise indicated.

3.16.3 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.

3.16.4 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.

3.17 Cable Trench

3.17.1 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.

3.17.2 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.

3.18 Paint

3.18.1 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.

3.18.2 Materials

A list of the painting materials and their color which are to be applied the specified surfaces shall be submitted to the Owner/Engineer for approval.

3.18.3 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: double coat wall putty for interior plaster and 1 coat of Alkali Resistance Primer for interior and exterior plastered surfaces.
   - Second Coat: double coat of weather shields Exterior wall finish in water proof 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 manufacturer'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.

3.19 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 material 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.
   2) One-part acrylic terpolymer sealant.

d) 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.

e) 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 from the color of the next coat.

f) Surface preparation and pretreatment

Cleaning and pretreatment of surface prior to painting shall be accomplished in accordance with the detailed requirements specified.

g) 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.

3.20 Ventilation and Fans

Rooms shall be provided with ceiling fans and suitable exhaust fans shall be installed din the battery room and toilet.

3.21 Fire Fighting System

The Contractor shall supply and install all firefighting system for control building and switchyard.

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.

3.22 Gabion Wall

The standard type gabion (Maccaferi) shall be a flexible hot dip galvanized gabion of the type and size specified below. It is made of wire mesh of the type and size and selvedge as specified in the following:

- The mesh shall be hexagonal woven mesh, with the joints formed by twisting each pair of wires through three and half turns.
- The size of mesh shall not be less than 100mm.
- All wires used in the fabrication of the gabions shall be galvanized "Mild steel wire", having average tensile strength of 44 kg/sq.mm.
- The diameter of the wire used in the fabrication of the netting shall be at least 3.0 mm depending on the design requirement.
- The selvedge and mesh wire shall have a diameter of 3.9 mm 3.0 mm respectively.

The gabion wall shall be filled with quarry stone as approved by the Employer. The rock shall be of compact, firmly bound and uniformly grain texture and absolutely weather-resistance.

The standard gabion shall have following dimension: 2*1*1 meter (Length*Width *Height).

Sufficient lacing and connecting wires of 2.4 mm diameter shall be supplied with the gabions, for all the wiring operations to be carried out in the construction of the gabion work.

3.22.1 Payment

Measurement for payment of gabion works shall be made on the basis of actual placed volume of gabions in cubic meters. Payment shall be made for the number of cubic meters measured as provided at the unit price specified in the schedule. The unit price shall include all labors, equipment, materials and all other cost necessary for the performance and completion of the works.

3.23 Payment

The payment to the Control Building shall be made per unit basis as per the Price Schedule.

VOLUME – IIA OF III

SECTION – 2

SPECIFICATIONS OF SUBSTATION EQUIPMENT

FOR

33/11 kV SUBSTATION CONSTRUCTION WORKS

Table of Contents

1. Power Transformer

1.1 General

This specification covers the design, manufacture, assembly, shop test, supply, delivery, installation works and field test of the power transformers complete with all accessories, fittings and auxiliary equipment for efficient and trouble free operation as specified hereinafter.

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

IEC 60076 Power transformer
IEC 60137 Insulating bushings for alternating voltages above 1 kV
IEC 60156 Insulating liquids - Determination of the breakdown voltage at power frequency – Test method
IEC 60296 Specification for unused mineral insulating oils for transformers and switchgear
IEC 60551 Determination of transformer and reactor sound levels
IEC 60616 Terminal and tapping markings for power transformer
IEC 60722 Guide to the lightning impulse and switching impulse testing of power transformers and reactors

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

Equipment to be furnished:

33/11 kV, 6/8 MVA Power Transformer.

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

1.2 Design Requirement

1.2.1 The Transformer shall be connected to Three Phase 50Hz system with Higher Side Voltage being 33 kV.

1.2.2 The Transformers shall be installed Outdoor in the Hot and Humid atmosphere. The Transformer shall be Oil Immersed and designed for the cooling system as specified in the appendices.

1.2.3 The Transformer should be capable of operating continuously at its rated output without exceeding the temperature rise limits as specified in the appendices.

1.2.4 The Transformer winding shall be designed to withstand short circuit stresses at its terminal with full voltage maintained behind it for a period as per IEC-76.

1.2.5 The Transformer shall be capable of operation at the rated output under the following conditions:

i. The voltage varying $\pm$ 10% of rated Voltage.
ii. The Frequency varying $\pm$ 5% of rated Frequency.

1.2.6 The Transformer shall be capable of delivering its rated output at any tap position.

1.2.7 The Transformer shall be free from annoying hum and Vibration when in Operation even at 10% over Voltage. The noise level should be as per respective IEC Standards.

1.2.8 The manufacturer of the transformer shall be the holder of valid ISO 9001 certificate (including design).

1.3 Construction Features

1.3.1 Tank:

The Tank should be suitable to house complete core, and maintain oil level up to the top of the core and windings even when the cover is open. The Tank shall be all

welded Construction and fabricated from the sheet steel of adequate thickness. All seams shall be properly welded to withstand requisite impact during short circuit without distortion. All welding shall be stress relieved.

The Tank shall be reinforced by stiffener of structural steel for general rigidity. The Tank shall have sufficient strength to withstand stress without any deformation by mechanical shock during transportation and vacuum filling in the field.

The Transformer cover shall be bolted on to the tank with weather proof, hot oil resistant, resilient gasket in between for complete oil tightness. If gasket is compressible, metallic stops should be provided to prevent complete compression. Bushing turrets, cover of inspection holes and other devices shall be designed to prevent leakage of water into or oil from the tank during normal or abnormal conditions. The tank cover shall be provided with two numbers of grounding pads and connected separately to tank grounding pads.

The tank shall be provided with sets of bi-directional flanged wheels for rolling the Transformer parallel to either central lines on the rail.

All heavy removable parts shall be provided with mounting rails along with the eye bolt for ease of handling and necessary lugs and shackles shall be provided to enable the whole Transformer to be lifted by the Crane or other means. Manholes of sufficient size shall be provided for access to leads, windings, bottom terminal of bushing and taps.

There shall be the provisions for the opening of the part of the Tank cover for cleaning of the Cores and Coils with Hot oil during overhauling.

1.3.2 Core & Windings:

The Transformer shall be of Core type. The Core shall be constructed with interleaved grade non-aging, low loss, non-ageing, high permeability, grain oriented, and cold rolled silicon steel lamination, properly treated after being sheared, to remove any burr and shall be re-annealed to remove any residual stresses.

All Steel sections used for the support of the core shall be thoroughly sand blasted after cutting, drilling and welding.

All lamination shall be properly insulated with the materials that will not deteriorate due to pressure and hot oil.

The core shall be rigidly clamped to ensure adequate mechanical strength. Core and Coil Assembly shall be capable of withstanding the vibrations and shock during transportation, Installation, service and adequate provision shall be made to prevent movement of core & coil assembly relative to the tank during these conditions.

The bidder shall submit following documents, as applicable, as a proof towards use of PRIME CORE MATERIALS before manufacturing a Transformer.

i. Invoice of the supplier.
ii. Mill's Test Certificates
iii. Packing List.
iv. Bill of Lading
v. Bill of Entry certificate by the Customs.

Core Materials shall be directly purchased either from the manufacturer or through their accredited marketing organization of repute and not through any agent.

The core shall be provided with lifting lugs suitable for lifting complete core and Coil assembly of transformer.

The Coils shall be manufactured from electrolytic copper of suitable grade as per relevant IS. The maximum current density for design of the transformers shall not exceed 2.5 A/Sq.mm. They should be properly insulated and stacked. All Insulating materials shall be of proven design. Coils shall be so insulated that impulse and Power Frequency Voltage stresses are minimum.

1.3.3 Tapping

No Load Tap as specified in the appendices shall be provided on the high voltage winding of the Transformers.

The Transformer shall be capable of operation at rated output at any tap position provided the primary does not vary by more than ± 10% of the rated voltage corresponding to the normal tap.

The winding including the tapping arrangement shall be designed to maintain the electromagnetic balance between H.V. and L.V. winding at all voltage ratios.

1.4 Transformer Oil

The Transformer Oil shall conform to the latest revision of IEC Publication 296, properly inhibited for preventing of sludging.

The necessary first filling of oil shall be supplied for the Transformer in non-returnable container suitable for outdoor storing. Ten percent (10%) excess oil shall also be provided to take wastage into account.

1.5 Oil Preservation System

Oil preservation system shall be by means of Conservator Tank.

1.5.1 Conservator Tank System

The Conservator Tank shall be mounted on a bracket fixed on the Tank.

The Conservator Tank shall be provided without compartment, for the main Transformer Tank.

The Conservator Tank shall be connected with the Main Transformer tank by pipes through double float Bucholz relay (Gas Operated Relay) with valves at both ends.

Contact of the Oil in the compartment for the Main Tank with atmosphere shall be prohibited by using a flexible urethane air cell. The cell shall be vented into the atmosphere through a silica gel breather and shall inflate or deflate as Oil volume changes.

The Conservator Tank shall be provided with its own breather, filler cap and drain plug.

The Conservator Tank shall be provided with dial type Level Indicator visible from the ground level and fitted with low oil level alarm Contact and Plain oil level gauge.

1.6 Temperature Indicators

One set of Winding Temperature Indicator shall be supplied and fitted locally so as to be readable at a standing height from ground level. Necessary Current Transformer and Heating Coil for obtaining thermal images of winding temperatures and detector elements shall be furnished and wired or fitted inside the transformer marshaling box.

The above Winding Temperature Indicator shall be provided with necessary contacts to take care of the following:

i. Starting cooling Units in stages with the rise of Temperature.
ii. Alarm on High Temperature.
iii. Trip on Higher Temperature.

One set of Oil Temperature Indicator with Maximum reading Pointer and Electrically Separate sets of Contacts for Alarm and Trip shall be mounted locally so as to be readable at the standing height from ground level.

1.7 Bucholz Relay (Gas Operated Relay – For Conservator Type of Oil Preservation)

The Bucholz relay shall be provided with two floats and two pairs of electrically separate contacts – One pair for Alarm & other pair for Tripping function.

The Bucholz relay shall be provided with the facility for testing by Injection of air by hand pump and with cock for draining and venting of air.

A Sudden Gas Pressure relay shall be furnished and mounted on top of the Tank in the region of the Gas Space. The Relay shall respond to sudden increase in the internal Gas Pressure in the Transformer due to internal arcing. The Relay shall be provided with trip contact. The above relay shall be stable during change in Oil or Gas pressure due to change in ambient temperature and / or loading.

1.8 Transformer Bushings

All Bushings shall confirm to the requirements of the latest revisions of IEC Publication 137.

The Bushings shall be located so as to provide adequate electrical clearances between phases and also between phase and ground as per relevant standards.

All Bushings shall be porcelain type and shall be furnished complete with terminal connectors of adequate capacity. The porcelain used in bushings shall be Homogenous, Nonporous, uniformly glazed to Brown color and free from Blisters, Burns and other defects.

Stresses due to expansion and contraction in any parts of the Bushings shall not lead to deterioration.

Liquid / Oil filled Bushings for 36kV and above shall be equipped with Liquid Oil Level Indicators and means for sampling and draining of liquid. The angle of inclination to vertical shall not exceed 30°.

Oil in oil filled Bushings shall meet the requirement of the Transformer Oil standards specified.

1.9 Marshaling Box

A Sheet metal weatherproof marshaling box of IP-55W construction shall be provided. The box shall contain all the auxiliary devices except those which must be located directly on the Transformer. All terminal blocks for external cable connections shall be located in this box.

The Marshaling Box shall have the following but not limited to them

1.9.1 Load disconnect Switch for Incoming Power Supply for Auxiliaries.

1.9.2 Cooler Fan and Pump Motor starters.

1.9.3 FAN START STOP Control Switches for ONAF type only.

1.9.4 AUTO-MANUAL Switches.

1.9.5 Wiring and Termination individually of the following alarm contacts for remote pre trip alarm.

- Bucholz relay alarm for Main Tank.
- Winding Temperature High Alarm.
- Oil Temperature High Alarm.
- Tank Oil Level Low Alarm.
- Tap Change incomplete alarm.

1.9.6 Wiring and Termination individually of the following Trip Contacts for remote trip and trip alarm.

- Winding Temperature High Trip
- Oil temperature High Trip
- Bucholz Relay Trip or Sudden Oil Pressure Relay Trip
- Pressure Relief Device.

Cubicle Illumination lamp with door switch and space heater with thermostat and ON-OFF switch shall be provided.

1.10 Wiring

Wiring shall be done as specified.

1.11 Cable Termination

Marshaling box shall be designed to facilitate cable entry from bottom. Removable plates shall be furnished with compression type cable glands to make entry dust proof and no weight is transferred to the terminal. The glands shall be suitable for terminating Cable Armor.

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 should be provided.

1.12 Terminal Blocks

Terminal Blocks shall be as specified

1.13 Painting Works

All painting works shall be done as specified

1.14 Auxiliary Supply

All indication, alarm and trip contacts provided shall be suitable for separation on a nominal 110V DC system.

1.15 Current Transformer

The Bidders are required to propose the detail scheme of ac circuit after making a Site visit and studying the existing ac system of the Transformer Protection and Metering. The existing data are enclosed. The details about the Current Transformer will be finalized after the approval of the scheme or as instructed by the Owner.

1.16 Tests

1.16.1 Routine Tests

During Manufacturing and on Completion, the Transformer shall be subjected to the following Routine Tests but not limited to as laid down in the latest revision of the IEC Publication 76.

i. Applied Voltage Tests

ii. Induced Voltage Tests

iii. No-Load and Excitation Current Test

iv. Impedance Voltage and Load Loss Test.

v. Resistance Measurement

vi. Ratio Test

vii. Polarity and Phase Relation Test

viii. Leakage Test.

ix. Insulation Resistance Test

x. Insulation Power Factor Test

1.16.2 Special Tests

The Following tests shall be performed.

i. Zero Phase Sequence Impedance measurement.

ii. After fabrication, the tank fitted with all Valves, Covers, Conservator Tank etc shall be completely filled with Transformer Oil and subjected to a pressure of 25% over the Normal pressure of the Oil. This pressure shall be maintained for 12Hours during which time there should be no leakage of oil nor there shall be permanent set when pressure is released. If any leakage or permanent set occurs, the test shall be conducted again after rectification of the defects.

iii. The Transformer Tank shall be subjected to full Vacuum as far as possible for 12Hours.

iv. After assembly, each core shall be pressure tested for 1 minute at 2kV ac between all bolts, side bolts, structural steel works and core.

v. Excitation loss and current measurement shall be made at 90%, 100% and 110% of rated Voltage.

1.16.3 Design Tests

Following design Test shall be performed on the Transformer in accordance with latest revision of IEC Publication 76, if such tests have not yet performed by the Manufacturer earlier in size commensurate with the Tendered Transformer. However, if such had been performed earlier, then the design tests can be submitted. If the submitted design tests in the opinion of the Owner, cannot be approved, then such tests have to be conducted.

i. Temperature Rise Test
ii. Impulse Voltage Withstand Test
iii. Short Circuit Test

1.16.4 Tests of Miscellaneous Components

The various components of the Transformer such as insulating oil, Bushings, Current Transformers etc. shall be tested with the relevant Standards.

The bodies of all valves and pipe works shall withstand a hydraulic pressure of 20psig for 15 minutes. The Testing medium shall be insulating oil as per IEC Publication 296.

1.16.5 Test Certificates

Test Certificates should be submitted in required number of copies for approval.

The Routine, Special and Design Test Certificates of the Transformer shall be furnished for approval before the delivery of the Equipment from the Factory.

The Routine and Type Test Certificates of miscellaneous components shall be furnished for approval.

1.16.6 Field Tests

After Installation at Site, the Transformer shall be subjected but not limited to the following field tests

i. Construction Inspection & Completeness inspection
ii. Insulating Oil Test
iii. Insulation Resistance Measurement
iv. Ratio Test
v. Tap Changer Operation Test
vi. Magnetic Balance Tests
vii. Short Circuit Test
viii. Magnetizing Current Test
ix. Vector Group Test
x. Winding Resistance Test
xi. Calibration of WTI & OTI.
xii. Setting of Alarm/Trip and cooler Controls and operation Check.

1.17 Tender Evaluation

1.17.1 Capitalization of Transformer Losses

When evaluating the individual bid received from various Bidders, the transformer shall be evaluated for the cost of losses based on the following relation

$$P_E = P_b + K_L \times L_L + K_{NL} \times L_{NL}$$

P_E = Evaluated Price

P_b = Bid Price

K_L = Value of Load Loss

L_L = Guaranteed Load losses at rated current (Maximum MVA base)

K_{NL} = Value of no load Loss

L_{NL} = Guaranteed no load losses

The transformer losses shall be capitalized as follows:

Value of No Load Loss = US$ 4684.00 per KW

Value of Load Loss = US$ 1180.00 per KW

1.17.2 The Bidder shall furnish guaranteed no load and full load loss data at rated load with the bid for al rating of transformers contained herein. The supplier shall furnish a test certificate for each transformer supplied, which shall show the actual no load and full load losses of the transformer at rated load. For the purpose of evaluation, the higher values of no-load and load losses shall be considered from the values guaranteed by the Bidder and the values given in the test reports.

1.17.3 If the actual no load and full load losses of any transformer exceed the guaranteed values, then the contract price for that transformer shall be reduced by the following calculated amounts for the losses in excess of the guaranteed values:

No Load Loss = US$ 4684.00 per KW

Load Loss = US$ 1180.00 per KW

Any transformer shall be rejected if losses exceed the guaranteed value by an amount in excess of the following

Total losses: 10%

Component losses: 15% (unless the total loss exceeds 10 %)

1.18 Performance Guarantee

The Performance figures quoted on the Technical data shall be guaranteed within the tolerances permitted by relevant standards listed below, and will a part of the successful Tenderer's Contract.

1.19 Drawings, Data & Manuals

1.19.1 Submission

Submission of Drawings, Data & Manuals by the Tenderer along with the Tender Document and that after the Award of Contract for approval shall be as follows:

1.19.1.1 Drawings and Details to be submitted with the Tender

i. Tenderer's Proposed typical general arrangement drawing showing Constructional Features of
   - Tank including Conservator, level Gauge etc.
   - Bushing Configuration Arrangement
   - Cable Termination Arrangement
   - Wheel Base Dimension and Detail
   - Head Clearance required for De-tanking of Coil Assembly.

ii. Routine and Type Test Certificates of Similar Transformer as quoted

iii. Technical Manuals on Accessories such as
   - Bucholz Relay, Sudden Gas Pressure / Oil Pressure Relay
   - Temperature Indicators

- High and Low Voltage Bushings

1.19.1.2 After Award of Contract

After Award of Contract, the successful Bidder shall submit the required numbers of copies of following data for approval

i. Outline Detail Drawing showing the general arrangement, indicating the space required for:
   - Cable Termination Arrangement
   - Wheel base Dimension & Details

ii. Head Clearance required for De-tanking of Core and Coil Assembly

iii. Foundation Plans and Loading

iv. Transport/Shipping details with net weight and weights of various parts.

v. Final calculation of the Impedance for Each Transformer.

vi. Schematic flow diagram of cooling System showing the number of Cooling Units.

vii. Technical details along with Control Schematic and Wiring Diagram for Marshaling box, Remote Tap Changer Control Panel.

1.19.2 Any other relevant Data, Drawings and information necessary for the review of the items under Clause 1.17.3 of this section whether specifically mentioned or not, shall be furnished along with this information.

1.19.3 The General Arrangement Drawing, the Schematic Wiring Diagram showing the Control Scheme, Cable Termination Arrangement, Location of Terminal Blocks, etc. shall be furnished for comment / approval in compliance with the **Clause 1.17.3 of this Section**. The Employer / Owner will return those drawings after their review with the comments and / or and the Configuration and the arrangement of the accessories fitted on the Transformer. The Contractor on receipt of their returned drawings, with comments from the Owner, shall prepare final schematic drawing, and coordinate the terminal markings of their final wiring diagram. The outgoing terminals of the wiring diagram shall be specially indicated for different functions, such as closing, tripping, alarm, indication etc. The responsibility for correctness of the wiring diagram shall lie with the Contractor.

The Owner will only check the final schematic diagram after submission. If any modification, addition or alteration is considered necessary thereon to comply with the Owner approved schematic drawing stated hereinabove, the said modification, addition, or alteration shall be carried out by the Contractor either at works if it is before delivery or at site after delivery at no cost to the Owner.

1.20 NAME PLATE

Each Transformer shall be provided with a nameplate of weather resistant material fitted in a visible portion showing but not limited to the following items.

i. Kind of Transformer.
ii. Number of the Specification.
iii. Manufacturer's Name
iv. Year of Manufacture.
v. Manufacturer's Serial Number
vi. Number of phases and Frequency.
vii. Rated Power
viii. Rated Voltages and Currents
ix. Connection Symbol.
x. Impedance Voltage at Rated Current.
xi. Type of Cooling
xii. Total Weight
xiii. Insulating Oil Weight

xiv. Class of Insulation
xv. Temperature Rise
xvi. Connection Diagram
xvii. Insulation Levels
xviii. Weight of Transportation and untanking.
xix. Details regarding Tapping.
xx. No-Load losses
xxi. Load Losses

1.21 TRANSPORTATION

The Core and Coils shall be completely dried before shipment and Assembled with Tank and with Oil or Dry Nitrogen depending upon the size of the Transformers. In order to facilitate Handling and shipping, as many external accessories as practical, including bushing shall be removed and replaced by special shipping covers.

Bushings, Radiators and other accessories which may be affected by moisture shall be packed in moisture proof containers.

1.22 TECHNICAL PARTICULARS

The Technical Particulars of Power Transformer and Accessories are

Description	**Requirement**
Rated Capacity	6/8MVA
Quantity Required	As per price schedule
Type	Out Door Oil Immersed
Type of Cooling	ONAN
Temperature Rise above 45ºC Ambient Temperature	
In Oil by Thermometer	50°C
In winding by Resistance	55°C
Number of Phases	3
Maximum Voltage (Phase to Phase)	
Primary, kV	36
Secondary, kV	12
Rated Voltage (Phase to Phase)	
Primary, kV	33
Secondary, kV	11
Insulation Level of Winding	
Basic Impulse level as per IEC 60076	
Primary, kV	170
Secondary, kV	75
Power Frequency Induced Over Voltage (Impulse)	
Primary, kV	70
Secondary, kV	28
Connections	
Primary	Delta
Secondary	Star
Vector Group Reference	
Primary – Secondary	Dyn 11
Tap Changer	
Type of Tap changer	OLTC
Range of Taps	± 10%, Step 1.25%
Number of Taps	17
Method of Tap Changer Control	
Mechanical Local	Yes
Percentage Impedance Voltage at Rated MVA and 75C	
System Grounding	
Primary	Ungrounded
Secondary	Solidly Grounded
System Fault Level	10kA at 33kV
Neutral Terminals	
Primary	No
Secondary	Yes

1.23 TRANSFORMER ACCESSORIES

1.23.1 Transformers furnished under this Specification shall be equipped with:

i. Oil Conservator with one compartment with filler caps and drain plugs.

ii. Two sets of Silica Gel Breather with Connecting Pipes and Oil Seals.

iii. Air Release Plugs.

iv. Double float Bucholz Relay with Electrically Separate Trip and Alarm Contacts for Transformer Tank

v. Two Nos. of Shut-Off valves at both sides of each Bucholz.

vi. Sudden Gas Pressure relay with Trip Contact.

vii. Mechanically Operated Self Resetting Type Pressure Relief Device with visible Operation Indicator and Trip Contact.

viii. 150mm Dial Magnetic Level Gauge with Low Oil level alarm.

ix. Direct reading Plain Oil Level Gauge.

x. 150mm dial Oil Temperature Indicator with Maximum Reading pointer and individually adjustable Separate Sets of Contact for Alarm and Trip.

xi. 150mm Dial Winding Temperature Indicator with individually adjustable electrically separate sets of Contacts for two stage cooler control, Alarm and Trip with detector element complete with Heating Coil, CT's etc.

xii. Drain Valve with Threaded Adapter.

xiii. Sample Valve (Top and Bottom)

xiv. Filter Valve with Threaded Adapter (Top and Bottom)

xv. Cover Lifting Eyes

xvi. Jacking Pads, Hauling and Lifting Lugs.

xvii. Bi-directional Wheels.

xviii. Rails

xix. Clamping Device with Nuts & Bolts for clamping the Transformer on Foundation rails.

xx. Ladder with Safety device for access to the Transformer top and Bucholz relay.

xxi. Grounding Pads each with 2nos. tapped holes, bolts and washer for Tank, Radiator and cable end box Grounding.

xxii. Rating Plates and Terminal marking plate.

xxiii. Marshaling Box for housing Cooler Control Equipment and Terminal Connections.

xxiv. Any other Accessories.

GUARANTEED TECHNICAL PARTICULARS
(To be completed by Bidder/Manufacturer)

Item: Power Transformer

S.N.	Description	Unit	NEA requirement	To be filled by Bidder/Manufacturer
1	Name of Manufacturer			
2	Country of Origin			
3	Year of manufacturing experience			
4	Applicable Standard		IEC	

S.N.	Description	Unit	NEA requirement	To be filled by Bidder/Manufacturer
5	Type		Out door, oil immersed, core type	
6	Winding/Phase		Two/ 1 phase	
7	Cooling		ONAN/ONAF	
8	Rating			
8.1	Rated MVA			
8.1.1	ONAN	MVA	6	
8.1.2	ONAF	MVA	8	
8.2	Rated Voltage			
8.2.1	Primary	kV	33	
8.2.2	Secondary	kV	11	
8.3	Maximum Voltage			
8.3.1	Primary		36	
8.3.2	Secondary	kV	12	
9	Number of Phases		Three	
10	Rated Frequency	Hz	50	
11	Noise Level			
	On ONAN Rating	db	As per IEC	
	On ONAF Rating	db		
12	Temperature Rise			
12.1	Temperature rise above 45 deg C ambient			
	In Oil by thermometer	deg C	50	
	In winding by resistance	deg C	55	
	Manufacturer for winding temperature indicator		Messko, Germany or Equivalent	
	Manufacturer for oil temperature indicator		Messko, Germany or Equivalent	
12.2	Hottest spot temperature in winding limited to			
13	Connection			
13.1	High Voltage		Delta	
13.2	Low Voltage		Star	
14	Vector Group		Dyn11	
15	Taps			
15.1	Type of Tap Changer		OLTC	
15.2	Tap Steps		1.25%	
15.3	Tap Range		+/- 10%	
15.4	No of Tap		17	
16	Cooling System			
16.1	Number of connected Fans	Nos		
16.2	Numbers of standby Fans	Nos		
16.3	Rated Voltage	Volts	400/230 V AC	
16.4	Adjustable Control Gear			
17	OLTC Gear			
	Manufacturer		Maschinenfabrik Reinhausen (MR) Germany or ABB Sweden or equivalent	
17.1	Rating			
17.1.1	Rated Voltage	Volts	110	
17.1.2	Rated Current	A		
17.1.3	Step Voltage	Volts	2000	
17.1.4	Number of steps	No	17	

S.N.	Description	Unit	NEA requirement	To be filled by Bidder/Manufacturer
17.2	Control Suitable For			
	Remote/Local Operation	yes/no	yes	
	Auto manual Operation	yes/no	yes	
	Parallel Operation	yes/no	yes	
	Master slave Operation	yes/no	yes	
17.3	Rated Voltage of Drive Motor	V	110	
18	Guaranteed Losses			
18.1	No load losses at rated voltage and frequency on max MVA base	kW		
18.2	Load losses at rated current and at 75 deg C on max MVA base	kW		
18.3	Cooler losses for full load operation on max MVA base	kW		
18.4	Total Loss	kW		
19	Impedance volt at rated current and frequency at 75 deg C winding Temp on ONAN, MVA base	%	Min 7%	
19.1	Positive Sequence Impendence at name plate Normal Tap			
19.2	Positive Sequence at maximum voltage tap			
19.3	Positive Sequence at minimum voltage tap			
19.4	Zero sequence at Name plate tap			
20	Reactance at rated current and frequency at 75deg C on maximum MVA base at a nameplate tap	%		
21	Maximum flux density in core iron at normal voltage and frequency			
21.1	In Cores	T	1.6	
21.2	In Yokes	T	1.6	
22	Maximum current density in winding at rated power			
22.1	In LV Windings	A/mm2	2.5	
22.2	In HV Windings	A/mm2	2.5	
23	Efficiency at 75 deg C winding temperature			
23.1	At 100% Load	%		
23.2	At 75% Load	%		
23.3	At 50% load	%		
23.4	Load in Percentage of full load and Power Factor at which maximum efficiency occurs	%		
24	Regulation at full load and 75 deg C			
24.1	At Unity Power Factor	%		
24.2	At 0.85 Power Factor Lagging	%		
25	No load Current in percentage of rated current referred to HV and 50 Hz			
25.1	At 90% rated voltage	A		
25.2	At 100% rated voltage	A		
25.3	At 110% rated voltage	A		
26	Clearances			
26.1	Minimum clearance in air HV/LV	mm		
26.2	Between phases	mm		
26.3	Between phases and ground	mm		
27	Insulation level			
27.1	Power Frequency withstand voltage(1min rms)			
27.1.1	Primary	kV	70	
27.1.2	Secondary	kV	28	
27.2	Impulse withstand voltage			

S.N.	Description	Unit	NEA requirement	To be filled by Bidder/Manufacturer
27.2.1	Primary	kV peak	170	
27.2.2	Secondary	kV peak		
28	Details of Oil Preservation system			
28.1	Type		Conservator Type	
28.2	If conservator type, urethane air cell provided	yes/no	yes	
28.3	Volume of Conservator	rs		
28.4	Volume of oil between the highest and lowest levels			
29	Pressure relief device min pressure settings			
30	Details of bushing HV/LV/HV Neutral, Manufacturer/ Type			
30.1	Name of Manufacturer			
30.2	Type			
30.3	Voltage Class	kV	36/12	
30.4	Creep Distance	mm	825/275	
30.5	Weight of Bushing	kg		
30.6	Standard reference			
30.7	Dry flash over voltage	kV	70/28	
30.8	Wet flash over voltage	kV	70/28	
30.9	Impulse withstand voltage	kV peak	170/75	
31	Insulating Oil			
31.1	Type and Grade of oil			
31.2	Approx. volume of oil	Liters		
31.3	First filled of oil with 10% excess provided	yes/no	yes	
32	Bushing Current transformer			
32.1	Type and voltage class			
32.2	Number of cores			
	HV	Nos	1/phase	
	LV	Nos	1/phase	
32.3	Accuracy class and Burden			
	Accuracy		PS	
	Burden	VA	15	
32.4	Max resistance of secondary winding	ohm		
33	Make of OLTC control panel with AVR			
34	Core Material			
34.1	Type			
34.2	Source			
34.3	Losses	W/kg		
35	Approximate overall dimension	L*W*H		
36	Approximate weight	kg		
36.1	Core	kg		
36.2	Coil	kg		
36.3	Tank and fitting	kg		
36.4	Oil	kg		
36.5	Total weight	kg		
37	Shipping			
37.1	Total Shipping weight	kg		
37.2	Total Shipping dimensions (LxWxH)	mm		
38	Delivery of equipment following award of contract and approval of drawing	months		
39	ISO 9001 (including design) holder	yes/no	yes	
39.1	ISO 9001 certificate submitted	yes/no	yes	

S.N.	Description	Unit	NEA requirement	To be filled by Bidder/Manufacturer
40	Type test certificate submitted	yes/no	yes	
40.1	Submitted for the required rating	yes/no		
40.2	Type test certified by			
41	User's certificate submitted	yes/no	yes	
42	Has exported to third country	yes/no	yes	
43	Copies of relevant standards attached	yes/no	yes	
44	Outline Drawings and associated GA attached	yes/no	yes	

Signed by……..
Designation……..
As Representative for……..
Place……
Date……..
Seal of Bidder/Manufacturer …….

2. Station Service Transformer

2.1 General

This specification covers the design, manufacture, assembly, shop test, supply, delivery, installation, field testing and commissioning of the station service transformers complete with all accessories, fittings and auxiliary equipment for efficient and trouble-free operation as specified herein under. The Contractor shall undertake all the works (complete supply and installation) relating to the connection of the station service transformer to the HV/LV control and distribution panels.

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

IEC60076	Power transformers
IEC 60137	Bushings for alternating voltages above 1 kV
IEC 60156	Method of determination of electric strength of insulating oils
IEC 60296	Specification for unused mineral insulating oils for transformers and switchgear
IEC 60551	Measurement of transformer and reactor sound levels
IEC 60616	Terminal and tapping markings for power transformer
IEC 60722	Guide to lightning and switching impulse testing of power transformers

Manufacturer of station service transformer shall be ISO 9001 Certificate (including design) holder.

2.2 Equipment to be furnished

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

2.3 Design Requirements

The transformers shall be connected to three phase, 50Hz system of 33kV system.

The transformer shall be installed outdoor in a hot, humid atmosphere. The transformer shall be oil immersed and designed for the cooling system as specified in Appendices.

The transformer shall be capable of operating continuously at its rated output without exceeding the temperature rise limits as specified in Appendices.

2.4 Construction Features

2.4.1 Tank

The transformer shall be provided with steel case of rigid construction, which shall be oil-tight complete with oil preservation system.

The tank shall be capable of withstanding, without leakage or permanent distortion, a pressure 25% greater than the maximum operating pressure resulting from the system of oil preservation used. The tank cover shall be bolted and provided with suitable hand hole. Two grounding pad complete with clamp type terminal connector shall be provided on the tank wall near the base.

2.4.2 Core & Coils

The core shall be built up with interleaved grade non-aging, low loss, high permeability, grain-oriented, cold rolled silicon steel lamination properly treated for core material. The coils shall be manufactured from electrolytic copper of suitable grade. They should be properly insulated and stacked.

All insulating material shall be of proven design. Coils shall be insulated that impulse and power frequency voltage stresses are minimum.

The core and coil assembly shall be securely fixed in position so that no shifting or deformation occurs during movement of transformer or under short circuit stresses.

2.4.3 Tap changer

An externally operated tap changer shall be furnished with each transformer, to be operated only when the transformer is de-energized. The tap changer shall include an operating handle, visible indication of tap position and mans for locking the tap changer in any desired position. The locking device shall be arranged to prevent locking the tap changer in an off position. Mechanical means shall be provided for limiting the maximum and minimum traveling of the extreme tap positions to be at the maximum and minimum positions of the tap changer.

2.4.4 Insulating oil

The insulating oil shall conform to the latest revision of IEC Publication 296, properly inhibited for preventing of slugging.

2.4.5 Oil preservation system

Oil preservation shall be by means of conservator tank system.

2.5 Accessories

The following accessories shall be provided with each transformer:

(a) Upper oil filter valve

(b) Lower oil filter and drain valve

(c) Oil sampling device

(d) Liquid level gauge

(e) Lifting lugs

(f) Nameplate

(g) Hand-hole

(h) Tank grounding terminal connector suitable for grounding cable

2.6 Tests

2.6.1 Routine tests

Transformer shall be subjected to the following tests but not limited to them:

(a) Applied voltage test

(b) Induced voltage test

(c) No-load loss and excitation current tests

(d) Impedance voltage and load loss tests

(e) Resistance measurement

(f) Ratio tests

(g) Polarity and phase-relation tests

(h) Leakage tests

(i) Insulation resistance tests

2.6.2 Design tests

Transformer shall be subjected to the following tests but not limited to them. These tests may be waived if a record of the tests performed on an identical unit can be supplied.

(a) Temperature rise tests

(b) Impulse voltage tests

2.6.3 Field test

After installation at Site, the transformer shall be subjected but not limited to the following field tests.

(a) Construction inspection

(b) Measurement of insulation resistance

(c) Ratio test

(d) Polarity test

2.7 Technical Particulars of Station Service Transformers

1.	Rating (ONAN)		100kVA
2.	Quantity required		as per price schedule
3.	Service		Outdoor
4.	Type		Oil-immersed
5.	Type of cooling		ONAN
6.	Temperature rise above 45 deg. C ambient temperature		
	(a)	In oil by thermometer	50 deg. C
	(b)	In winding by resistance	55 deg. C
7.	Number of phases and frequency		3 phase. 50Hz
8.	Maximum system voltage		
	(a)	Primary	36kV
	(b)	Secondary	440V
9.	Rated voltage (line to line)		
	(a)	Primary	33kV
	(b)	Secondary	400/230V
10.	Insulation level		
	(a)	Basic impulse level as per IEC 60076	
		- Primary	170kV
	(b)	Power frequency induced over voltage (1 min.)	
		- Primary	70kV
		- Secondary	3kV
11.	Connection		
	(a)	Primary	Delta
	(b)	Secondary	Star
12.	Vector group reference		Dyn 11
13.	Type of tap changer voltage taps		±2.5%. ±5% on HV side
14.	Percentage impedance voltage at rated kVA and 75 deg. C		7% on 100kVA
15.	System grounding		
	(a)	Primary	Ungrounded
	(b)	Secondary	Solidly grounded

GUARANTEED TECHNICAL PARTICULARS
(To be completed by Bidder/Manufacturer for each transformer rating)

Item: Station Service Transformer

S.N.	Description	Unit	NEA Requirement	To be filled by Bidder/Manufacturer
1	Name of Manufacturer			
2	Country of Origin			
3	Year of manufacturing experience			
4	Applicable Standard			
5	Winding material:		Copper	
6	Primary Winding BIL	kV		
7	Primary Bushing BIL	kV		
8	Accessories listed below furnished?			
8.1	Lower oil filter valve	Yes/No	Yes	
8.2	Liquid level gauge	Yes/No	Yes	
8.3	Lifting lugs	Yes/No	Yes	
8.4	Hand hole	Yes/No	Yes	
8.5	Tank earthing terminal	Yes/No	Yes	
8.6	Overload protection	Yes/No	Yes	

S.N.	Description	Unit	NEA Requirement	To be filled by Bidder/Manufacturer
	If yes, details attached?	Yes/No	Yes	
9	Design Information			
9.1	Rated kVA (IEC rating)	kVA		
9.2	Number of phases	Number	3	
9.3	Frequency, Hz	Hz	50	
9.4	Voltage ratio at no-load	V/V	11000/400	
9.5	Winding connections		Dyn11	
9.6	Type of core sheet			
9.7	Magnetizing current at normal ratio:			
	in HV side	A		
	in LV side	A		
9.8	Maximum flux density in core iron at normal voltage and frequency based on the net section of iron:			
	in Cores	T	1.6	
	in Yokes	T	1.6	
9.9	Type of winding:			
	HV winding			
	LV winding			
9.10	Maximum current density in winding at rated power:			
	in HV winding	A/mm^2	2.5	
	in LV winding	A/mm^2	2.5	
9.11	Type of insulation used for			
	HV winding			
	LV winding			
9.12	No-load loss at normal voltage ratio and 75°C	W		
9.13	Load loss at rated current and at 75°C	W		
9.14	Regulation at 75 degC and rated power as a percentage of normal voltage			
	at power factor =1	%		
	at power factor =0.8	%		
9.15	Impedance voltage at 75 degC and rated power			
	at normal tapping	%	7	
	at -5% tapping	%		
	at +5% tapping	%		
9.16	Efficiency			
	at 1 p.f and 125% of rated current	%		
	at 1 p.f and 110% of rated current	%		
	at 1 p.f and 100% of rated current	%		
	at 1 p.f and 75% of rated current	%		
	at 1 p.f and 50% of rated current	%		
	at 1 p.f and 25% of rated current	%		
9.17	Temperature rise at rated kVA by thermometer in oil	°C		
9.18	Temperature rise at rated kVA by resistance of windings	°C		
9.19	Permissible overload			
9.20	Transformer insulating oil specification			
9.21	Total volume of insulating oil at 20°C	L		
9.22	Effective expansion capacity of conservator.	L		
10	Approximate weight and dimensions			
10.1	Weight of transformer core	kg		
10.2	Weight of transformer windings	kg		
10.3	Weight of transformer tank and fittings	kg		
10.4	Weight of Oil	kg		
10.5	Total weight of transformer	kg		
10.6	Thickness of tank sides	mm		
10.7	Thickness of tank bottom	mm		
10.8	Thickness of radiator	mm		
10.9	Approximate dimensions including fittings(LxWxH)	mm		
11	Shipping details			
11.1	Total Shipping weight	kg		
11.2	Total Shipping dimensions (LxWxH)	mm		
12	Delivery of equipment following award of contract and approval of drawing	months		
13	ISO 9001 (including design) holder	yes/no	yes	
13.1	ISO 9001 certificate submitted	yes/no	yes	
14	Type test certificate submitted	yes/no	yes	
14.1	Submitted for the required ratings	yes/no		
14.2	Type test certified by			
15	User's certificate submitted	yes/no	yes	
16	Has exported to third country	yes/no	yes	

S.N.	Description	Unit	NEA Requirement	To be filled by Bidder/Manufacturer
17	Copies of relevant standards attached	yes/no	yes	
18	Outline Drawings and associated GA attached	yes/no	yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer …….

3. Circuit Breaker

3.1 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 Schneider/CGL/ABB/Siemens/GE/Hitachi/Mitsubishi/LG/Fuji 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

3.2 Equipment to be furnished

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

3.3 Design Requirements

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

3.3.2 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.

3.3.3 The maximum temperature rises 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.

3.3.4 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”.

3.3.5 Technical particulars of the circuit breaker shall be as per 3.10.

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

3.4 Construction Features

3.4.1 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.

3.4.2 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.

3.4.3 **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 either

of both moving and stationary arcing contacts, which are exposed directly to the arc, shall be faced with suitable arc resisting material.

3.4.4 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.

3.4.5 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.

3.4.6 Position indicator

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

3.4.7 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%.

3.4.8 Operation Counter

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

3.4.9 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

3.4.10 Spare parts

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

3.5 Tests

3.5.1 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

3.5.2 Design tests

The Contractor shall conduct the following design tests on one circuit breaker being furnished. However, if these tests have been previously conducted on identical circuit breakers, the Contractor may furnish certified copies of such previous reports instead of performing tests on the actual circuit breakers being furnished. The Bidder shall submit the copy of design test for identical circuit breaker with the proposal.

(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.

3.5.3 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

3.6 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.

3.7 Drawings, Data and Manuals

3.7.1 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

3.7.2 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.

3.8 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

3.9 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.

3.10 Technical Particulars of 33kV 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	170kV

	(b) Power frequency withstand voltage (1 min)	75kV
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
10. First pole to clear factor		1.5
11. Additional auxiliary contacts		8 NO, NC
12. Maximum make time		120 ms
13. Spring charging motor		110 V DC

GUARANTEED TECHNICAL PARTICULARS

(To be completed by Bidder/Manufacturer)

Item: 33kV Circuit Breaker

S. N.	Description	Unit	NEA requirement	To be filled by Bidder/Manufacturer
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 deg C 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	kA	25	
12	Rated short circuit making current			
12.1	Peak	kAp	62.5	
12.2	RMS symmetrical	kA		
13	Interrupting time at 100% capacity			
13.1	Maximum opening time	ms	40	
13.2	Total interrupting time	ms	60	
14	Closing time	ms	100	
15	Make time	ms	120	
16	Maximum current breaking capacity	A		
17	Insulation level			
17.1	Impulse withstand voltage(peak)	kV	170	
17.2	Power frequency withstand voltage	kV	70	
18	Operating Mechanism			

S. N.	Description	Unit	NEA requirement	To be filled by Bidder/Manufacturer
18.1	Type		Spring Loaded	
18.2	Number of mechanism per beaker		1	
18.3	Single/Three phase auto-reclosure		not required	
18.4	Operating voltage of closing and tripping coil	V DC	110	
18.5	Operating voltage range	% of rated voltage		
	Closing		85-110%	
	Tripping		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	Yes/No	Yes	
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		O-0.3sec-CO-3min-CO	
24	Number of possible operation without maintenance under			
24.1	Rated short circuit breaking current	No		
24.2	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	Mechanical dimension (LxWxH)			
29	Shipping details			
29.1	Total Shipping weight	kg		
29.2	Total Shipping dimensions (LxWxH)	mm		
30	Delivery of equipment following award of contract and approval of drawing	months		
31	ISO 9001 (including design) holder	yes/no	yes	
31.1	ISO 9001 certificate submitted	yes/no	yes	
32	Type test certificate submitted	yes/no	yes	
32.1	Submitted for the required ratings	yes/no		
32.2	Type test certified by			
33	User's certificate submitted	yes/no	yes	
34	Has exported to third country	yes/no	yes	
35	Copies of relevant standards attached	yes/no	yes	
36	Outline Drawings and associated GA attached	yes/no	yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer …….

4. Disconnecting Switch

4.1 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 isolator shall hold valid ISO 9001 (including design) quality certificate.

4.2 Equipment to be furnished

33 kV Disconnecting Switch

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

4.3.2 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.

4.3.3 The maximum temperature rises 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^{o}·C as an ambient temperature of the site, if it is designed for any lower ambient temperature.

4.3.4 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."

4.3.5 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.

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

4.3.7 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.

4.3.8 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.

4.4 Construction Features

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

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

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

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

4.4.5 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.

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

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

4.4.8 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.

4.4.9 **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.

4.4.10 **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.

4.5 Operating Mechanism

The operating mechanism for 33kV Disconnecting switches 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, interphase 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.

4.6 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.

4.7 Tests

4.7.1 Type and routine tests on the equipment and components shall be in accordance with latest revision of IEC Standards or equivalent standards approved by the Employer/Employer's Representative.

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.

4.7.2 The type and routine test certificate shall be furnished in the required number of copies to the Employer/Employer's Representative for approval before dispatch of the equipment from the works.

4.7.3 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

4.8 Drawings, Data and Manuals

4.8.1 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.

4.8.2 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.

4.9 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	33kV
	(b)	Rated maximum voltage	36kV
4.	Frequency		50Hz
5.	Insulation levels		
	(a)	Basic impulse level (BIL)	170kV
	(b)	Power frequency withstand voltage (1 min.)	75kV
6.	Current ratings		
	(a)	Continuous current	800A
	(b)	Short time current (1 seconds)	25 kA
	(c)	Peak short time current	32kA
	(d)	Making current of grounding switch	32kA
7.	Operating mechanism		Manually gang operated

4.10 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	33kV
	(b)	Rated maximum voltage	36kV
4.	Frequency		50Hz
5.	Insulation levels		
(a)	Basic impulse level (BIL)		170kV
(b)	Power frequency withstand voltage (1 min.)		75kV
6.	Current ratings		
	(a)	Continuous current	800A
	(b)	Short time current (1 seconds)	25kA
	(c)	Peak short time current	32kA
7.	Operating mechanism		Manually gang operated

GUARANTEED TECHNICAL PARTICULARS
(To be completed by Bidder/Manufacturer)

Item: 33kV Disconnecting Switch

S. N.	Description	Unit	NEA requirement	To be filled by Bidder/Manufacturer
1	Manufacturer			
2	Country of Origin			
3	Year of manufacturing experience			
4	Model No.			
5	Applicable Standard		IEC	
6	Type		3pole, single throw, outdoor, center rotating	
7	frequency	Hz	50	
8	Rated voltage			
8.1	Nominal	kV	33	
8.2	Maximum	kV	36	
9	Rated Current			
9.1	Continuous at 45 deg C ambient	A	800	
9.2	Short time for 3 sec at max kV	kA	25	
9.3	Peak short time current	kA		

S. N.	Description	Unit	NEA requirement	To be filled by Bidder/Manufacturer
10	Temperature rise above 45 deg C ambient at normal rated current			
10.1	Contacts	deg C		
10.2	Current carrying parts	deg C		
11	Maximum current the switch can safely interrupt			
11.1	Bus/Line charging current	A	0.5 min	
11.2	Potential transformer magnetizing current	A	0.5 min	
12	Clearance			
12.1	Between live parts and ground	mm		
12.2	Between fixed contact and blade in open position	mm		
13	Insulation level			
13.1	Impulse withstand voltage(peak)	kV	170	
13.2	Power frequency withstand voltage (1min,rms)	kV	75	
14	Main contacts			
14.1	Material of fixed contact		copper alloy	
14.2	Coating of fixed contact		copper alloy	
14.3	Material of moving contacts		copper alloy	
14.4	Coating of moving contacts		copper alloy	
14.5	Material of the contacts of the earthing switch		copper alloy	
14.6	Coating of the contacts of the earthing switch		copper alloy	
15	Material of Terminals			
15.1	Coating of terminals			
16	Operating mechanism		Local, manual operation	
17	Auxiliary Contacts			
17.1	Type	Convertible or fixed	convertible	
17.2	Continuous current at 110 V DC	A	0.5	
17.3	Material		copper	
17.4	contacts silver plated	yes/no	yes	
18	No of operation switch can withstand without deterioration of contact	No		
19	Type of interlock furnished		Electrical and mechanical	
20	Are the disconnector and the earthing switch mechanically interlocked to each other	yes/no	yes	
21	Insulator			
21.1	Manufacturer			
21.2	Type			
21.3	Ref Standard			
21.4	No of units per stack			
21.5	Power frequency withstand voltage			
21.5.1	Dry	kV		
21.5.2	Wet	kV		
21.6	Impulse withstand voltage (1min)			
21.7	Creepage distance in Air	mm		
21.8	Tensile strength			
21.9	Cantilever strength			
21.10	Compression strength			
21.11	Torsional strength			
22	Enclosure Protection		IP-55w	
23	Operating mechanism		Manual, gang operated	
24	Type of interlock furnished		Manual	
25	Weight of Isolator	kg		
26	ISO 9001 holder	yes/no	yes	
26.1	ISO 9001 certificate submitted	yes/no	yes	
27	Type test certificate submitted	yes/no	yes	
27.1	Submitted for the required ratings	yes/no		
27.2	Type test certified by			
28	User's certificate submitted	yes/no	yes	
29	Has exported to third country	yes/no	yes	
30	Copies of relevant standards attached	yes/no	yes	
31	Outline Drawings and associated GA attached	yes/no	yes	

Signed by……..
Designation……..

As Representative for……..

Place……
Date……..
Seal of Bidder/Manufacturer …….

5. Power Fuse

5.1 General

This specification covers the design, manufacture, assembly, shop test, supply, delivery, installation works and field test of power fuse.

Manufacturer of fuse shall be holder of valid ISO 9001 Certificate (including design).

5.2 Equipment to be furnished

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

5.3 Design Requirements

Power fuse shall be in accordance with IEC standards. The fuse set shall be of drop out type and fuse shall be contained inside fiberglass suitable for outdoor use in a tropical climate. Complete fuse mountings and holders shall be furnished as specified in Technical Particulars enclosed. Refill units are to be furnished separately.

All terminals shall be of high conductivity copper alloy and all terminals for aluminum shall be plated with hot-flowed electro-tin or cadmium.

The insulated stick furnished for replacing the fuses shall be 6m (20 feet) and a combination type suitable for operating hook stick disconnectors. The stick shall be of fiberglass or plastic over a wood or plastic foam cane and have voltage withstand rating of 246 kV per meter.

Technical particulars of power fuse shall be as per Appendices enclosed.

5.4 Tests

In addition to the manufacturer's routine production tests, power fuse of each type and rating shall be subject to the tests in accordance with IEC standards.

5.5 Data

The contractor shall furnish complete data for applying and coordinating the fuses supplied. This data shall include log-log time-current curves of minimum and maximum clearing for each fuse size furnished.

5.6 TECHNICAL PARTICULARS OF POWER FUSE

1.	Type	Single pole, single throw, drop out, hook stick operated, outdoor type
2.	Application	Protection of Station Transformer
3.	Quantity required	As per Price Schedule
4.	Voltage ratings	
	(a) Nominal voltage class	33kV
	(b) Rated maximum voltage	36kV
5.	Basic impulse level (BIL)	170kV
6.	Power frequency withstand voltage	70kV
7.	Current rating	100A
8.	Interrupting rating (Max. rms)	8kA (Symmetrical)
9.	Mounting position	Vertical

GUARANTEED TECHNICAL PARTICULARS
(To be completed by Bidder/Manufacturer)

Item: 33kV Power Fuse

S. N.	Description	Unit	NEA requirement	To be filled by Bidder/Manufacturer
1	Manufacturer			
2	Country of Origin			
3	Year of manufacturing experience			
4	Model No.			
5	Applicable Standards		IEC 60282-2	

S. N.	Description	Unit	NEA requirement	To be filled by Bidder/Manufacturer
6	Type		Single pole, single throw, drop out, hook stick operated, outdoor type	
7	frequency	Hz	50	
8	Rated voltage			
8.1	Nominal	kV	33	
8.2	Maximum	kV	36	
9	Current Rating			
9.1	Continuous at 45 deg C ambient	A	100	
9.2	Short time for 3 sec at max kV	kA	25	
9.3	Peak short time current	kA		
10	Interrupting rating (Max. rms)	kA	8 (Symmetrical)	
11	Insulation level			
11.1	Impulse withstand voltage(peak)	kV	170	
11.2	Power frequency withstand voltage (1min, rms)	kV	75	
12	Fuse			
12.1	Fuse Rating	A		
12.2	Fuse Type			
13	Mounting Position		Vertical	
14	Number of Pole		3	
15.1	Type of Contact			
15.2	Materials of Contact Service			
16	Creepage Distance	mm		
17	Air Gap between pole of phase			
18	Clamp Type Terminals for Copper/Aluminum Cable (25-150 mm2 size)	yes/no	yes	
19	Steel mounting bracket provided	yes/no	yes	
20	Dimensions (LxWxH)	mm		
21	Total Weight of Unit	kg		
22	Weight of Isolator	kg		
23	ISO 9001 holder (including design)	yes/no	yes	
23.1	ISO 9001 certificate submitted	yes/no	yes	
24	Type test certificate submitted	yes/no	yes	
24.1	Submitted for the required ratings	yes/no		
24.2	Type test certified by			
25	User's certificate submitted	yes/no	yes	
26	Has exported to third country	yes/no	yes	
27	Copies of relevant standards attached	yes/no	yes	
28	Outline Drawings and associated GA attached	yes/no	yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer …….

6. Instrument Transformer

6.1 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.

6.2 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.

i. 33 kV Current Transformer for Measurement & Protection

ii. 33kV/110V Potential Transformer for Measurement & Protection

6.3 Design Requirements

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

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.

6.4 Construction Features

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

6.4.2 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.

6.4.3 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.

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

6.4.5 **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 1.2 mm. 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.

6.4.6 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.

6.4.7 Protective devices

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.

6.4.8 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

6.5 Tests

Tests shall be performed as specified hereunder.

6.5.1 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

Type test records of an identical unit of current transformer shall be submitted to Employer/Employer's Representative. In case type test records are not available, the actual tests shall be performed. The items of test shall be as follow:

-Short time current test

-Temperature rise test

-Power frequency withstand voltage (wet) test

-Impulse voltage withstand test

-Temperature rise test

6.5.2 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

Type test records of an identical unit of potential transformer shall be submitted. In case type tests records are not available, the actual tests shall be performed. The items of test shall be as follows:

-Voltage test between phase and ground terminals

-Power frequency withstand (wet) test

-Impulse test

-Radio-influence voltage test

-Short-time over voltage test

-Thermal burden test

6.5.3 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

6.6 Drawings, Data and Manuals

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

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.

6.7 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	33kV
4.	Max. system voltage	36kV
5.	Impulse withstand voltage	170kV
6.	Rated frequency	50Hz
7.	Number of cores	3
8.	Current Ratio	300-150-75/1A
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

6.8 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/√3 V
10.	Rated burden for each winding	100 VA
11.	Accuracy	5P20 for protection and 0.5 for metering
12.	Power factor	0.85
13.	Rated voltage factor	1.1 continuous, 1.5 for 30 sec

GUARANTEED TECHNICAL PARTICULARS
(To be completed by Bidder/Manufacturer)

Item: Current Transformer

S. N.	Description	Unit	NEA requirement	To be filled by Bidder/Manufacturer
1	Manufacturer			
2	Country of Origin			
3	Year of manufacturing experience			
4	Model No.			
5	Applicable Standard		IEC	
6	Type		one phase outdoor, oil immersed	
7	Number of phases	Nos	1	
8	Number of core in each CT	Nos	3	
9	Frequency	Hz	50	
10	Rated primary voltage			
10.1	Nominal	kV	33	
10.2	Maximum	kV	36	
11	Temperature rise above 45 deg C ambient at normal rated current	deg C		
12	Insulation level			
12.1	Impulse withstand voltage	kV	170	
12.2	Power frequency withstand voltage (1min rms)	kV	75	
13	Creepage distance	mm	825	
14	Short time thermal rating	kA	25	
15	Current ratings	A	300-150-75/1	
16	Rated VA burden	VA	50	
17	Accuracy class		5P20 for protection and 0.5 for metering	
18	Rated thermal VA burden	VA		
19	Over load factor	%	200	
20	Dimension	(LxWxH)		
21	Weight	kg		
22	ISO 9001 holder	yes/no	yes	
22.1	ISO 9001 certificate submitted	yes/no	yes	
23	Type test certificate submitted	yes/no	yes	
23.1	Submitted for the required ratings	yes/no		
24.2	Type test certified by			
25	User's certificate submitted	yes/no	yes	
26	Has exported to third country	yes/no	yes	
27	Copies of relevant standards attached	yes/no	yes	
28	Outline Drawings and associated GA attached	yes/no	yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer …….

GUARANTEED TECHNICAL PARTICULARS

(To be completed by Bidder/Manufacturer)

Item: Potential Transformer

S. N.	Description	Unit	NEA requirement	To be filled by Bidder/Manufacturer
1	Manufacturer			
2	Country of Origin			
3	Year of manufacturing experience			
4	Model No.			
5	Applicable Standard		IEC	
6	Type		outdoor, oil immersed	
7	Number of phases	No	1	
8	Frequency	Hz	50	
9	Rated primary voltage			
9.1	Nominal	kV	33√3	
9.2	Maximum	kV	36√3	
10	Temperature rise above 45 deg C ambient at normal rated current			
10.1	with 1.1 times rated primary voltage continuously	deg C		
10.2	with 1.5 times rated voltage for 30 seconds	deg C		
11	Insulation levels			
11.1	Impulse withstand voltage (peak)	kV	170	
11.2	Power frequency withstand voltage (1min rms)	kV	75	
12	Creepage distance	mm	825	
13	Open circuit intermediate voltage	V		
14	Ratings			
14.1	Voltage ratio	kV	33/√3:0.11/√3	
14.2	Rated burden	VA	100	
14.3	Accuracy class		5P20 and 0.5	
14.4	Over voltage factor			
14.4.1	30 seconds		1.1	
14.4.2	Continuous		1.5	
14.5	Connection			
14.6	Secondary fuse			
14.6.1	Manufacturer			
14.6.2	Amp. Ratings	A		
14.7	By pass device for protection provided	yes/no	yes	
14.8	Knife switch and fuse on secondary provided	yes/no	yes	
15	No of secondary windings	No	2	
16	Dimension (LxWxH)	mm		
17	Weight	kg		
18	ISO 9001 holder	yes/no	yes	
28.1	ISO 9001 certificate submitted	yes/no	yes	
19	Type test certificate submitted	yes/no	yes	
19.1	Submitted for the required ratings	yes/no		
19.2	Type test certified by			
20	User's certificate submitted	yes/no	yes	
21	Has exported to third country	yes/no	yes	
22	Copies of relevant standards attached	yes/no	yes	
23	Outline Drawings and associated GA attached	yes/no	yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer …….

7. Lightning Arrester

7.1 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 Arrester shall hold valid ISO 9001(including design) quality certificate.

7.2 Equipment to be furnished

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

7.3 Design Requirements

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.

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

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

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

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

7.4 Test

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

Type test certificates on similar equipment 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

7.5 Drawings and Data

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

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

7.6 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

7.7 TECHNICAL PARTICULARS OF 30kV LIGHTNING ARRESTER

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

GUARANTEED TECHNICAL PARTICULARS
(To be completed by Bidder/Manufacturer)

Item: 30kV Lightning Arrester

S. N.	Description	Unit	NEA requirement	To be filled by Bidder/Manufacturer
1	Manufacturer			
2	Country of Origin			
3	Year of manufacturing experience			
4	Model No.			
5	Applicable Standard		IEC	
6	Type		Outdoor, Gapless, Zinc-oxide, porcelain housed	
7	Voltage rating of LA	kV	30	
8	Nominal Discharge Current	kA	10	
9	Surge counter with insulating base furnished	yes/no	yes	
10	Minimum power frequency spark over voltage	kV		
11	Maximum 1/50 impulse spark over voltage	kV		
12	Maximum front wave spark over voltage	kV		
13	Maximum switch surge spark over voltage	kV		

14	Number of section per pole			
15	Insulation level			
15.1	Impulse withstand voltage (peak)	kV	170	
15.2	Power frequency withstand voltage (1min rms)	kV	75	
16	Creepage distance	mm	265	
17	Earth terminal and accessories provided	yes/no	yes	
18	Surge counter	yes/no	yes	
19	ISO 9001 holder	yes/no	yes	
20.1	ISO 9001 certificate submitted	yes/no	yes	
21	Type test certificate submitted	yes/no	yes	
21.1	Submitted for the required ratings	yes/no		
21.2	Type test certified by			
22	User's certificate submitted	yes/no	yes	
23	Has exported to third country	yes/no	yes	
24	Copies of relevant standards attached	yes/no	yes	
25	Outline Drawings and associated GA attached	yes/no	yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer …….

8. Battery and Battery Charger

8.1 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.

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

8.2 Equipment to be furnished

110 V Battery and Battery Charger

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

8.3 Design Requirements

8.3.1 Battery & battery charger

8.3.1.1 Maintenance free Battery

(a) The Maintenance free Battery shall be rated for supplying total DC load of 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 min - Emergency lighting load

- Control, indication, protection and annunciation load.

Last min - 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 (10hour 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 250 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.

(i) The manufacturer of above said maintenance free battery shall be holder of ISO 9001 certificate.

8.3.1.2 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 battery charger should have proper protection against supply over-voltages and under-voltages including surges on supply voltages.

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

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

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

(g) 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.

(h) The manufacturer of above said battery charger shall be holder of valid ISO 9001 certificate. In case such manufacturer is not available the contractor has to take the written permission from the employer.

8.3.2 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 2.5sqmm (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.

8.3.3 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 200mm from the gland plate to the nearest terminal block shall be provided.

8.3.4 Terminal blocks

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

8.3.5 11.3.5 Ground bus

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

All devices shall be grounded to the ground bus.

8.4 Accessories

8.4.1 The following accessories shall be furnished for the batteries:

(a) One (1) connector bolt wrench

(b) One (1) cell testing voltmeter with leads.

(c) Battery racks

(d) Other necessary accessories

8.4.2 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

8.5 Tests

Type and 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

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

Test certificates shall be submitted to the Employer/Employer's Representative for approval.

8.6 Drawings, Data and Manuals

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

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

8.7 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.

GUARANTEED TECHNICAL PARTICULARS
(To be completed by Bidder/Manufacturer)

Item: 110V Battery

S. N.	Description	Unit	NEA requirement	To be filled by Bidder/Manufacturer
1	Manufacturer			
	Country of Origin			
	Year of manufacturing experience			
2	Model No.			
3	Applicable Standards			
4	Type of battery		Maintenance free valve regulated lead Acid	
5	Number of cells	No		
6	Number of units	No		
7	Number cells in a unit	No		
8	Nominal voltage rating	V	110	
9	Nominal capacity at 27°C at 10h discharge time to cell end voltage 1.75	Ah	250	
10	Ampere capacity at 27°C at 10h 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 dimension			
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 can be kept without charging	month		
23	Battery life (guaranteed value)	years		
24	Rack interconnection furnished ?		Yes	
25	Delivery of equipment following award of contract and approval of drawing	months		
26	ISO 9001 holder (including design)	yes/no	yes	
26.1	ISO 9001 certificate submitted	yes/no	yes	
27	Type test certificate submitted	yes/no	yes	
27.1	Submitted for the required ratings	yes/no		
27.2	Type test certified by			
28	User's certificate submitted	yes/no	yes	
29	Has exported to third country	yes/no	yes	
30	Copies of relevant standards attached	yes/no	yes	
31	Outline Drawings and associated GA attached	yes/no	yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date……..
Seal of Bidder/Manufacturer …….

GUARANTEED TECHNICAL PARTICULARS
(To be completed by Bidder/Manufacturer)

Item: 110V Battery Charger

S. N.	Description	Unit	NEA requirement	To be filled by Bidder/Manufacturer
1	Manufacturer			
	Country of Origin			
	Year of manufacturing experience			
2	Model No.			
3	Applicable Standards		IEC	
4	Manufacturer's designation			
5	Type of battery		Constant Voltage	
6	Output rating	A	80	
7	Range of DC voltage variation	±V		
8	Maximum AC input	kVA		
9	Input Voltage/phase	V	400 V, 3phase	
10	Ripple	%	<2%	
11	Emergency of charger at 100% output	%		
12	Temperature rise above ambient of 45 degree C			
	a) Solid state elements	°C		
	b) Wound elements	°C		
13	Voltage regulation	%	+3% to -2% max	
14	Float voltage adjustment			
15	Equalizing voltage adjustment			
16	Auto equalizing charge provided ?	Yes/No	Yes	
17	Timer for equalizing charge provided ?	Yes/No	Yes	
18	End switching to limit equipment	type		
19	Manual over-ride switch for selection of float/equalizing charge provided ?	Yes/No	Yes	
20	Delivery of equipment following award of contract and approval of drawing	months		
21	ISO 9001 holder (including design)	yes/no	yes	
21.1	ISO 9001 certificate submitted	yes/no	yes	
22	Type test certificate submitted	yes/no	yes	
22.1	Submitted for the required ratings	yes/no		
22.2	Type test certified by			
23	User's certificate submitted	yes/no	yes	

24	Has exported to third country	yes/no	yes	
25	Copies of relevant standards attached	yes/no	yes	
26	Outline Drawings and associated GA attached	yes/no	yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer ……

9. Control and Relay Panel

9.1 General

9.1.1 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:

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

9.1.2 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.

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

9.1.4 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)	Schneider	b)	CG
c)	ABB	d)	Reyrolle/Easun Reyrolle
e)	Fuji	f)	Siemens
g)	Toshiba	h)	Mitsubishi

9.2 Equipment to be furnished

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

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.

9.3 Construction Features

The Panel Dimensions specified are tentative only and it is the responsibility of Tenderer 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.

The 33 kV panel shall be of Simplex type as per the layout of the respective Substation. For the Simplex type panels, it shall comprise of two vertical fronts side by side, with door at rear sections with built in locking facility.

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.

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 3 mm for front and rear portions and 2 mm for sides, top and bottom portions. There shall be sufficient reinforcement to provide level surfaces, resistance to vibration and rigidity during transportation and installation.

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.

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.

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.

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.

9.4 Component Mounting

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.

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.

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.

The centerline of switches, push buttons and indicating lamps shall be not less than 750 mm 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 450 mm from the bottom of the panel. No components shall extend below 200 mm.

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

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.

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

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.

The standard phase arrangement when facing the front of the switch-board shall be R-Y-B 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.

9.5 Mimic Diagrams

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.

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

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.

9.6 Annunciators

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.

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 is 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.

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.

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.

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.

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.

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.

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.

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.

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.

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

9.7 Specific Protection Requirements

9.7.1 Relay Protection

9.7.1.1 Overcurrent and Earth fault Protection

i. Non-Directional Phase Overcurrent Protection shall:

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

have a variable setting range of 5-200% of rated current

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 an adjustable setting of 5-80% of rated current.

9.7.1.2 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.

9.7.1.3 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 30 ms at 3 times of pickup current. Similarly, unrestrained operation time shall be 10-20ms at 2 times pickup current with minimum impulse time of 3 minutes.
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.

9.7.2 Manufacturer of Protection Relay shall be as specified

9.7.3 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.

iii. 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.

vii. 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.

9.7.4 Miscellaneous Accessories

i. Space Heater

Each panel shall be equipped with space heaters to prevent moisture condensation within the enclosure and shall be completed with switch fuse units for power supply. Space heaters and switch fuse units shall be suitable for continuous operation.

ii. Plug Point

A 230 V, 1 phase, 50Hz AC plug point shall be provided in the interior of each cubicle with on-off switch for connection of hand lamps.

9.8 Tests

9.8.1 Relay and Control Panels shall be subjected but not limited to the following tests:

i. Mechanical operation test

ii. Verification of degree of protection

iii. Calibration test for meters

iv. Characteristic test for relays

v. High voltage test of insulation (2000 volts for 1 minute)

vi. Electrical control, interlock and sequential operation tests

vii. Verification of wiring as per approved schematic diagram.

9.8.2 Type tests and routine tests shall be carried out on all associated equipment as per relevant standards approved by the Employer.

9.8.3 Certified copies of all type and routine test certificates shall be submitted for the Employer's approval before dispatching the control and relay panel.

9.8.4 After completion of the installation, panels shall be subjected but not limited to the following field tests:

i. Electrical control, interlock and sequential operation tests
ii. Calibration test for meters
iii. Measurement of insulation resistance
iv. Characteristic test for relays

9.8.5 Transformer Protection

33/11 kV, 6/8 MVA transformer shall be protected by the following relays
a Over current relay
b Earth fault relay
c Differential relay

9.8.6 Line Protection

33kV transmission liine shall be protected by the following relays
a Over current relay
b Earth fault relay

9.9 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.

TRANSFORMER CONTROL & RELAY PANEL			
	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:	1 Lot
		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	
		2. Transformer LV Backup Protection trip	
		3. Transformer Differential Protection trip (6/8 MVA Transformer)	
		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	50/50N	Overcurrent Protection with Instantaneous Protection	1 Lot
2.2	51/51N	Earth Fault Protection with Instantaneous Protection	1 Lot
2.3	87	Differential Relay	1 Lot
2.4	51E	Transformer Protection	1 Lot
2.5	50B	Breaker Failure Protection	1 Lot
2.6		Trip circuit supervision relay	1 Lot
2.7		Interlocks, Switching & Tripping Relay	1 Lot
3	A	Indicating Ammeter, Digital (300-150-75/1A)	3 Nos
4	V	Indicating Voltmeter, Digital (0-36kV)	3 Nos

5	kVA	0-10 MVA	1 Nos
6	kWh	TOD type	
7	P.F.	Power factor 0.6-1-0.6 lead	1 Nos
8		Breaker control switch, and with 2-separately mounted indicating lamps,	1 Nos
9		Disconnecting control switch, and with: 2-separately mounted indicating lamps	1 Nos
10		Electrically operated mimic disconnect device, 110V DC, to indicate the position of disconnecting switch	1 Lot
11		Electrically operated mimic connected to position of line ground switch	1 Lot
12		Trip Transfer Switch, for transferring trip signal, reclosing relay, PT circuit to bus tie Breaker. (wherever required)	1 Lot
13		Multiple Adjustable Ratio Intermediate Current Transformer for Differential Protection, if required	1 Set
LINE CONTROL & RELAY PANEL			
1.	ANN	Annunciator assembly, 18 active points, 110V DC, 3 rows high by 6 columns wide, flush mounted, and with:	1 Lot
		3-separately mounted push buttons 2-separately mounted indicating lamps, one white lamp, and one red lamp Following minimum annunciation shall be provided:	
		1. Overcurrent Trip	
		2. Earth-fault Trip	
		3. Trip Circuit-1 Unhealthy	
		4. Trip Circuit-2 Unhealthy	
		5. Relay Unhealthy	
		7. Circuit Breaker Trip	
		8. AC Fail	
		9. DC Fail	
		10 –18. 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	50/50N	Overcurrent Protection with Instantaneous Protection	1 Lot
2.2	51/51N	Earth Fault Protection with Instantaneous Protection	1 Lot
2.3	50B	Breaker Failure Protection	1 Lot
2.4		Trip circuit supervision relay	1 Lot
2.5		Interlocks, Switching & Tripping Relay	1 Lot
3	A	Indicating Ammeter, Digital (300-150-75/1A)	3 Nos
4	V	Indicating Voltmeter, Digital (0-36 kV)	3 Nos
5	kVA	0-10 MVA	1 Nos
6	kWh	TOD type	1 Lot
7	P.F.	Power factor 0.6-1-0.6 lead	1 Nos
8		Breaker control switch, and with 2-separately mounted indicating lamps,	1 Nos
9		Disconnecting control switch, and with: 2-separately mounted indicating lamps	1 Nos
10		Electrically operated mimic disconnect device, 110V DC, to indicate the position of disconnecting switch	1 Lot
11		Electrically operated mimic connected to position of line ground switch	1 Lot
12		Trip Transfer Switch, for transferring trip signal, reclosing relay, PT circuit to bus tie Breaker. (wherever required)	1 Lot
13		Multiple Adjustable Ratio Intermediate Current Transformer for Differential Protection, if required	1 Set

GUARANTEED TECHNICAL PARTICULARS

(To be completed by Bidder/Manufacturer)

Item: Control and Relay Panel for Transformer

S. N.	Description	Unit	NEA requirement	To be filled by Bidder
1	Manufacturer			
	Country of Origin			
	Year of manufacturing experience			
	Model No.			
	Applicable Standard			
2	**Control switches**			
2.1	Manufacturer and Country of origin			

S. N.	Description	Unit	NEA requirement	To be filled by Bidder
2.2	Type	Flush type		
2.3	Current Rating	A		
2.4	Catalog Furnished	yes/no	yes	
2.5	Applicable standard		IEC	
3	**Push Bottom**			
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	<0.5	
5	**Ammeter**		Required (separate)	
	Manufacturer and Country of origin			
	Type		Digital	
	Accuracy Class		0.5	
	Scale		Linear	
	Range of indication	A	0-300	
	Overloaded range	%	1.5	
	VA burden			
	Auxiliary DC supply	V	110	
	Catalog furnished	yes/no	yes	
	Transducer operated	yes/no	yes	
6	**Voltmeter**		Required (separate)	
	Manufacturer and Country of origin			
	Type		Digital	
	Accuracy class		0.5	
	Scale		Linear	
	Range of indication	kV	0-36	
	Over scale range	%	1.1	
	VA burden			
	Auxiliary DC supply	V	110	
	Catalog furnished	yes/no	yes	
	Transducer operated	yes/no	yes	
7	**Apparent power meter (kVA)**		Required (separate)	
	Manufacturer and Country of origin			
	Type		digital	
	Rated voltage	kV	33/√3:0.11/√3	
	Rated current	A	300-150-75/1	
	Current range (Transducer operated)	mA		
	Accuracy class		0.5	
	Scale			
	Type of scale		linear	
	Range of indication		0-10	
	VA burden			
	Current coil			
	Voltage coil			
	Auxiliary DC supply	V	110	
	Catalog furnished	yes/no	yes	

S. N.	Description	Unit	NEA requirement	To be filled by Bidder
	Transducer operated	yes/no	yes	
8	**kWh Meter**		Not Required	
	Manufacturer and Country of origin			
	Type		TOD (static) Should have a provision of recording in T1, T2 & T3	
	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	300-150-75/1	
	VA burden			
	Current coil			
	Voltage coil			
	Impulse contact provided 1pulse 100kW	yes/no	yes	
	Reverse rotation locking mechanism provided	yes/no	yes	
	Additional Requirement		Should be programmable on NEA laboratory	
9	**Power factor meter**		Required (separate)	
	Manufacturer and Country of origin			
	Type		digital	
	Accuracy class		0.5	
	Auxiliary DC supply	V	110	
10	**Annunciators**			
	Manufacturer and Country of origin			
	Type			
	Manufacturer's type designation			
	Number of inputs (annunciator/event)			
	Number of active points	nos	24	
	Number of rows		4	
	Number of column		6	
	Type of mounting		Flush	
	Auxiliary DC supply	V	110	
	Catalog furnished	yes/no	yes	
	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**		Required (separate)	
	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	5-200%	
	Operating time at 10 times current settings	m sec	3	
	Reset time	ms		
	Characteristics		IDMT (Standard inverse)	
	Instantaneous unit provided	yes/no	yes	
	Operating range			

S. N.	Description	Unit	NEA requirement	To be filled by Bidder
	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**		Required (separate)	
	Manufacturer and Country of origin			
	Type		Static, Non directional	
	Manufacturer's type designation			
	Applicable standard		IEC	
	Triple pole or single pole		Single*3	
	Continuous overload capacity	xIn		
	Current setting range	% of rated current	5-80%	
	operating time at 10 times current setting	msec	3	
	Characteristics		IDMT (Standard inverse)	
	Instantaneous unit provided	yes/no	yes	
	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 Overcurrent 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	

S. N.	Description	Unit	NEA requirement	To be filled by Bidder
	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		
	Current setting range	% of rated current	10-80%	
	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**		Required (separate)	
	Manufacturer and Country of origin			
	Standard reference			
	Type			
	Type of Mounting		Flush	
	Operating time setting	ms	<30	
	Sensitivity setting		20-50%xIn	
	Bias setting			
	CT ratio Compensating range			
	Burden for Current Circuit	VA		
	DC Burden	VA		
	Tripping Current	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**		Required (separate)	
	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			

S. N.	Description	Unit	NEA requirement	To be filled by Bidder
	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		Required (separate)	
	DC Voltage Rating	V	110	
	Nos of electrically separate NO and NC Contacts			
11.8	Break Failure Lockout Relay BF		Required (separate)	
	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	
	Painting		Light grey RAL 7032	
	All instruments, meters, relays and control switches flush or semi flush type		flush	
13	Ground Bus			
	Material		copper	
	Size	mm x mm		
14	Internal Wiring			
	Type of Insulation			
	Voltage Grade of Wires	V	600	
	Cross Section of Wires	sq.mm	min. 2.5	
	Current Circuit			
	Voltage and auxiliary circuit			
15	Over all dimension of control board (LxWxH)	mm		
16	Weight	kg		
17	Shipping data			
	Size of large package (LxWxH)	mm		
	Weight of heaviest package	kg		
18	ISO 9001 holder (including design)	yes/no	yes	
18.1	ISO 9001 certificate submitted	yes/no	yes	
19	Type test certificate submitted	yes/no	yes	
19.1	Submitted for the required ratings	yes/no		
19.2	Type test certified by			
20	User's certificate submitted	yes/no	yes	
21	Has exported to third country	yes/no	yes	
22	Copies of relevant standards attached	yes/no	yes	
23	Outline Drawings and associated GA attached	yes/no	yes	

Signed by……..

Designation……..

As Representative for……..
Place……
Date……..
Seal of Bidder/Manufacturer …….

GUARANTEED TECHNICAL PARTICULARS
(To be completed by Bidder/Manufacturer)

Item: Control and Relay Panel for Line

S. N.	Description	Unit	NEA requirement	To be filled by Bidder
1	Manufacturer			
	Country of Origin			
	Year of manufacturing experience			
	Model No.			
	Applicable Standard			
2	**Control switches**			
2.1	Manufacturer and Country of origin			
2.2	Type	Flush type		
2.3	Current Rating	A		
2.4	Catalog Furnished	yes/no	yes	
2.5	Applicable standard		IEC	
3	**Push Bottom**			
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	<0.5	
5	**Ammeter**		Required (separate)	
	Manufacturer and Country of origin			
	Type		Digital	
	Accuracy Class		0.5	
	Scale		Linear	
	Range of indication	A	0-300	
	Overloaded range	%	1.5	
	VA burden			
	Auxiliary DC supply	V	110	
	Catalog furnished	yes/no	yes	
	Transducer operated	yes/no	yes	
6	**Voltmeter**		Required (separate)	
	Manufacturer and Country of origin			
	Type		Digital	
	Accuracy class		0.5	
	Scale		Linear	
	Range of indication	kV	0-36	
	Over scale range	%	1.1	
	VA burden			
	Auxiliary DC supply	V	110	
	Catalog furnished	yes/no	yes	

S. N.	Description	Unit	NEA requirement	To be filled by Bidder
	Transducer operated	yes/no	yes	
7	**Apparent power meter (kVA)**		Required (separate)	
	Manufacturer and Country of origin			
	Type		digital	
	Rated voltage	kV	33/√3:0.11/√3	
	Rated current	A	300-150-75/1	
	Current range (Transducer operated)	mA		
	Accuracy class		0.5	
	Scale			
	Type of scale		linear	
	Range of indication		0-10	
	VA burden			
	Current coil			
	Voltage coil			
	Auxiliary DC supply	V	110	
	Catalog furnished	yes/no	yes	
	Transducer operated	yes/no	yes	
8	**kWh Meter**		Required (separate)	
	Manufacturer and Country of origin			
	Type		TOD (static) Should have a provision of recording in T1, T2 & T3	
	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	300-150-75/1	
	VA burden			
	Current coil			
	Voltage coil			
	Impulse contact provided 1pulse 100kW	yes/no	yes	
	Reverse rotation locking mechanism provided	yes/no	yes	
	Additional Requirement		Should be programmable on NEA laboratory	
9	**Power factor meter**		Required (separate)	
	Manufacturer and Country of origin			
	Type		digital	
	Accuracy class		0.5	
	Auxiliary DC supply	V	110	
10	**Annunciators**			
	Manufacturer and Country of origin			
	Type			
	Manufacturer's type designation			
	Number of inputs (annunciator/event)			
	Number of active points	nos	18	
	Number of rows		3	
	Number of column		6	
	Type of mounting		Flush	
	Auxiliary DC supply	V	110	
	Catalog furnished	yes/no	yes	

S. N.	Description	Unit	NEA requirement	To be filled by Bidder
	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**		Required (separate)	
	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	5-200%	
	Operating time at 10 times current settings	m sec	3	
	Reset time	ms		
	Characteristics		IDMT (Standard inverse)	
	Instantaneous unit provided	yes/no	yes	
	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**		Required (separate)	
	Manufacturer and Country of origin			
	Type		Static, Non directional	
	Manufacturer's type designation			
	Applicable standard		IEC	
	Triple pole or single pole		Single*3	
	Continuous overload capacity	xIn		
	Current setting range	% of rated current	5-80%	
	operating time at 10 times current setting	msec	3	
	Characteristics		IDMT (Standard inverse)	
	Instantaneous unit provided	yes/no	yes	
	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 Overcurrent Relay**		not required	
	Manufacturer and Country of origin			
	Type		static/ directional	

S. N.	Description	Unit	NEA requirement	To be filled by Bidder
	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		
	Current setting range	% of rated current	10-80%	
	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**		Not Required	
	Manufacturer and Country of origin			
	Standard reference			
	Type			
	Type of Mounting		Flush	
	Operating time setting	ms	<30	
	Sensitivity setting		20-50%xIn	
	Bias setting			
	CT ratio Compensating range			

S. N.	Description	Unit	NEA requirement	To be filled by Bidder
	Burden for Current Circuit	VA		
	DC Burden	VA		
	Tripping Current	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**		Required (separate)	
	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		Required (separate)	
	DC Voltage Rating	V	110	
	Nos of electrically separate NO and NC Contacts			
11.8	Break Failure Lockout Relay BF		Required (separate)	
	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	
	Painting		Light grey RAL 7032	
	All instruments, meters, relays and control switches flush or semi flush type		flush	
13	Ground Bus			
	Material		copper	
	Size	mm x mm		
14	Internal Wiring			
	Type of Insulation			
	Voltage Grade of Wires	V	600	
	Cross Section of Wires	sq.mm	min. 2.5	

S. N.	Description	Unit	NEA requirement	To be filled by Bidder
	Current Circuit			
	Voltage and auxiliary circuit			
15	Over all dimension of control board (LxWxH)	mm		
16	Weight	kg		
17	Shipping data			
	Size of large package (LxWxH)	mm		
	Weight of heaviest package	kg		
18	ISO 9001 holder (including design)	yes/no	yes	
18.1	ISO 9001 certificate submitted	yes/no	yes	
19	Type test certificate submitted	yes/no	yes	
19.1	Submitted for the required ratings	yes/no		
19.2	Type test certified by			
20	User's certificate submitted	yes/no	yes	
21	Has exported to third country	yes/no	yes	
22	Copies of relevant standards attached	yes/no	yes	
23	Outline Drawings and associated GA attached	yes/no	yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date……..
Seal of Bidder/Manufacturer …….

10. Bus-bar Materials including insulators

10.1 General

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

10.2 Equipment to be furnished

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

10.3 Technical Requirements

10.3.1 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 11kV disc insulator.

(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 60168.

(f) Standard particulars of insulator units

Insulator units shall comply with the following requirements. (IEC 60305)

-	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 60120 (1977), and the internal height of the socket shall also comply with the requirements of IEC Publication 60372-1.

10.3.2 **Bus Conductor and fittings**

(a) General

Bus bars and electrical connections in outdoor substations shall be in accordance with IEC, IS or equivalent international standards in respect of current rating and material analysis.

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

	Bus	Material	Min. Size
-	33kV Main	ACSR	BEAR
-	33kV Branch	ACSR	BEAR
-	Overhead ground wire	GSW	55sq.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 busbars shall be arranged so that they may be readily extended in length with a minimum of disturbance to existing equipment.

Busbars 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, busbars 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)

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 IS or equivalent international standards.

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.

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 busbars. 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 wire shall be galvanized steel wire, stranded with a cross sectional area of 55 sq.mm. 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.

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.

10.4 Tests

10.4.1 The insulators shall be tested in accordance with the applicable 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

10.4.2 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

10.5 Packing and Marking

10.5.1 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.

10.5.2 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 it 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.

10.6 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. 12kV Switchgear

11.1 Scope of work:

12KV cubicle type Indoor Switchgear Panel shall be an air insulated metal clad switchgear with withdrawable 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 a 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)

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.

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.

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.

The cubicle shall be of modular design consisting of separate modules for bus bar, 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.

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

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

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.

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.

The proposed switchgear panel shall be extendible.

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

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.

Panel shall be of enclosure protection of class IP54

11.2 WITHDRAWABLE PART (CARRIAGE)

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.

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

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.

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

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.

11.3 11 kV METALCLAD SWITHGEAR:

11.3.1 Main Equipment Characteristics

11.3.1.1 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.

11.3.1.2 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 bus bars shall be insulated by High Grade Phase Insulation. Bus bars partitioning shall be done by means of a bushing plate with Cast-Resin Insulators and Cubicles shall be partitioning with earthed sheet metal barriers.

11.3.1.3 Current Carrying Capacity:

i. Switchgear 12KV Bus bars 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 bus work 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

11.3.2 Circuit Breakers:

11.3.2.1 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 Support and the 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.

11.3.2.2 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 :1200A
Feeder Breaker : 800A
Incomer for Main Power Transformer : 1200A
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.
Bus Bar Rating 2000 A.

11.3.2.3 **Technical Requirements:**

i. The Circuit Breakers shall meet requirements of 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 aluminium 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 DC 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 bus bars of not less than 200 Sq.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 'Bus bars' 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 BS 5311 and IEC 56 and IEC 60 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 equipment's and their auxiliary shall be based on ISO 9001 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 operations 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.

11.4 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.

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

11.4.2 **Main Data**

Rated Voltage	KV	12
Rated Current	A	1200
Short Circuit Current withstand capability (as specified above)		
Bus Bar Rating	A	2000

11.4.3 **Technical Requirements:**

i. The Earthing Switches shall meet the requirements of 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.

11.5 INTERLOCKING

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

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

i. Control Circuit Plug Inserted
ii. High Voltage Compartment Door closed.
iii. Circuit Breaker in OPEN Position.
iv. Earthing Switch in OPEN Position

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

i. Circuit Breaker in OPEN Position.

11.5.3 Operating the Circuit breaker

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

11.5.4 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 BS 5253, IEC 129 and IEC 265 and shall include the following routine tests:

- Operating and Mechanical tests
- Measurements of the resistance of the main circuit.

11.5.5 Safety Device

Individual explosion vents should be provided for breaker / bus bar / 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.

11.6 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 circuit breaker only)
- 1 No KVA meter, Digital type of class designation. (for incoming circuit breaker only)
- 1 No Energy meter 3 Phase 4 wire, 3 Element, as specified. (for incoming and outgoing circuit breakers)
- 1 No Power Factor Meter Digital type 3Ph, 4Wire, 3 Element. (for incoming and outgoing circuit breaker only)
- 3 Nos Overcurrent Relay Static Type 5A secondary current with (for incoming and outgoing bus coupler circuit breaker)

Setting range 50-200% (for Overcurrent element)
Setting range 200-400-600% (for High Set Element)

- 1 Earth fault Relay, Static Type, with Secondary Current 5A and with Instantaneous Tripping Setting range 10-40% (For incoming and outgoing circuit breaker)
- Auxiliary relay and coupling relay if required
- Anti-condensation heater (for incoming and outgoing circuit breaker)

11.7 CURRENT TRANSFORMERS:

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)	1200/600/1	5P20	15VA
	Core 2 (for Metering)	1200/600/1	0.5	15VA
	Core 3 Differential		PS	15VA
For Bus coupler	Core 1 (for Protection)	1200/600/1	5P20	15VA
	Core 2 (for Metering)	1200/300/1	0.5	15VA
For Outgoing	Core 1 (for Protection)	600/300/1	5P20	15VA
	Core 2 (for Metering)	600/300/1	0.5	15VA

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

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

Maximum temperature rises at rated primary current shall not exceed 50 degrees centigrade.

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.

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.

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.

11.8 VOLTAGE TRANSFORMERS

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

i. Type: Epoxy-resin insulated, single pole with 7.3A Primary side fuses
ii. Basic Impulse Level: 75kV
iii. Primary Voltage: 11/ √3 kV
iv. Secondary Circuit: 110/ √3 V
v. Rated burden: 100 VA

vi. Accuracy classification: 0.5 Class

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.

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.

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.

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

i. Verification of terminal markings.
ii. High voltage power frequency withstand test on primary windings.
iii. High voltage power frequency withstand test on secondary windings.
iv. Tests for accuracy.

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

11.9 CONTROL PROTECTION AND INSTRUMENTATION:

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

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.

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

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

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

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

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

Solid state modular equipment shall be used wherever possible.

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

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

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.

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

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 disconnectors shall be indicated by means of discrepancy indicators.

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.

Annunciators shall have the following sequence:

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

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.

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.

Protection required:

i. For incoming & outgoing O/C and E/F protection with instantaneous tripping
ii. For bus coupler panel O/C protection.

Transformer Protection:

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

1. Transformer Differential

Differential relay shall be provided for the protection of 33/11kV 6/8 MVA transformer.

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.

11.10 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.

11.11 MINIMUM REQUIREMENT FOR SWITCHGEAR

11.11.1 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 indication1 No
- Multiple pole lug for control signals 1 No.
- motor operated spring charged 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

11.11.2 **Bus Coupler**

- Copper bus bars, rating shall be 2000A 1 Set
- Epoxy resin insulated block type current transformer as mentioned above in clause 9.7. 2 Nos.
  1st Core: 0.5 class 30 VA (for measurement)
  2nd Core: 5P20 30 VA (for protection)
- Breaker Carriage 1No.

11.11.3 **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. It is up to manufacturer / designer whether needed or not. If it is needed, then its cost should be within the cost of required VCB. Its cost shall not be paid separately.

11.11.4 **Specification of Meter to be installed**

Please refer above in the Energy Meter

GUARANTEED TECHNICAL PARTICULARS
(To be completed by Bidder/Manufacturer)

Item: 12kV Switchgear

S. N.	Description	Unit	NEA requirement	To be filled by Bidder/Manufacturer
1	Manufacturer			
	Country of Origin			
	Year of manufacturing experience			
	Model No.			
	Manufacturer's designation			
2	Applicable Standard		IEC 62271	
3	Type		3 Phase, Indoor	
4	System Parameters			

	Operating Altitude	m	Up to 3000 above msl	
	Max. ambient temperature	Deg. C	45	
	frequency	Hz	50	
	System fault level	kA	25 for 3 sec.	
	Rated Nominal Voltage	kV	11	
	Rated Maximum Voltage	kV	12	
	Power frequency withstand voltage (1min rms)	kV	28	
	Impulse withstand voltage (peak)	kVp	75	
5	Rated Current (Continuous at 45 degree ambient)			
	incomer	A	1200	
	outgoing	A	800	
	Trunking chamber	A	2000	
	Busbar	A	2000	
9				
9.1	Short time for 1 sec at max. kV	kA	25	
	Momentary	kV		
	Rated short circuit breaking current	kA		
	Peak	kA	63	
	RMS Symmetrical	kA		
10	Interrupting time at 100% capacity			
10.1	Maximum Opening time	ms		
10.2	Total interrupting time	ms	60	
11	Closing time	ms		
12	Make time	ms	120	
13	Maximum capacitive current breaking capacity (rms)	A		
14	Insulation level			
14.1	Impulse withstand voltage (peak)	kV	75	
14.2	Power frequency withstand voltage	kV	28	
15	Vacuum chamber			
	Make time	ms		
	Rating	A		
16	**Breaker**			
16.1	Manufacturer & Country of origin			
16.2	Reference standard			
16.3	Type	Spring Operated		
16.4	Operating voltage of closing and tripping coil (DC)	V	110	
16.5	Operating voltage range	% of rated voltage		
16.6	Closing time		85-110%	
16.7	Tripping time		70-110%	
16.8	Closing and tripping current	A		
16.9	Rated Voltage (DC) for tripping and closing	V	110	
16.10	Spring charging motor rating			
	Capacity	W		
	Rated voltage (DC)	V	110	
16.11	Time required by motor to charge the spring completely	sec		
16.12	Push button for local/ remote control	yes/no	yes	
16.13	Selection switch for local/remote control	yes/no	yes	
17	**Potential transformer**		Required	

	Manufacturer & Country of origin			
	Type			
	Reference standard		IEC	
	Frequency	Hz	50	
	Voltage class	kV	12	
	Number of phases		3	
	Voltage Ratio	kV	11/√3:0.11/√3	
	Rated Nominal primary voltage	kV	11/√3	
	Rated Maximum primary voltage	kV	12/√3	
	Power frequency withstand voltage (1min rms)	kV	28	
	Impulse withstand voltage (peak)	kVp	75	
	Rated burden	VA	100	
	Accuracy class		0.5	
	Over Voltage factor			
	Creepage Distance	mm	280	
18	**Current transformer**		Required (Separate for each incomer & feeder panel)	
	Manufacturer and country of origin			
	Type			
	Frequency	Hz	50	
	Voltage class	kV	12	
	Reference standard		IEC	
	Auxiliary DC Supply	V	110	
18.1	For Incoming			
	Nos of core		3	
	Ratio/class/burden		1200-600/1A	
	Metering		5P20,15VA	
	Protection		0.5,15VA	
	Differential		PS,15VA	
18.2	For outgoing			
	Nos of core		2	
	Ratio/class/burden		600-300/1A	
	Metering		5P20,15VA	
	Protection		0.5,15VA	
19	**Indicating Instruments**			
19.1	**Ammeter**		Required (Separate for each incomer & feeder panel)	
	Manufacturer and country of origin			
	Type		digital	
	Numbers		1/phase	
	Range of indication	A	0-1200-for incomer 0-600-for outgoing	
	Accuracy class		0.5	
	Scale		Linear	
	Overload range	%	1.5	
	Auxiliary DC Supply	V	110	
	VA Burden	VA		
	Catalogue furnished	yes/no	yes	
19.2	**Voltmeter**		Required (Separate)	
	Manufacturer and country of origin			
	Type		digital	
	Numbers		1/phase	

	Range of indication	kV	0-15	
	Accuracy class		0.5	
	Scale		Linear	
	Overload range	%	1.1	
	Auxiliary DC Supply	V	110	
	VA Burden	VA		
	Catalogue furnished	yes/no	yes	
19.3	**Apparent Power meter**		Required (Separate for each incomer & feeder panel)	
	Manufacturer and country of origin			
	Type			
	Rated voltage	kV	11√3:0.11√3	
	Rated Current	A	300-200-100/1	
	Accuracy class		0.5	
	Range of indication	MVA	0-15 or 10	
	Auxiliary DC Supply	V	110	
	VA burden	VA		
	Current coil			
	Voltage coil			
	Catalogue furnished	yes/no	yes	
19.4	**kWh Meter**		Required (Separate for each incomer & feeder panel)	
	Manufacturer and country of origin			
	Type		static 3-phase, 4 wire	
	Accuracy class		0.2/0.5	
	Rated voltage	kV	11√3:0.11√3	
	Rated Current	A	300-200-100/1	
	VA burden	VA		
	Current coil			
	Voltage coil			
	Auxiliary DC Supply	V	110	
	Reverse rotation locking mechanism provided	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	**Overcurrent relay**			
	Manufacturer and country of origin			
	Type		static Non-directional	
	Manufacturer's type designation			
	Applicable standard			
	No of poles		Single*3	
	Current setting range	% of rated current	5-200%	
	Operating range			
	Operating time at 10 times current setting	sec	3	
	Reset time	ms		

	Characteristics		IDMT (standard inverse)	
	Instantaneous unit provided	yes/no	yes	
	Operating range			
	NO Contacts			
	Insulation test according to 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 provided	yes/no	yes	
20.2	**Earth fault relay**			
	Manufacturer and country of origin			
	Type		Static, Non-directional	
	Applicable standard		IEC	
	Continuous overload capacity	xIn		
	Current setting range	% of In	5-80%	
	Operating range			
	Operating time at 10 times current setting	sec	3	
	Characteristics		IDMT (standard inverse)	
	Instantaneous unit provided	yes/no	yes	
	NO Contacts			
	Insulation test according to IEC	yes/no	yes	
	Indication			
	Hand reset flags provided	yes/no	yes	
	Light emitting diode provided	yes/no	yes	
	Auxiliary DC supply	V	110	
	Is Manufacturer ISO 9001 holder?	yes/no	yes	
	Technical literature submitted	yes/no	yes	
	Type test certificate submitted	yes/no	yes	
20.3	**Auxiliary Tripping and Lockout Relay**			
	Manufacturer and country of origin			
	Type			
	Manufacturer's type designation			
	Applicable standard			
	Operating time	ms	<15	
	Contact rating at 125V DC	A		
21	Construction of Control and Relay Panel			
	Type			
	Manufacturer's type designation			
	Applicable Standard			
	Location		Indoor	
	Mounting		Floor/Trench mounted	
	Lifting hooks	yes/no	yes	
	Control panel furnished as per specification	yes/no	yes	
	Enclosure protection class	IP	IP54	
	Type of Sheets used			
	Thickness of sheet metal used			
	Load Bearing parts	mm	>3	
	Non-load bearing parts	mm	>2	
	Painting		Light grey RAL 7032	
	All instruments, meters, relays and control switches flush or semi flush type		flush	

22	Earthing switch			
	Type		Integrated	
	rating			
	interlocking	yes/no	yes	
23	Surge Arrestor			
	Type		ZnO	
	Rating	kA	9kV,10kA	
24	Space heater provided for cubicle	yes/no	yes/rating	
25	Operating duty cycle		0-0.3sec-co-3min-co	
26	Number of possible operation without maintenance under:			
	Rated short circuit braking current	No	100	
	Rated normal current	No	10000	
27	Clearances			
27.1	Phase to phase	mm	127	
27.2	Phase to earth	mm	76.2	
28	Padlocking provision for cubicle	yes/no	yes	
29	Total weight of the circuit breaker	kg		
30	Mechanical Dimension of circuit breaker (LXWXH)	mm		
31	Overall dimension of control Panel (LxWxH)	mm		
32	Overall Weight of control Panel	kg		
33	Shipping data			
33.1	Size of large package (LxWxH)	mm		
33.2	Weight of heaviest package	kg		
34	Delivery of equipment following award of contract and approval of drawing	months		
35	ISO 9001 holder for panels, instrument transformers, relay & meters (including design)	yes/no	yes	
35.1	ISO 9001 certificate submitted	yes/no	yes	
36	Type test certificate submitted	yes/no	yes	
36.1	Submitted for the required ratings	yes/no		
36.2	Type test certified by			
37	User's certificate submitted	yes/no	yes	
38	Has exported to third country	yes/no	yes	
39	Copies of relevant standards attached	yes/no	yes	
40	Outline Drawings and associated GA attached	yes/no	yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer …….

12. Power Cables (XLPE)

12.1 General

This specification covers the design, manufacture, factory test, supply, delivery, type test (in recognized laboratory), field test and installation of all Power cables required for the entire project. Manufacturer of 12kV and 1100V power cable shall be holder of valid ISO 9001 Certificate

12.2 Equipment to be furnished:

a) 12 kV XLPE Power Cable

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

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.

12.3 Design Requirement

12.3.1 12kV power cable

(a) General

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

(b) Conductor

Conductor shall consist of stranded aluminum 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 12kV 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.

Armor

The armor shall be of hard drawn round aluminum wires for mechanical protection of the cable. The size of armor shall be as specified in the relevant Standards.

Water-Tightness

The supplied cable shall be longitudinal water tight. For this purpose, a layer of suitable water swellable absorbent tape shall be provided over insulation screen.

(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 steel protected against corrosion.

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

Outdoor and indoor termination shall be done by heat 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 aluminum conductor cables shall be designed for identification ferrules.

(i) Voltage identification

The outer covering of the cable shall be embossed with the name/brand of the manufacturer, type designation, Voltage grade, cable size, year of manufacture, name of the Purchaser, type of insulation at the spacing of each 2 meters. Every meters of outer covering of the cable shall also be embossed with length of the cable.

(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

12.4 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.

12.5 Drawings, Data & Manuals

The following information shall be furnished along with the bid.

(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.

12.6 Tests

12.6.1 Type Tests

The Type Tests should be conducted in the recognized laboratory.

12.6.2 Routine and design tests

Routine test in accordance with the provision of standards shall be carried out at the manufacturer’s premises.

Type test and acceptance test as per standards shall have to be carried out to prove the general qualities and design of a given type of cable and for the

purpose of acceptance of the lot. The factory acceptance test shall be witness and approved by Employer/Employer's Representative before shipment.

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

12.6.3 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

12.7 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 at no extra cost to the Employer and without delaying the commissioning schedule.

GUARANTEED TECHNICAL PARTICULARS
(To be completed by Bidder/Manufacturer)

Item: 12 kV Power Cable

S.N.	DESCRIPTION	UNIT	NEA REQ.	To be filled by Bidder/Manufacturer
1	Manufacturer			
2	Country of Origin			
3	Year of manufacturing experience			
4	Model No.			
5	Applicable Standard		IEC 60502 IEC 60228	
6	Cable Type Designation			
7	Rated Voltage	kV		
7.1	Maximum System Voltage	kV	12	
7.2	Rated Voltage between conductor and screen	kV	6	
7.3	Rated Voltage between two conductors	kV	10	
7.4	Power Frequency Withstand Voltage	kV	21	
7.5	Impulse Withstand Voltage (BIL)	kV	75	
8	Conductor			
8.1	Conductor Material		EC Grade Aluminum	
8.2	Cross section of the Conductor	sq. mm.		
8.3	Is Conductor Stranded?	yes/no	yes	

8.4	Stranded Conductor			
	i) Number of strands in each core			
	ii) Size of strand	Sq. mm.		
	iii) Maximum DC Resistance at 20 deg. C	Ohm/km		
	iv) Class of Stranding			
9	Number of Cores		One	
10	Insulation			
10.1	Insulation material and Type Designation		XLPE	
10.2	Minimum thickness of insulation	mm	min 3.4	
10.3	Minimum volume resistivity at 27 deg. C, 70 deg. C and 90 deg. C	Ohm-cm		
11	Sheath			
11.1	Material for inner sheath, type of sheathing and Type Designation			
11.2	Minimum thickness of inner sheath	mm		
11.3	Material for outer sheath, type of sheathing and Type Designation			
11.4	Minimum thickness of outer sheath	mm		
12	Armor			
12.1	Material			
12.2	Shape			
12.3	Dimension	mm		
13	Conductor Screen			
13.1	Material			
13.2	Thickness	mm		
14	Insulation Screen			
14.1	Material			
14.2	Thickness	mm		
15	Metallic Layer/Screen			
15.1	Type			
15.2	Material			
15.3	Thickness	mm		
16.1	Overall Diameter of the Cable	mm		
16.2	Geometric Mean Radius (GMR) of the Cable/Conductor	mm		
17	Minimum Bending Radius	mm		
18	Insulation Resistance at 27 deg. C	Ohm/km		
19	Capacitive Reactance	Ohm/km		
20	Inductive Reactance	Ohm/km		
21	Conductor Temperature rise during			
21.1	Normal Operation	deg. C	90	
21.2	Short Circuit	deg. C	250	
22	Continuous Current Carrying Capacity			
22.1	Continuous Current Carrying Capacity in air and Corresponding assumptions/Conditions of installation	A		
22.2	Continuous Current Carrying Capacity under ambient temperature	A		
22.3	Continuous Current Carrying Capacity under Cable laid in Covered cable trenches	A		
22.4	Continuous Current Carrying Capacity under 3-6 Cables per tray touching each other in Covered cable trenches	A		
22.5	Continuous Current Carrying Capacity under ambient temperature for Cable laid in ground	A		
23	Short circuit current			
23.1	Short circuit current for 0.1 sec	kA		

23.2	Short circuit current for 1.0 sec (minimum kA)	kA		
23.3	Short circuit current for armor 1.0 sec (minimum kA)	kA		
24.1	Minimum tensile strength of insulation	kg/sq. cm		
24.2	Minimum elongation at break	%		
25.1	Minimum tensile strength of sheath	kg/sq. cm		
24.2	Minimum elongation at break	%		
26.1	Minimum tensile strength of armor	kg/sq. cm		
26.2	Minimum elongation at break	%		
27.1	Weight of Cable per km	kg/km		
27.2	Standard length of Cable per drum	m	min. 500m	
27.3	Net weight of cable in drum	kg		
28	Method of Core identification			
28.1	For Cables up to Five Cores			
28.2	For Cable with more than Five Cores			
29	Details of Anti Termite Covering			
30	Longitudinal water tight	yes/no		
31	Fire Retardant	Yes	Yes	
32	Moisture Resistant	Yes	Yes	
33	Please indicate in YES or NO whether the following tests have been carried out			
33.1	Ageing Test	Yes/No	Yes	
33.2	Loss of Mass Test	Yes/No	Yes	
33.3	Cold Impact Test	Yes/No	Yes	
33.4	Heat Shock Test	Yes/No	Yes	
33.5	Fire Retardant Test	Yes/No	Yes	
34	Delivery of equipment following award of contract and approval of drawing	months		
35	ISO 9001 holder (including design)	yes/no	yes	
35.1	ISO 9001 certificate submitted	yes/no	yes	
36	Type test certificate submitted	yes/no	yes	
36.1	Submitted for the required ratings	yes/no		
36.2	Type test certified by			
37	User's certificate submitted	yes/no	yes	
38	Has exported to third country	yes/no	yes	
39	Copies of relevant standards attached	yes/no	yes	
40	Outline Drawings and associated GA attached	yes/no	yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer …….

13. Power Cables (PVC) and Control Cables

13.1 General

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

Manufacturer of power and control cables shall be holder of valid ISO 9001 Certificate.

13.2 Equipment to be furnished:

a) 110 V Power Cable
b) Control and instrumentation cable
c) Communication cable

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

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.

13.3 Design Requirement

13.3.1 1100 volt PVC insulated cable.

(a) General

The low voltage cables shall be 1100V grade polyethylene insulated, four core, 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 aluminum wires. They shall comply with IEC standards. 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

13.3.2 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.

13.4 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.

13.5 Drawings, Data & Manuals

The following information shall be furnished along with the bid.

(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.

13.6 Tests

13.6.1 Type Tests

The Type Tests should be conducted in the recognized laboratory.

13.6.2 Routine and design tests

Routine test in accordance with the provision of standard as listed in Sub-Clause 2.3 of Section IV A shall be carried out for each drum of cable.

Type test and acceptance test as per standards as listed in Sub-Clause 2.3 of Section IVA shall have to be carried out to prove the general qualities and design of a given type of cable and for the purpose of acceptance of the lot. The test certificate shall be approved by Employer/Employer's Representative before shipment.

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

13.6.3 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

13.7 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 at no extra cost to the Employer and without delaying the commissioning schedule.

GUARANTEED TECHNICAL PARTICULARS

(To be completed by Bidder/Manufacturer)

Item: LV Power Cables

S. N.	Description	Unit	NEA requirement	To be filled by Bidder/Manufacturer
1	Manufacturer			
2	Country of Origin			
3	Year of manufacturing experience			
4	Model No.			
5	Applicable Standard		IEC	
6	Voltage ratings			
6.1	Suitable for max. system voltage	V	1000	
6.2	Voltage grade of the cables	V	600	
6.3	Rated voltage between each conductor and screen	V		
7	Type of system earthing		Solidly grounded	
8	Conductor			
8.1	Conductor Material		EC Grade Annealed Copper	
8.2	Cross section of the Conductor	sq. mm.		
8.3	Is Conductor Stranded?	yes/no	yes	
8.4	Stranded Conductor			
	i) Number of strands in each core			
	ii) Size of strand	Sq. mm.		
	iii) Maximum DC Resistance at 20 deg. C	Ohm/km		
	iv) Class of Stranding			
8.5	Number of Cores		Four	
8.6	Method of Core identification			
9.1	Insulating material		Polyethylene	
9.2	Thickness of insulating material	mm		
10.1	Overall jacket material		PVC	
10.2	Thickness of overall jacket	mm		
11.1	Overall cable diameter	mm		
11.2	Geometric Mean Radius (GMR) of the Cable/Conductor	mm		
12	Continuous current carrying capacity			
12.1	in ground	A		
12.2	in duct	A		
13	Electrical parameters			
13.1	Resistance	ohm		
13.2	Reactance	ohm		
14	Minimum Bending Radius	mm		
15	Insulation Resistance at 27 deg. C	Ohm/km		
16	Capacitive Reactance	Ohm/km		
14	Inductive Reactance	Ohm/km		
15	Conductor Temperature rise during			
15.1	Normal Operation	deg. C	90	
15.2	Short Circuit	deg. C	250	
16.1	Weight of Cable per km	kg/m		
16.2	Standard length of Cable per drum	m	min. 500m	
16.3	Net weight of cable in drum	kg		
17	Delivery of equipment following award of contract and approval of drawing	months		
18	ISO 9001 holder (including design)	yes/no	yes	
19.1	ISO 9001 certificate submitted	yes/no	yes	
20	Type test certificate submitted	yes/no	yes	
21.1	Submitted for the required ratings	yes/no		
21.2	Type test certified by			

22	User's certificate submitted	yes/no	yes	
23	Has exported to third country	yes/no	yes	
24	Copies of relevant standards attached	yes/no	yes	
25	Outline Drawings and associated GA attached	yes/no	yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date……..
Seal of Bidder/Manufacturer …….

GUARANTEED TECHNICAL PARTICULARS
(To be completed by Bidder/Manufacturer)

Item: Control Cables

S. N.	Description	Unit	NEA requirement	To be filled by Bidder/Manufacturer
1	Manufacturer			
	Country of Origin			
2	Year of manufacturing experience			
3	Manufacturer's type designation			
4	Applicable Standard		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	600	
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		
14.1	Number of Cores			
14.2	Method of Core identification			
15	Delivery of equipment following award of contract and approval of drawing	months		
16	ISO 9001 holder (including design)	yes/no	yes	
16.1	ISO 9001 certificate submitted	yes/no	yes	
17	Type test certificate submitted	yes/no	yes	
17.1	Submitted for the required ratings	yes/no		
17.2	Type test certified by			
18	User's certificate submitted	yes/no	yes	

19	Has exported to third country	yes/no	yes	
20	Copies of relevant standards attached	yes/no	yes	
21	Outline Drawings and associated GA attached	yes/no	yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer …….

14. Low Voltage Distribution Board

14.1 General

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

14.2 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, are 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.

14.3 Equipment to be furnished

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

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.

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

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

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

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.

14.4 Design Requirements

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.

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

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.

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

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.

14.5 Construction Features

14.5.1 General

The distribution boards shall be self-standing sheet steel cubicle 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 2,000mm. 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 200mm.

(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.

14.5.2 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).

14.6 Specific Requirement

14.6.1 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.

14.6.2 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.

14.6.3 Ground bus

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

14.6.4 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.

14.7 Tests

14.7.1 Routine and type test

Type test certificates and results 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.

14.8 Drawings, Data & Manuals

14.8.1 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.

14.8.2 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

(b) Any other relevant drawing and data necessary for approval.

15. Grounding System and Lightning Protection

15.1 General

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

15.2 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.

15.3 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.

15.4 Grounding Installation Features

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 workman like 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.

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.

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.

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

15.5 Grounding Conductor

15.5.1 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. 100sqmm (min) stranded bare copper conductor cable.

15.5.2 Ground electrodes

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

15.5.3 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. There should be two risers each for the outdoor substation equipment.

15.6 Design Requirement

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.

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

15.7 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.

15.8 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.

15.9 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.

GUARANTEED TECHNICAL PARTICULARS
(To be completed by Bidder/Manufacturer)

Item: Ground Conductor

S. N.	Description	Unit	NEA requirement	To be filled by Bidder/manufacturer
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		
5	Type of joint above and below ground level			
6	Ground electrode			
	Material		Copper clad steel	
	Diameter	mm		
	Length	m	as per IEEE80	

7	Fence grounding included			
8	Cross section of conductor rise for fence ground	sq.mm		
9	Fence separately grounded by electrode	yes/no	yes	
10	Calculation for grounding grid length and conductor size furnished	yes/no	yes	
11	Earthing system designed for	ohm	<1	

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer …….

16. Lighting System

16.1 General

This specification covers the design, complete supply and installation of the lighting system for the Switchyard area, Control Room, Guard Room, Staff Quarter and Substation area including all necessary supervision, labor, tools, equipment and accessories, miscellaneous materials, testing, and putting in acceptable operation of the lighting system.

16.2 Scope of Works

All equipment shall be complete and operative in all details and shall be left in a satisfactory working condition. The bidder shall furnish and install all materials and equipment, which are obviously a part of the complete illumination installation and without any additional charge to the Employer.

The miscellaneous materials include, but are not limited to, all conduit, wires, controls, lighting panel boards, junction boxes, fittings, supports and other accessories required for the complete installation and satisfactory operation of the indoor and outdoor lighting system.

The bidder shall perform the following work in addition to furnishing and delivering of the equipment, materials and accessories specified hereinafter in this specification.

(a) Assembling at the plant site
(b) Erection and complete installation
(c) Testing of all equipment
(d) Commissioning of all equipment prior to trial operation
(e) Trial operation and all necessary adjustments prior to initial operation.
(f) Obtaining Employer/Employer's Representative approval and written acceptance for satisfactory operation.

16.3 Codes & Standards

The lighting installation shall meet the requirements of the latest edition of the National Electrical Code (ANSI CI) of the National Fire Protection Association of America. In addition, any rules or regulations applicable to the work shall be followed. In case of any discrepancy, the more restrictive rule shall be binding.

16.4 Requirements

16.4.1 Illumination level of the new control building and outdoor switchyard complex

The illumination level above working plane in various areas in lux is as specified below.

(a)	Control room:	300 lux
(b)	Battery room:	150 lux
(c)	Store:	150 lux
(d)	Other indoor area:	150 lux
(e)	Outdoor equipment area:	20 lux
(f)	Road:	10 lux
(g)	Other outdoor area:	10 lux
(h)	Emergency lighting:	10 lux

16.4.2 Protection of Work

The Contractor shall effectively protect, at his own expense, such of his work, materials or equipment as is liable to injury during the construction period. All openings to any part of the conduit system, as well as associated fixtures and equipment, both before and after being set in place, must be securely covered or otherwise protected to prevent obstruction of the conduit or injury due to carelessly or maliciously dropped tools or materials, grit, dirt or any foreign matters. The Contractor will be held responsible for all damages so done until his work is fully and finally accepted. Conduit ends shall be covered with capped bushings.

16.4.3 Methods and materials

All works shall be done in a first-class, neat and workmanship manner by mechanics skilled in the trade involved. All details of the installation shall be mechanically and electrically correct.

All materials shall be new, of the best of their several kinds, and without imperfections and blemishes. All materials be standard products of manufacturer's latest design. Where two or more units of the same class of equipment are required, these units shall be of same manufacturer.

All conduits and equipment shall be installed in such a manner as to preserve access to any other equipment installed.

16.4.4 Steel conduit

All conduits except otherwise stated shall be rigid steel, hot dipped galvanized. Minimum diameter of all conduits shall be 19mm.

Each piece of conduit shall be straight, free from blisters and other defects, cut square and taper reamed and shall be furnished in 3-meter lengths and threaded at each end. Couplings shall be cleanly cut.

In no case shall the conduit be filled by more than 40 percent.

16.4.5 Installation of conduit system

The work covered by this section comprises the installation of the metallic conduit system.

Flexible steel conduit shall be used in dry and non-hazardous locations to provide flexible connections between the rigid conduit system and conduit boxes, and between the rigid system and any machine subject to vibration. Flexible conduit shall be galvanized steel.

Where interference occurs, the Employer/Employer's Representative shall be notified before any relocation is made. If it should become necessary to make a field change before consulting the Employer/Employer's Representative, every precaution shall be taken to insure that the change is coordinated with other conduit work, structural work, plumbing work, piping and architectural features; and information shall be obtained regarding the completed conduit run to insure that there will be no interference when the conduit run is extended. A complete record of such change shall be sent at once to the Employer/Employer's Representative.

Exposed conduits shall be run in straight lines parallel to column lines, walls, or beams. Where conduits are grouped, the bends and fittings shall be installed so as to present an orderly appearance. Unnecessary bending or crossing shall be avoided.

Supports for exposed horizontal conduit runs shall be provided every 1.0m for 19mm conduit and not more than every 1.5m for 25mm conduit and larger, where it is difficult to provide supports at intervals other than those specified above, the supports for 19mm conduit may be every 1.5m and supports for 25mm and larger every 2.0m as a special case and the Employer/ Employer's Representative approval must be taken. Supports for exposed vertical conduit runs shall be not more than 1.5m for 19mm and 25mm conduit and not more than 2.5m for 32mm and larger conduit.

Conduit shall be supported on approved types of galvanized wall brackets, ceiling trapeze, strap hangers, or pipe straps, secured by means of anchor bolts on hallow masonry units, expansion bolts in concrete or brick, and machine screws on metal surfaces. Wooden plugs inserted in masonry or concrete shall not be used as a base to secure conduit supports.

Conduit joints and connections shall be made thoroughly watertight and rustproof by means of the application of a thread compound, which will not insulate the

joint. Each threaded joint shall be thoroughly cleaned to remove all the cutting oil before the compound is applied. Red lead is suitable for application for embedded conduits, and white lead is suitable for application for exposed conduits.

Couplings may be used in dry and exposed locations. They may also be used in wet exposed locations in vertical runs only, provided they are installed with fixed threaded connection at top. They may be used in concrete if adequately waterproofed to prevent leakage.

Standard radius bends are generally to be used for steel conduits but special long radius bends shall be used wherever specifically required, the long radius bends are to have radii as large as the physical conditions will permit.

Field bends of metallic conduit shall be made in such a manner that the internal diameter of the conduit is not materially changed, and the protective coating on the inside and also on the outside of the conduit is not injured. The bends shall be free of kinks, indentation, or flattened surfaces. Heat shall not be applied in making any conduit bends.

Structural steel shall not be cut or drilled to avoid interferences except with the specific approval of the Employer/Employer's Representative in each case. Where the Employer/Employer's Representative approves cutting holes in reinforced concrete for conduit, the reinforcing bars shall not be cut, but shall be bent to permit passage of the conduits.

Galvanized structural steel members may be drilled or punched for conduit supporting bolts, provided the holes are immediately painted with aluminum paint and galvanized or rust-resisting bolts are used.

Conduits and fittings shall be properly protected during the construction period against mechanical injury, from impact from structural steel heavy machinery, or batches of mass concrete pours. Conduits, which extend out of floors, walls, or beams, shall be boxed or otherwise protected and the ends shall be plugged or capped.

In supporting embedded steel conduit, if welding or brazing is used, extreme care should be taken to avoid injury of the surface of the conduit. Welding or brazing shall not be done on the bottom of a conduit or on the inside of a bend, or at any other location that might interfere with the pulling of conductors. The welded or brazed joint shall be painted.

Metallic conduit shall be securely fastened to sheet metal boxes and cabinets, each with a locknut and insulated bushing inside the box and a locknut outside. The conduits shall be of such length that when the bushings are screwed tight against the ends of the conduits no appreciable space will be left between the bushings and the locknuts. The locknuts shall be tightened against the box without deforming the box.

After a conduit run is completed, it shall be inspected and swabbed out. Compressed air may be used in blowing out any excessive amount of water.

In complete installation, each outlet box shall be provided with cover, unless a fixture canopy is used.

Round outlet boxes shall not be used where conduits or connectors require the use of locknuts of bushings to be connected to the side of the box. Rectangular or octagonal boxes having knockout or opening at each flat bearing surface for the locknut or bushing shall be used.

16.4.6 Wire & Cable

The contractor shall furnish and install all wire and cable required for the complete installation. All wire shall be of stranded copper conductor, PVC insulated. The wire shall have a voltage grade of 600V as per IEC. Minimum cross-section shall be 2.5 sqmm. All wire shall be run in conduit.

All wiring between distribution boards and lighting panels and all outdoor branch circuit wiring shall be done using power cables as specified in Sub-Section 11.

Cables and wires shall be installed without joints as far as practicable. Where splicing or joints are required, they shall be made in accordance with the cable manufacturer's recommendations.

All splicing shall be done in outlet boxes and junction boxes and not in the conduit or on the trays. All connectors and splicers shall be of the solderless type and shall be self-insulated. In lieu of self-insulated type connectors and splices, the Contractor may use the non-insulated type, but be will wrap the connection or splice with insulating tape to the same dielectric value as the original insulation. If insulating tape is used, they shall be of a type as recommended by the manufacturer of the wire or cable.

16.4.7 Outlet and switch boxes

Furnish and install for each outlet, and outlet box suited to the use for which the outlet is to be put and to the location in which it occurs.

All outlet and conduit fittings in exposed conduit runs shall be cast metal with integral threaded hubs ("Condulets") with appropriate covers and shall be provided with gasketed covers. Sealing fittings shall be furnished where required.

16.4.8 Junction and pull boxes

Junction and pull boxes for indoor use shall be made from sheet steel and shall have set-in or flange construction cover. All corners shall be placed approximately 150mm apart. Each box and cover shall be hot dipped galvanized after fabrication. All drilling for conduits or armored cable shall be done in the field. The box sizes shall be in accordance with the National Electrical Code.

Junction boxes for outdoor use shall be similar to the above except they shall be provided with screwed-on covers with gaskets to make them weatherproof. Conduit connections shall be made through threaded hubs or chase nipples welded to the box.

16.4.9 Lighting fixtures

The Contractor shall furnish, install and wire required number of lighting fixtures to meet the various maintained illumination levels as specified in this specification. It shall be noted that the illumination intensities indicated for various areas are the maintained illumination levels (and not initial illumination level) considering a maintenance factor of not more than 0.7. The Contractor shall be responsible for producing the above illumination levels for each specific area with the type of fixture specified.

Lamps - All fixtures shall have installed therein by the Contractor a lamp of wattage as noted in this specifications. They shall be of the LED type as required for each unit. The CRI of LED lamps should be >90.

Lamps to be used shall have the longest life, from the respective kinds approved for this application. If the fixture provided has more than one lamp and it requires a ballast, then one ballast per lamp shall be furnished.

Accessories - Each fixture shall be supplied with necessary straps, supports, or hangers or other miscellaneous materials and devices to install them in a satisfactory manner, and to conform to the architectural treatment in the area in which they are to be installed.

The Contractor shall prepare the detailed layout to meet the above requirement. The lighting layout and wiring drawings of the Contractor shall be submitted for the Employer's/Employer's Representative's approval.

Fixture type for each area is as specified below:

(a) Control Room: Indoor, pendant type fixture with acrylic prismatic lens, complete with two (2) - 40W. cool white LED lamp.

(b) Switchgear Room/Toilet: Indoor, industrial pendant type fixture with sheet steel reflector complete with two (2) - 40W, cool white LED lamp.

(c) Battery Room: Indoor, pendant or surface mounted moist proof and acid-proof, with sheet steel reflector complete with one (1) 60W LED lamp covered with clear glass globe.

(d) Substation/outdoor: Outdoor, weather-proof, high pressure mercury vapor or sodium fixture or LED, complete with one (1) - 300W lamp, ballast, aluminum reflector and photo electric control.

(e) Emergency Lights: Indoor, recessed or pendant mounted fixture with standard dome reflector Substation complete with one (1) - 60W LED lamp.

All the fixtures shall be approved by the Employer/Employer's Representative before shipping.

16.4.10 Lighting panels

The Contractor shall furnish and install all 400/230 volts lighting panels as required and shall be obviously included in the cost of electrical wiring of the building.

Each 400/230-Volt lighting panel shall be, three phase, four wire, and solid neutral. Each branch circuit shall have a 20-ampere single pole quick-make quick-break circuit breaker. Each circuit breaker shall empty thermal means of inverse time overload protection supplemented by an instantaneous magnetic short circuit trip. The maximum load on each branch circuit shall be limited to 2400W. The number of branch circuit in each lighting panel shall be determined based on the load and the above criteria. Mains shall be provided with solderless lugs.

All circuit breakers shall have an interrupting capacity suitable for the fault level fed by the preceding transformer. Power supply to 230V receptacles, as required shall be taken from this panel. The enclosure protection of the panel shall be IP-50 per IEC.

16.4.11 Emergency lighting

Emergency lighting shall be provided in Control Room, Switchgear Room and Battery Room. The power source for the emergency lighting shall be drawn from the D.C. distribution board. The emergency lighting shall be normally “Off” type.

16.4.12 Receptacles

The Contractor shall furnish and install all receptacles and specified herein.

The receptacles shall be of 230V, 20 Ampere, 3-pole, 3 wire, polarized with third pole grounded.

The receptacles shall be provided on the walls of all the rooms at a spacing of 6m. (maximum) between two receptacles with minimum of two (2) receptacles per room.

16.4.13 Local wall switches

Local wall switches for controlling lighting cubicles shall be furnished and installed for each enclosed area such as offices, switchgear rooms, battery room, etc. All switches shall be single pole or 3-way as required.

General indoor areas - Local switches mounted indoors shall be single pole and shall be rated 6 amperes at 230 Volts.

Outdoors and wet locations - Local switches installed in outdoor and wet locations shall be weatherproof switches, single pole or as required rated 20 Amperes at 230 Volts.

16.4.14 Grounding

Each lighting fitting shall be provided with a grounding terminal suitable for connection to the earthling conductor.

All metal or metal enclosed parts of the housing shall be bonded and connected to the grounding continuity throughout the fixture.

16.5 Tests

The Contractor shall thoroughly test and measure insulation resistance for all cables and equipment and prove that same are free of grounds and short circuits. If a ground or short circuit is found on any cable or equipment, the faulty condition shall be eliminated or the cable and/or equipment replaced. The minimum value of insulation resistance shall be 10 mega ohms.

All equipment shall be demonstrated to operate in accordance with the requirement of this specification and other specifications.

Functional tests shall be performed to check each requirement.

All tests shall be performed in the presence of the Employer/Employer's Representative. Contractor shall furnish all instruments and personnel for all tests.

16.6 Drawings

The Contractor shall furnish shop drawings, relevant catalogues, data sheets, etc., required to cover specific information for all items in any way designed for the works. None of the following items shall be installed until final approval of all the data sheets and drawings, as listed, has been given by the Employer/Employer's Representative.

(a) Conduit
(b) Cable
(c) Lighting panel boards
(d) Shop drawings or catalog cuts for all lighting fixtures and receptacles
(e) Switches and molded case circuit breakers
(f) Junction and pull boxes
(g) AC and DC contactor for emergency lighting panel boards
(h) Layout drawings showing fixtures, conduit and circuitry of fixtures
(I) Calculation of illumination level in various areas.

17. Steel Structure

17.1 General

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

17.2 Codes & Standards

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

17.3 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 frame.
(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.

17.4 Technical Requirements

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.

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

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.

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.

No welding will be permitted in steel structure fabrication

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.

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.

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.

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

All materials including nuts and bolts shall be hot dip galvanized. The process of galvanization shall be as per latest version of ISO. The thickness of zinc coating shall not be less than 90 microns (645 gm/sq. m).

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.

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.

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

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.

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.

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

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

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

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.

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.

17.5 Tests

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

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

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

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.

17.6 Drawings

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

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

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

17.7 Packing, Marking and Shipping

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

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.

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.

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

18. Wall mounted Split-type Air-Conditioners

18.1 General

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

18.2 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.

18.3 Scope of Works

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

(a) Civil works like breaking of wall and repairing wherever necessary.
(b) Any support structures and leak proofing compounds required for proper sealing.

18.4 Technical Requirements

a) Type - Split wall-mounted (Cooling/heating)
b) Minimum Cooling/heating Capacity - 1800 BTU/hr
c) Indoor noise level should be < 46 dB
d) Compressor
   - Super silent, Power saving
   - Hermetically sealed
   - Rotary/reciprocating
e) Rated Voltage/Frequency
   - 230 V, 50 HZ, Single Phase
f) Fan Speed
   - Three Speed with air deflection System
   - Operation mode with remote control
   - Heat/Cool/ Dry/Fan
g) Air Swing
   - To be Present, Automatic
h) Air filter
   - Anti –fungal/cleanable
i) Refrigerant
   - R410A (Non-CFC)

18.4.1 Manufacturers

The AC shall be from the following reputed manufacturers
- Blue Star
- Daikin
- Mitsubishi
- Hitachi
- Samsung
- LG
- Voltas
- Or equivalent reputed make

18.4.2 Quality Certification:

ISO 9001 certified and CE certification.

18.4.3 Warranty:

12 months from the date of commissioning.

Technical Specifications of 1.5 Ton Split AC (with remote control)				
S.N.	**Specification**	**Description**	**Unit**	**Requirement**
1	Capacity	Cooling	BTU/hr	1800
		Heating	BTU/hr	19500
		Compressor		Rotary
2	Power Supply	Power Supply	V/Ph/Hz	230/Single/50
		Power Input (Cooling/heating)		
		Current		
3	Energy Star Rating			> 5
4	Performance	EER	BTU/hr./W	10/10
		Air Circulation (Indoor/outdoor)	CFM	> 460/1485
		Moisture Removal	l/hr	> 2.5
		Noise Level (indoor/outdoor)	dB	< 46
5	Operation	Panel Display		LCD
		Remote Controller		LCD
6	Features	Auto Air Swing		√
		Speed Setting	Cooling/Fan	3/3
		Operation Control		Microprocessor controlled codeless remote
		Auto Restart		√
		Sleep Mode		√
		On Timer		√
		OFF Timer		√
		Dehumidification		√
		Chaos Logic		√
		Fuzzy Logic		√
		Jet Cool		√
		Evaporator Type		2 Row
		Evaporator Fin Type		Blue fin/Gold fin
		Condenser Fin Type		Blue fin/Gold fin
		Refrigerant		Eco-friendly (non-CFC)
		Anti-bacteria Filter		√
7	Dimensions	Indoor (LxWxH)	mm	
		Outdoor (LxWxH)	mm	
8	Net Weight	Indoor	kg	
		Outdoor	kg	
9	Warranty			Minimum two years (min. five years on compressor)
10	Additional Requirement			The Equipment shall be supplied along with • 4 m copper pipe with superlon insulation for suction line • 4 m copper pipe with superlon insulation for discharge line • 1 m PVC pipe for drain • Base plate for hanging outdoor unit

19. Laptop Computers

19.1 General

The computers must be manufactured by an internationally reputable manufacturer. The required specifications are as stated below in the technical particulars.

Computers must be provided with necessary cables, accessories, operation/users manuals, and so on.

19.2 Technical Requirements

Technical Specification of Laptop Computers		
SN	**Description**	**Requirement**
1	Preferred make	Lenovo, Dell, HP, Asus, Acer, Toshiba, Sony or equivalent reputed
2	Processor	Intel® Core™ i7 (latest generation) 2.5 Ghz. minimum, Cache 4MB or higher
3	Graphics	Inbuilt (minimum 2GB)
4	Memory	8GB DDR4 (Minimum)
5	Storage	SSD (minimum 256GB) OR HDD (minimum 1TB, 7200 rpm)
6	Display	14" FHD antiglare or equivalent
7	Battery	48 Whr (minimum) with up to minimum of 6-8 hours backup
8	Power Supply	230V, 1-ph,50 Hz., AC
9	Operating System	Windows® 10 pro (Genuine)
10	Webcam/Microphone	720p HD Camera with noise cancelling microphones (minimum)
11	Speakers	In-built Stereo Speakers
12	WLAN	• WiFi 802.11ac or higher • Bluetooth 4.1 or higher
13	I/O Ports	• Integrated Touchpad • Spill resistant Standard US keyboard • USB 3.0 (minimum 3 ports) • 3.5 mm Combo Audio Jack • HDMI Port • RJ45 Gigabit Ethernet • 4-in-1 Card Reader (SD, MMC, SDHC, SDXC)
14	Security	Anti-virus with web security pre-installed with at least for a year validity
15	Warranty	Minimum one year including parts and services at the manufacturer authorized service center
16	Other Accessories	• Good Quality Carrying Case (Back-pack or side-bag) • Standard AC Adapter supplied with laptop

20. Television

20.1 General

The television must be manufactured by an internationally reputable manufacturer. The required specifications are as stated below in the technical particulars.

Television must be provided with necessary cables, accessories, operation/users manuals, and so on.

20.2 Technical Requirements

Technical Specification of Television		
SN	**Description**	**Requirement**
1	Television Type	LED wall mounted type
2	Preferred Make	Sony, Samsung, LG, Panasonic, Toshiba or equivalent reputed
3	Display	32", FHD, Aspect Ratio 16:9; narrow bezels
4	Input	• HDMI • USB • Analog A/V
5	Audio	• Built-in Stereo Speakers • Analogue A/V out
6	Video Playback formats	• Containers: AVI, MKV • H264/MPEG-4 • MPEG-1 • MPEG-2 • MPEG-4 • WMV
7	Audio Playback formats	• AAC • MP3 • WMA
8	Picture Playback formats	JPEG
9	Power Supply	230V, 1-ph, 50 Hz. AC
10	Accessories	• Wall Hanging Bracket • Remote Control with batteries • Power Cord • Table Top Stand
11	Warranty	Minimum two years including parts and services at the manufacturer authorized service center

VOLUME – IIA OF III

SECTION – 3

INSPECTION, TESTING AND COMMISSIONING

FOR

33/11 kV SUBSTATION CONSTRUCTION WORKS

Table of Contents

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.

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.

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 provisions of the clauses on Test and Inspection of the General Conditions of Contract and Special Conditions of Contract shall be applicable to the supply and erection portions of the Works. 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.

4. Tests at Manufacturers Works "Factory Acceptance Tests"

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 IEC, ISO or equivalent international 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, 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.

4.2 Testing Arrangements

After receiving the prior information about the completion of manufacturing at the factory, the Employer will depute his personnel to the manufacturer's factory to witness the fabrication, assembly and testing of any or all parts of major equipment. The costs of such visits shall be borne by the Employer. If any additional Tests are required or the listed below visit is insufficient, the manufacturer/contractor shall bear the cost required for visit by the Employer/Employer's representative. The number of the Employer's personnel and equipment to be witnessed will be as listed below. The duration of such visits shall be minimum of three days to maximum of seven days as per inspection/testing requirements.

33/11kV Substation		
SN	**Equipment**	**Required Numbers**
1	Power Transformer & Station Transformer	2 persons, 1 visit
2	Circuit Breaker & Control and Relay Panel	1 person, 1 visit
3	Instrument transformers	1 person, 1 visit
4	Disconnecting Switch; Lightning Arrester & Power Fuse	1 person, 1 visit
5	Battery & Battery Charger	1 person, 1 visit
6	12kV Switchgear	2 persons, 1 visit
7	Power Cable (XLPE) and Termination Kit	1 person, 1 visit
8	Power Cables (PVC) and Control Cables	1 person, 1 visit
9	Steel Structure for Substation	1 person, 1 visit

During the visit of Manufacturer's premises by the Employer/Employer's representative, all tests shall be duly completed by the manufacturer with the witness of Employer/Employer's representative. "Factory Acceptance Test" reports shall be duly signed and if the results are satisfactory, the dispatch clearance instructions shall be provided by the Employer/Employer's representative.

4.3 Test Certificates

Within 30 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.

4.4 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 IEC, ISO, IS or equivalent international 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.

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.

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 energize able from the existing system.

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.

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.

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.

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.

10.1 Test Procedures

The following basic tests, in addition to others, shall be carried out:

- Measurement of insulation resistance.
- AC withstand voltage test

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 megger.

After completion of the measurement of insulation resistance mentioned above, A C 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 A C withstand voltage test. The indication value of meters mounted on the board during the A C 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.

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.

10.4 "As-Built" Drawings

Keep an ongoing record of all changes on a master set of drawings. Produce and supply a minimum of three 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.

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.

Power Transformers

Make all tests as per commissioning tests called for in the Manufacturers' instructions manual.

Record and submit to Employer in a hardcover binder, all test data obtained.

Circuit Breaker Tests

For the SF6 circuit breakers, test the gas system to prove the gas density, its dryness and its di-electric strength. Measure the gas leakage rate.

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 megger 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 busbars 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 busbars and connections to ensure that the busbars 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 busbars at 75% of the specified value for the equivalent factory test. Carry out with at least 1000 V DC megger 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.

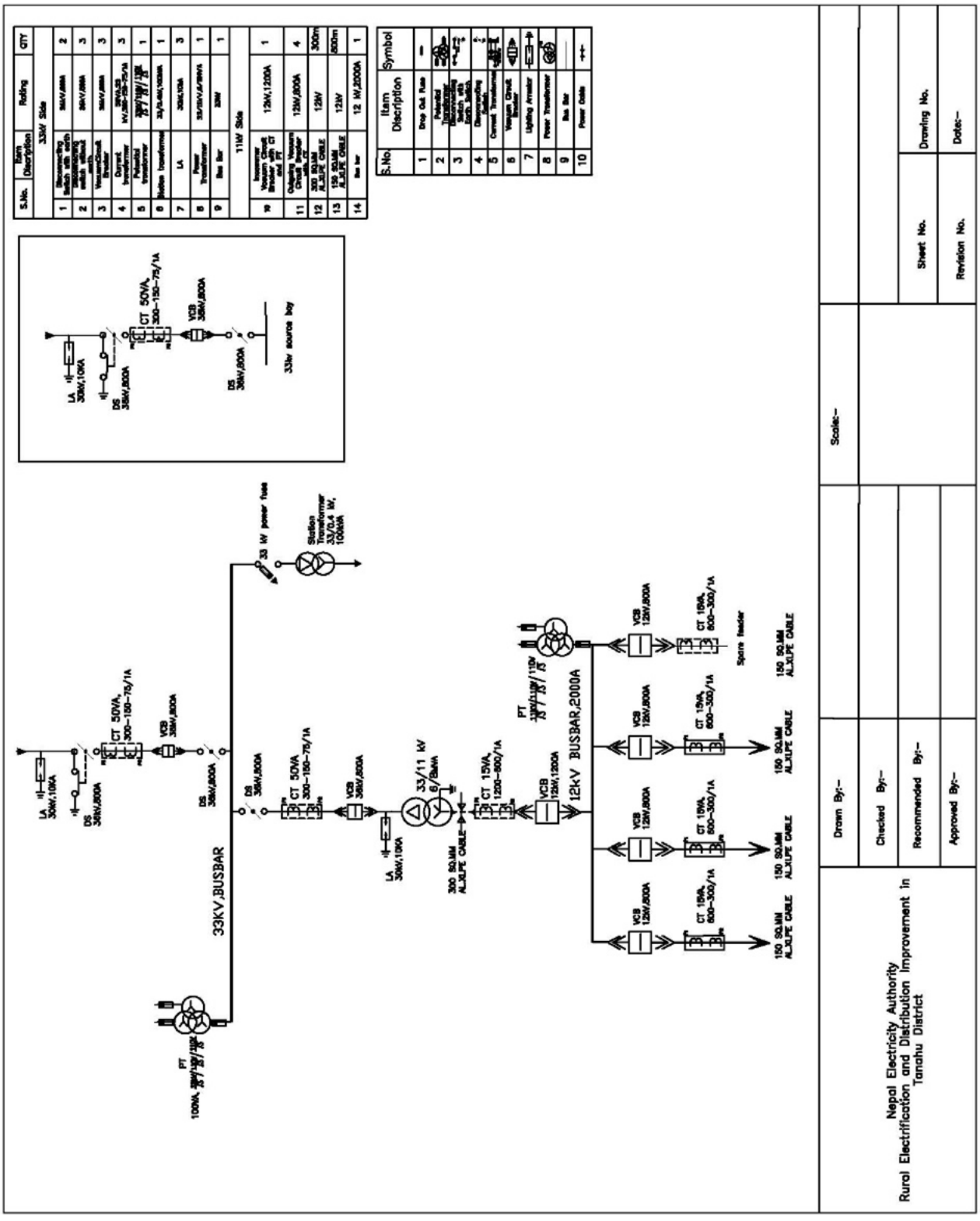
VOLUME – IIA OF III

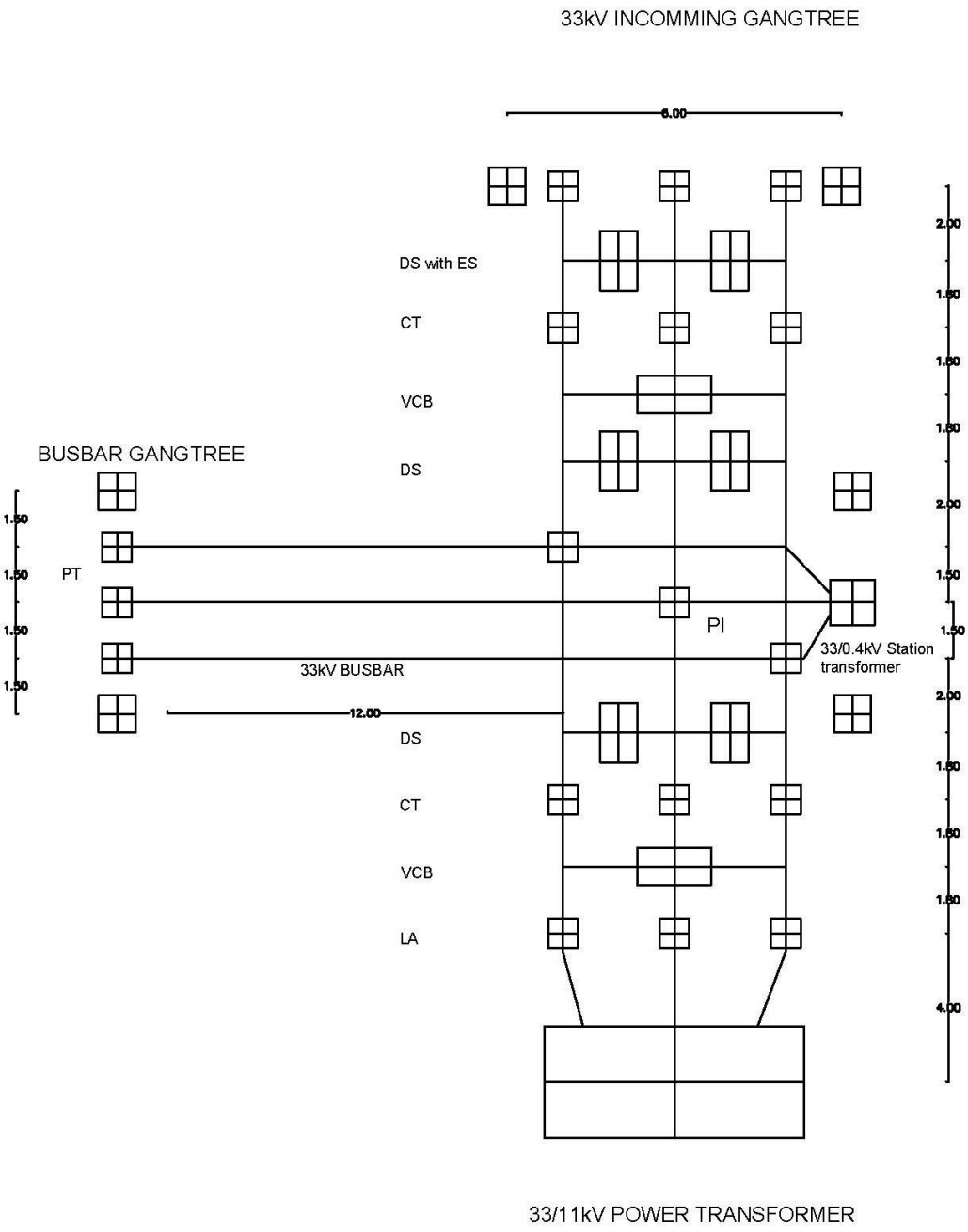
SECTION – 4

DRAWINGS

FOR

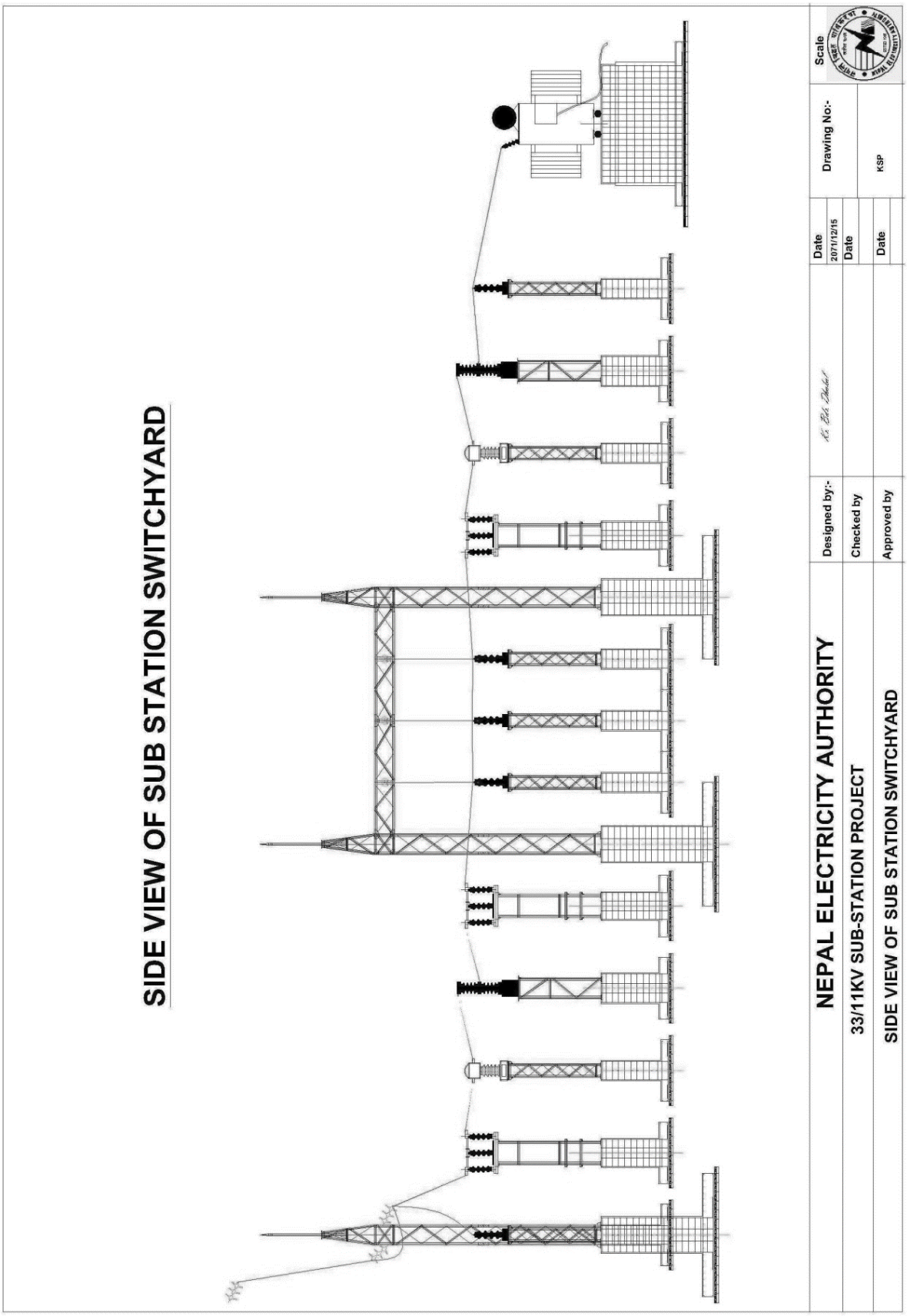
33/11kV SUBSTATION CONSTRUCTION WORKS

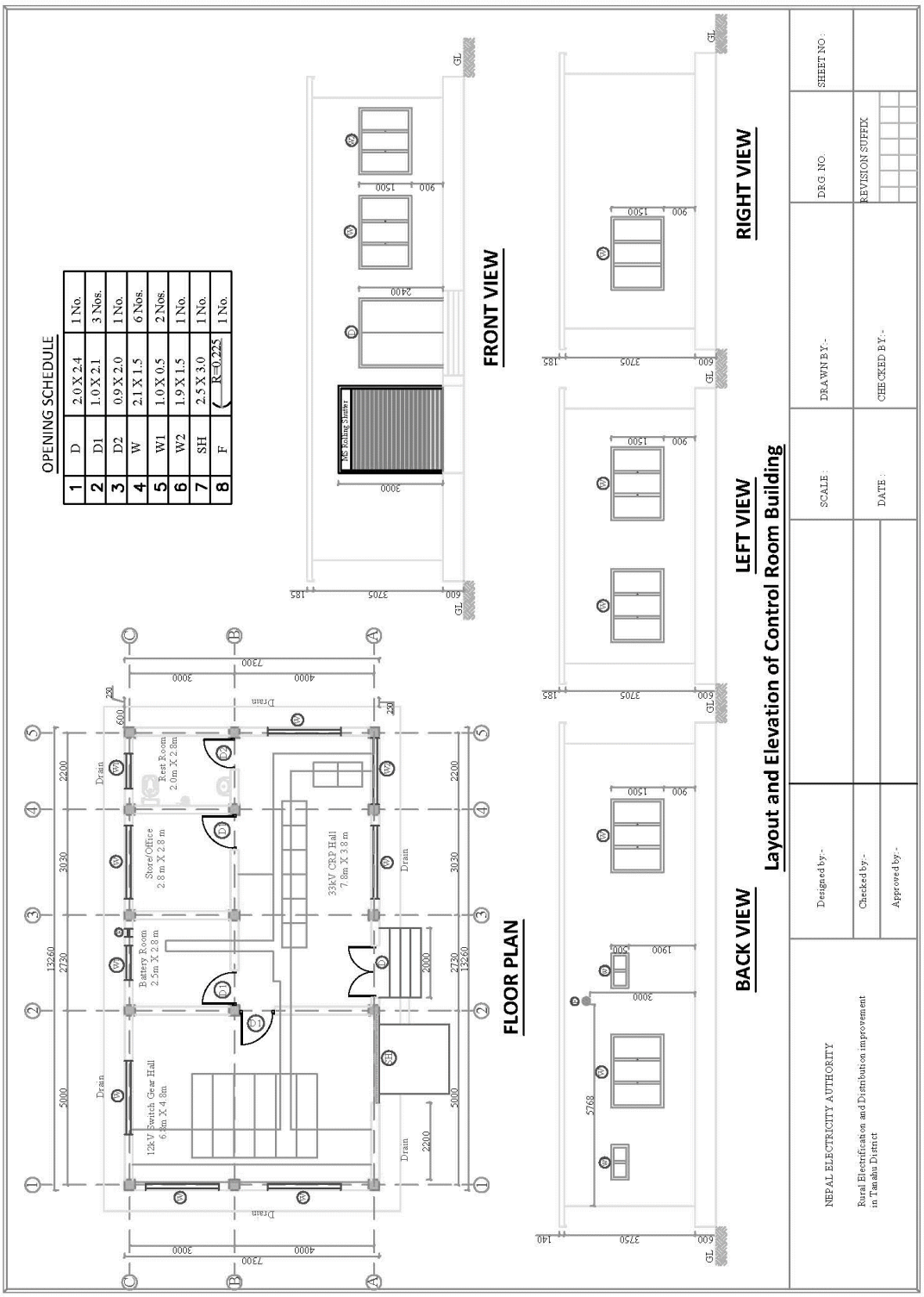

33KV BUSBAR
12kV BUSBAR,2000A
Nepal Electricity Authority
Rural Electrification and Distribution Improvement in Tanahu District
Drawn By:-
Checked By:-
Recommended By:-
Approved By:-
Scale:-
Sheet No.
Drawing No.
Revision No.
Date:-

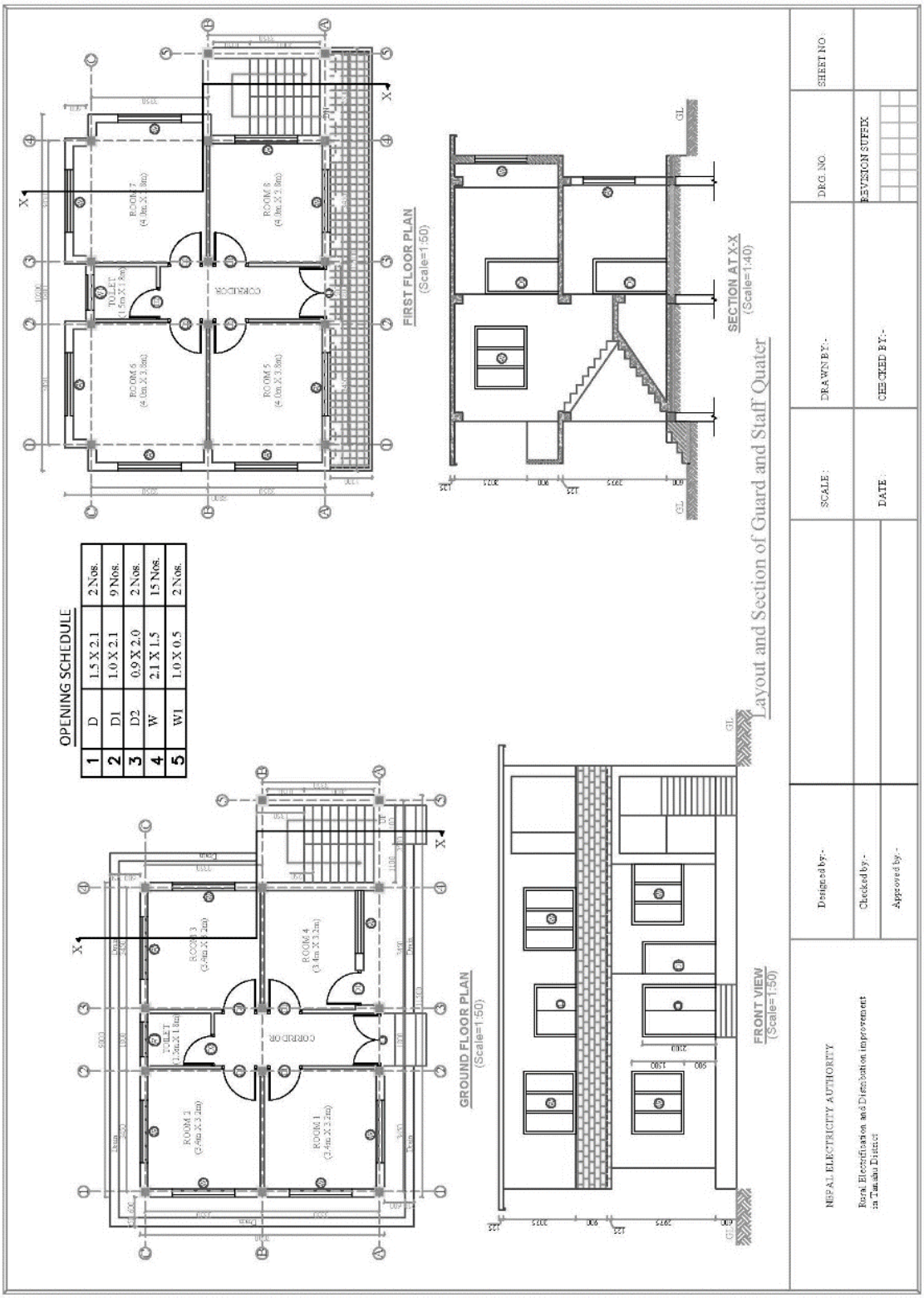


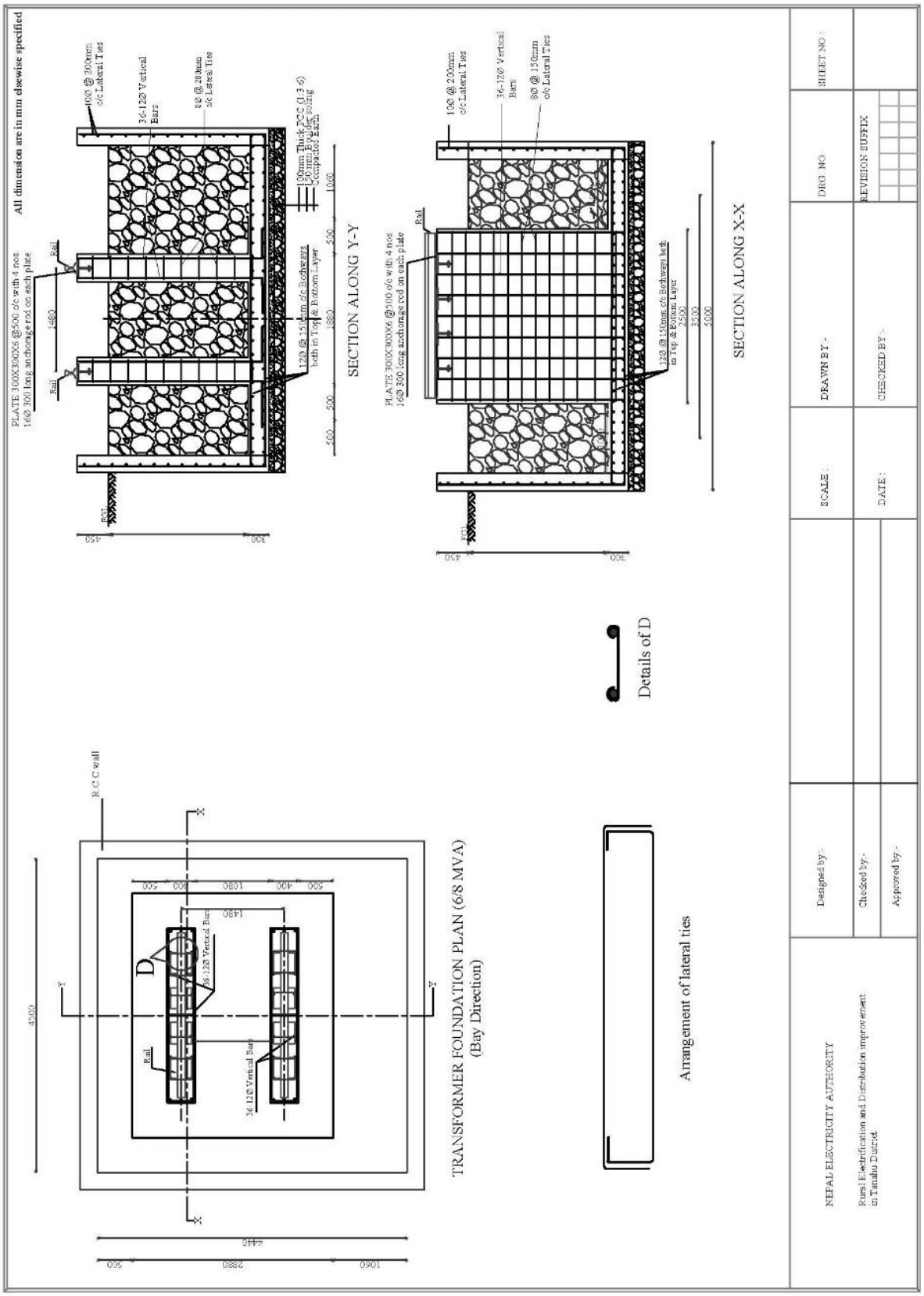
LAYOUT OF SWITCHYARD

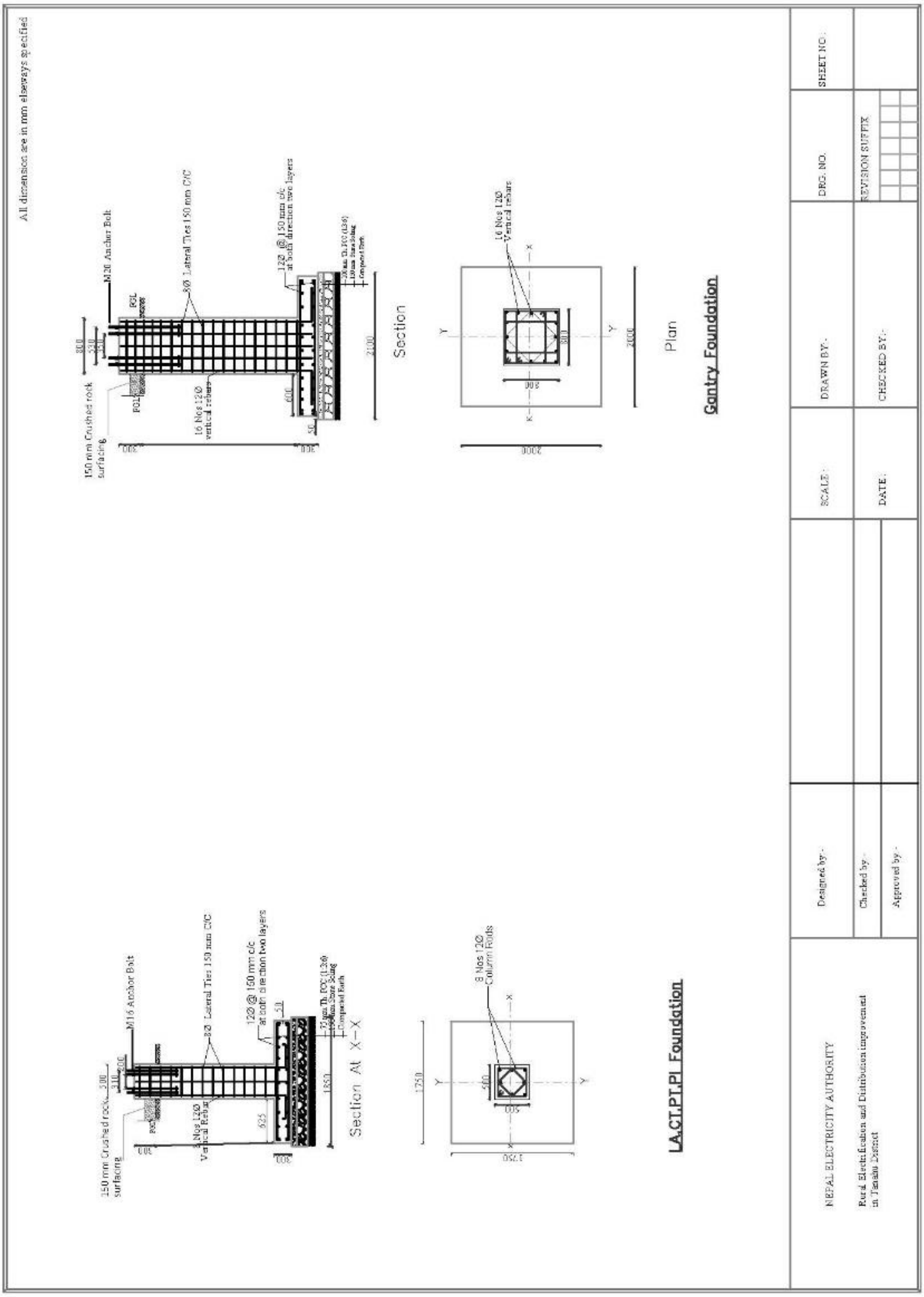
NEPAL ELECTRICITY AUTHORITY Rural Electrification and Distribution improvement in Tanahu District	Designed By:-		Date:	LAYOUT OF SWITCHYARD
	Checked By:-			Drawing No.
	Recommendation by:-			Scale: / Sheet No.
	Approved By:-			Revision No.


SIDE VIEW OF SUB STATION SWITCHYARD
NEPAL ELECTRICITY AUTHORITY
33/11KV SUB-STATION PROJECT
SIDE VIEW OF SUB STATION SWITCHYARD
Designed by:-
Checked by
Approved by
Date
2071/12/15
Date
Date
Drawing No:-
KSP
Scale

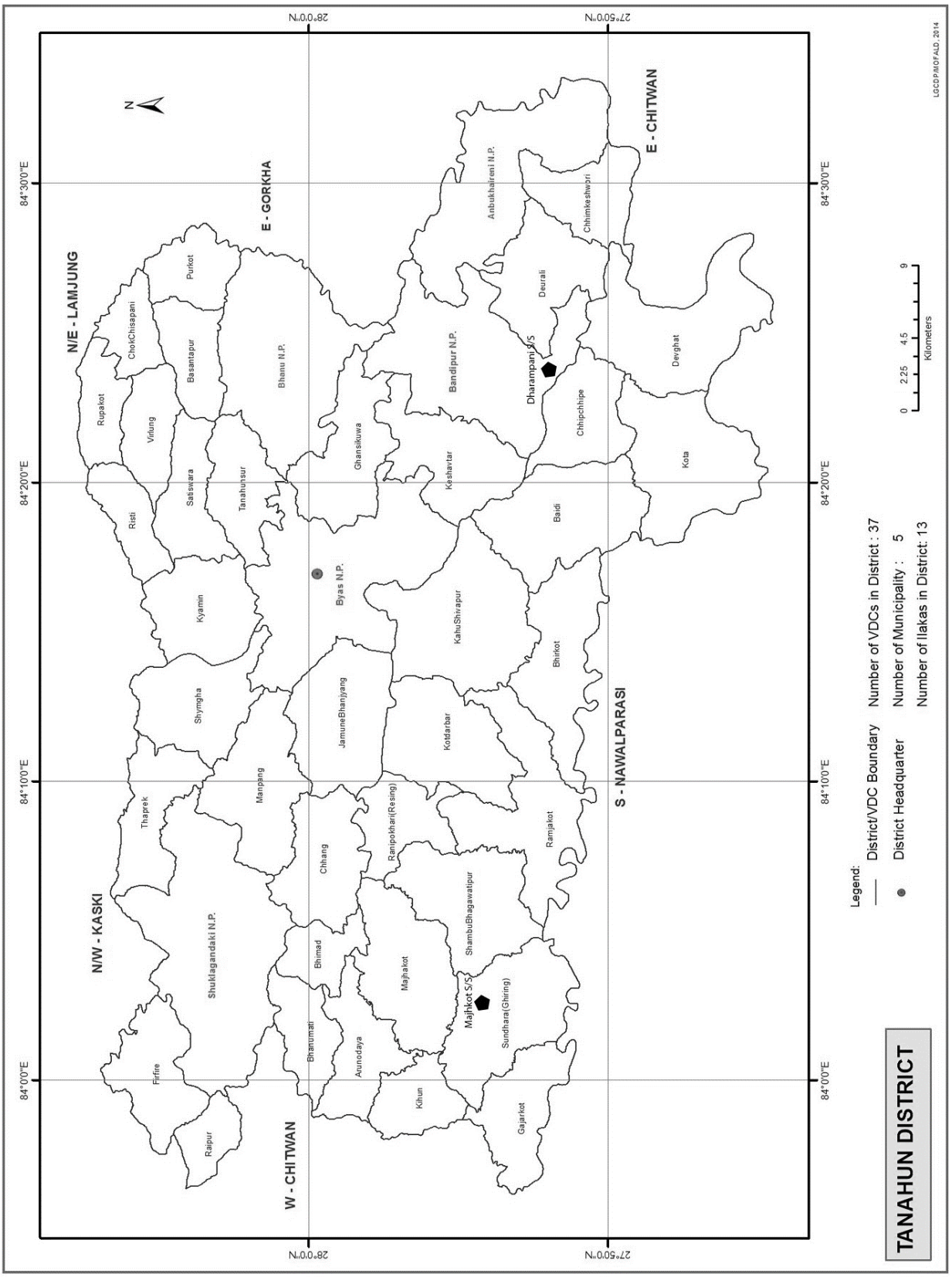

OPENING SCHEDULE
1 D 2.0 X 2.4 1 No.
2 D1 1.0 X 2.1 3 Nos.
3 D2 0.9 X 2.0 1 No.
4 W 2.1 X 1.5 6 Nos.
5 W1 1.0 X 0.5 2 Nos.
6 W2 1.9 X 1.5 1 No.
7 SH 2.5 X 3.0 1 No.
8 F R=0.225 1 No.
FRONT VIEW
RIGHT VIEW
LEFT VIEW
BACK VIEW
FLOOR PLAN
Layout and Elevation of Control Room Building
Ante Room 2.0m X 2.8m
Store/Office 2.8 m X 2.8 m
Battery Room 2.5m X 2.8 m
12kV Switch Gear Hall 6.8m X 4.8m
33kV CRP Hall 7.8m X 3.8 m
NEPAL ELECTRICITY AUTHORITY
Rural Electrification and Distribution improvement in Tanahu District
Designed by:-
Checked by:-
Approved by:-
SCALE:
DATE :
DRAWN BY:-
CHECKED BY:-
DRG. NO.
REVISION SUFFIX
SHEET NO.:


OPENING SCHEDULE
1 D 1.5 X 2.1 2 Nos.
2 D1 1.0 X 2.1 9 Nos.
3 D2 0.9 X 2.0 2 Nos.
4 W 2.1 X 1.5 15 Nos.
5 W1 1.0 X 0.5 2 Nos.
FIRST FLOOR PLAN
(Scale=1:50)
SECTION AT X-X
(Scale=1:40)
GROUND FLOOR PLAN
(Scale=1:50)
FRONT VIEW
(Scale=1:50)
Layout and Section of Guard and Staff Quater
NEPAL ELECTRICITY AUTHORITY
Rural Electrification and Distribution improvement in Tanahu District
Designed by:-
Checked by:-
Approved by:-
SCALE :
DATE :
DRAWN BY:-
CHECKED BY:-
DRG. NO.
REVISION SUFFIX
SHEET NO.


All dimension are in mm diswise specified
SECTION ALONG Y-Y
SECTION ALONG X-X
TRANSFORMER FOUNDATION PLAN (6/8 MVA)
(Bay Direction)
Details of D
Arrangement of lateral ties
R.C.C wall
NEPAL ELECTRICITY AUTHORITY
Rural Electrification and Distribution improvement in Tanahu District
Designed by :-
Checked by :-
Approved by :-
SCALE :
DATE :
DRAWN BY :-
CHECKED BY :-
DRG NO
REVISION SUFFIX
SHEET NO :


All dimension are in mm elseways specified
M20 Anchor Bolt
8Ø Lateral Ties 150 mm C/C
12Ø @ 150 mm c/c at both direction two layers
150 mm Crushed rock surfacing
16 Nos 12Ø vertical rebars
Section
Plan
Gantry Foundation
M16 Anchor Bolt
8Ø Lateral Ties 150 mm C/C
12Ø @ 150 mm c/c at both direction two layers
Section At X-X
8 Nos 12Ø Column Rods
LA,CT,PT,PI Foundation
NEPAL ELECTRICITY AUTHORITY
Rural Electrification and Distribution improvement in Tanahu District
Designed by:-
Checked by:-
Approved by:-
SCALE:
DATE:
DRAWN BY:-
CHECKED BY:-
DRG. NO.
REVISION SUFFIX
SHEET NO.

Indoor cable trench 12kv
bars size & spacing same as outdoor cbale trench
OUTDOOR CABLE TRENCH SECTION
Embeded channel steel (100)
Embeded steel flat (60*6)
100 THK RCC COVER
10 mm Ø @ 150mm C/C
75 mm THK. P.C.C.(1:3:6)
Ground Level
NEPAL ELECTRICITY AUTHORITY
Rural Electrification and Distribution improvement in Tanahu District
Designed by:-
Checked by:-
Approved by:-
SCALE:-
DATE:-
DRAWN BY:-
CHECKED BY:-
DRG. NO.
REVISION SUFFIX
SHEET NO.:


TANAHUN DISTRICT
N/E - LAMJUNG
E - GORKHA
E - CHITWAN
N/W - KASKI
S - NAWALPARASI
W - CHITWAN
Legend:
District/VDC Boundary
District Headquarter
Number of VDCs in District : 37
Number of Municipality : 5
Number of Ilakas in District: 13
Kilometers
Purkot
ChokChisapani
Rupakot
Basantapur
Virlung
Risti
Sasswara
Tanahunsur
Bhanu N.P.
Kyamin
Byas N.P.
Ghansikuwa
Anbukhaireni N.P.
Chhimkeshwori
Deurali
Bandipur N.P.
Dharampani S/S
Keshavtar
Chhipchhipe
Devghat
Kota
Baidi
Bhirkot
KahuShivapur
Koldarbar
JamuneBhanjyang
Shymgha
Manpang
Thaprek
Ramjakot
Ramjokhari(Resing)
Chhang
Shuklagandaki N.P.
ShambuBhagawatipur
Majhakot S/S
Sundhara(Ghiring)
Majhakot
Bhimad
Bhanumati
Arunodaya
Kihun
Gajarkot
Firfire
Raipur
84°0'0"E
84°10'0"E
84°20'0"E
84°30'0"E
28°0'0"N
27°50'0"N
N
LGCDP/MOFALD 2014

VOLUME – IIB OF III

SECTION – 1

REQUIREMENTS FOR EXECUTION OF WORKS

FOR

LINE AND DISTRIBUTION TRANSFORMER CONSTRUCTION WORKS

Standard Specifications

1. General

1.1 These Standard Specifications, together with the Standards of Nepal Electricity Authority shall govern the performance of the Works and shall be the basis for inspection and acceptance of the Work by the Project.

1.2 The Standard Specifications and the Standards of Nepal Electricity Authority shall be considered as mutually inclusive, and the conditions stated in each shall supplement the other as appropriate.

1.3 All Standard Specifications shall be followed at all times by the Contractor unless specifically accepted in writing by the Project, or unless some aspects of the work covered by these General Specifications are not required by the Scope of Work.

2. Route of Circuits

2.1 To the greatest extent practicable, all overhead circuits should be located along streets or travelled ways ordained by the local level authority or other required authority as public property, except as required for Service drops and circuits to individual consumers.

2.2 To the greatest extent practicable, all facilities should be located on public property, and in no case shall private property be occupied unless specifically authorized by the Project. The Project shall obtain any required permits for occupancy of public or private Right-of-Way.

3. Survey and Staking

3.1 All structures should be located at the outer limits of public property along streets or travelled ways. Structures should also be located along streets at property lines of adjacent private property. Structures and stays running parallel or perpendicular to the line route shall not block portions of streets, travelled ways, drives, passages, or gates.

3.2 All structures shall be so located as to reduce, to the greatest extent practicable, obstacles to pedestrian and vehicular traffic. Barriers shall be provided in accordance with instructions by the employer. As far as practicable, transformer structures shall be located to reduce visual and noise impact on adjacent residences or businesses.

3.3 Where underground facilities are indicated by surface conditions, or where such facilities can be located, structures and stays shall be so located as to avoid conflict with such facilities during construction.

3.4 All structure and stay lead locations shall be staked. At points of intersection (P.I.) of tangent line sections, steel rebar stakes shall be used to locate the P.I. A minimum of two (2) side sightings will be made at each P.I to permit re-location of P.I. in the event of stake removal. All structure locations in tangent line sections shall be staked.

3.5 All distances between structures, and other necessary measurements of length, shall be measured to accuracy of 0.1 metre and all angles shall be determined by transit to an accuracy of 0.1 decimal degree. All elevations shall be measured to an accuracy of 0.1 metre by means acceptable to the Project.

3.6 All measuring and staking activity shall be accomplished by personnel with experience in survey procedures, and standard survey equipment acceptable to the employer shall be used to perform the survey work. Field survey notes covering all survey work shall be produced and maintained and shall be turned over to the Project at the time of completion of the Works. The format of proposed survey notes shall be submitted to the Project for approval.

3.7 Survey work shall include center line and structure location and staking; determination of overhead and side clearings of other structures, wires, and obstacles; area surveys and plotting; and center-line profiles of terrain; as directed by the Project.

4. Technical Documentation

4.1 All technical documentation as specified herein, shall be prepared by the Contractor. The Contractor shall employ skilled drafting personnel to produce all documentation specified. All technical documentation prepared by the Contractor shall be subject to the approval of the Project prior to acceptance by the Project of such documentation. All technical documentation shall be prepared in the English language.

4.2 Structure Data Sheets (SDS) shall be prepared in accordance with the format provided by NEA. Structure Data Sheets shall be prepared by the Contractor showing his proposed construction details for erection of facilities in accordance with the Standards of Nepal Electricity Authority. The SDS shall be prepared after the center-line survey and staking is completed, for any line section designated by Project, and shall be submitted to Project for approval prior to any construction of the facilities shown in SDS. Submission of SDS for approval shall be in the form of ISO A3 paper size in clearly legible copy. Any unclear or illegible form entry or reproduction shall be rejected. Project may require any revisions to be made, at their sole discretion, prior to approval of the SDS for construction. An approved and field checked SDS is required for all Construction Units invoiced by the Contractor. Field checking of the SDS shall be performed jointly by the Contractor and Project representative. The SDS and As-Built Plan are intended as permanent records for Project. Any construction performed prior to the Contractor's receipt of approved SDS from Project shall be completely at the Contractor's risk, and Project shall have the right to require any correction due to the un-approved construction activities.

4.3 As-Built Drawings shall be prepared by the Contractor in the general format provided by the Project. The Project shall provide any available environmental background data for inclusion on the various drawings and the Contractor shall record (in ink) all facilities as-built.

4.4 The Contractor shall prepare other technical drawings, in the same medium and format as the As-Built Drawings, for As-Built Drawings index sheets, pole maps, and One-Line Diagrams as specified and required by the Project.

4.5 The Contractor shall prepare and furnish Transformer Record documents, in the format specified by the Project, for each transformer installed.

5. Material Storage

5.1 The Contractor shall procure all materials and equipment stated in the Bill of quantities. The Contractor shall provide all labor, equipment, and vehicles to load and transport materials and equipment to the Contractor storage facilities and worksites as required. All materials and equipment turned in to the Project reclaimed after demolition of existing facilities if any shall be transported to the Project warehouse and unloaded in the same manner.

5.2 Worksite

a) Extended storage of materials along the routes of lines will not be permitted. All small items of material shall be provided to the work crews on a daily basis and no small items of materials may be stored on the worksite overnight.

b) Transformers, ABC cable and conductor reels may be spotted at the worksites for a short period prior to installation provided that crating and reel lagging are intact to protect the items. Poles may be spotted at structure locations for short periods prior to setting.

c) All poles, transformers, ABC cable and conductor placed at the worksites shall be located so that the items are not subject to damage and do not impede pedestrian or vehicular traffic.

d) Any damage caused by imprudent placement of equipment and materials by the Contractor at the worksites shall be corrected by the Contractor, in a manner acceptable to the Project, at the Contractor's cost.

5.3 Contractor Storage Facility

a) The Contractor shall be financially responsible for the secure and proper storage of materials, which are to be provided by the Project prior to installation of the materials and equipment, to prevent loss or damage to any materials.

b) Any items of material and equipment contained in degradable packaging shall be stored under roof and protected from moisture. Other materials, except as specified in subparagraph (c) below shall be stored and covered in a well-drained level area, free from accumulation of surface water.

c) Transformers, disconnecting switches, reels of ABC Cable, reels of Cover Conductor, reels of XLPE Cable may be stored outdoors in a well-drained, level area free from accumulation of surface water. Reels of cable may be stacked on reel sides not more than three (3) reels high. Cable reels shall be placed on Wood pallets, wood lagging, or well-gravelled level surface.

d) Packaged items of material and equipment shall not be uncrated, or have packaging removed, prior to installation. The Contractor shall exercise due caution and care in the transportation, storage, and handling of all materials which are to be provided by the Project. Equipment consisting of, or containing, porcelain insulation should be transported and handled to avoid cracks or chipping. Lagging or other protection shall not be removed from ABC cable reels until the cable is to be installed.

e) The ends of installed cables shall be sealed immediately after being cut with a non-absorbent covering fastened around the outer jacket.

6. Excavations

6.1 All excavations made for the installation, or demolition, of facilities shall be accomplished in a timely manner according to the scheduled installation. Required excavations shall be opened, material installed, and backfill placed, as specified, in a continuing operation to the greatest extent practicable.

6.2 Any excavation left open during discontinuous construction which is accessible to the public or along public thoroughfare, shall be covered or barricaded, and marked by suitable visual means, to prevent a public hazard.

6.3 Excavations shall be properly located and sized for the intended use. Pole and stay plate/ anchor excavations shall be correctly sized to retain undisturbed soil to the greatest extent consistent with the means of excavation. Pole holes shall be made by power-driven auger or by manual methods; power-driven shovel equipment shall not be used. Pole holes shall be excavated to the specified depth with no tolerance shallow and tolerance of ten (10) centimetres deep. The bottom of pole holes shall be undisturbed soil, gravel or rock. Stay plate holes shall be excavated by manual methods to specified depth with no disturbed soil in the direction of the anchor rod.

6.4 All excavations shall be backfilled with excavated material, or as specified for the installation. Backfill shall be free of foreign materials and shall be well tamped with excess backfill graded over the excavated area to prevent depressions resulting from eventual natural compaction. Large amounts of excess backfill shall be removed from the site by the Contractor if so directed by employer. If so directed by Project, the Contractor shall provide suitable backfill materials for excavations where existing removed materials is insufficient, or inappropriate, to provide suitable grading of the excavated area.

7. Pole Setting

7.1 Poles shall be set in accordance with the appropriate Sections of the Standards of Nepal Electricity Authority.

7.2 Each pole shall be assigned a unique construction number at the time of structure staking for preliminary identification and preparation of structure Data Sheets (SDS).

7.3 Subsequent to the preparation and approval of SDS, and prior to provisional acceptance of a given line section, the Project shall provide the Contractor with unique permanent pole numbers. The Contractor shall then apply the specified permanent pole numbers to each pole with black oil-based paint in neat clear English letters and/or Arabic numerals. Permanent pole numbers shall be applied in letters/numerals five (5) centimetres in height at a point on the pole 1.6 meters above ground level. Numbers shall be applied on the side of the pole facing the adjacent street or travelled way.

8. Safety

8.1 The Contractor shall take all measures required to safeguard the public and private property from any hazard to life, limb, or property which may arise during the performance of the construction of the works. Such measures shall include, but not be limited to: barricades, signs, newspaper announcements, traffic control by police, or other advisory and control methods deemed appropriate.

8.2 The Contractor shall provide his work force with all tools and equipment in sufficient numbers and quality to perform all aspects of the works in a safe manner. The Contractor shall provide protective headgear for all members of his workforce, and shall provide protective clothing as required for specific tasks. The Contractor shall instruct his work force in proper and safe construction techniques and shall continuously monitor compliance with safety instructions throughout the period of the Contract.

8.3 The Contractor shall provide and require use of protective grounding equipment when:

a) Work is being performed on lines adjacent either in extension of or parallel to energized circuits.
b) Work is being performed on isolated circuits after conductors have been installed.

8.4 The Contractor shall maintain all tools and equipment in good working order. All mechanized equipment shall have adequate safety mechanisms and guards in place and be fully operational. Operators of such equipment shall be skilled and fully trained in the operation of such equipment.

8.5 The Contractor shall provide and maintain emergency medical supplies to cover with accidents and snakebites for his work force on a readily available basis. The Contractor shall also instruct all supervisory personnel in the action to be taken in the event of serious injury, and the sources and locations of professional medical assistance which shall be employed in such cases.

8.6 The Contractor shall apply all accidental insurance policies to his work force for an accident occurring during the working period of the construction.

9. Tests

9.1 The Contractor shall furnish the electrical test equipment and personnel to perform electrical tests of equipment and circuits, as specified by, and under the supervision of the Project.

9.2 The Contractor shall megger all circuits installed with a motor-driven megger to demonstrate the acceptable insulation characteristics of the line prior to energization and Provisional

Acceptance. 11 kV and 400 V overhead circuits shall be tested at 2500/1000 volts AC and 33 kV overhead circuits shall be tested at 5000 volts AC.

9.3 The Contractor shall megger all transformers with a motor-driven megger prior to installation

9.4 All tests specified shall be conducted during suitable atmospheric conditions under the supervision and witness of the Project. All test results shall be documented and signed by both parties.

10. Demolition

10.1 The Contractor shall perform the removal of all existing facilities, if any, in accordance with the specific directions of the Employer. All materials removed shall remain the property of Project and the Contractor shall deliver all salvaged materials to the Project warehouse, or as specifically directed by the Employer.

10.2 All poles shall be removed by pulling the complete pole from the ground; poles shall not be cut off at the ground line. Holes shall be backfilled and compacted completely with sufficient added backfill piled above grade to prevent depressions being created by natural compaction. Backfill material shall be provided by the Contractor.

10.3 All conductor materials removed shall be returned to the Project. Methods of conductor removal shall be specified by the Project. If conductor is removed in the longest length practicable for future re-use, the said conductor shall be wound on empty conductor reels, with the reels marked with the conductor size and approximate length. Different conductor sizes shall not be mixed on any reel. If conductor is removed from structures and specified as scrap, conductors may be cut down in lengths and made up in rolls. Conductor sizes for scrapping may be mixed; different conductor metals shall be separated.

10.4 Care shall be taken in removing, handling, and transporting cutouts, and surge arresters to minimize porcelain damage.

10.5 Transformers removed from service shall be delivered to the Project warehouse or as specifically directed by the Employer. Care shall be taken in removing, lifting, and transporting transformers.

10.6 Other structures shall be removed, such as concrete transformer pedestals in the most appropriate manner, as specified by the Project. Existing stay rods may be cut 20 centimetres below finished ground level.

11. Cleanup

11.1 The Contractor shall ensure that all worksites shall be free of all manner of debris resulting from the construction activity.

11.2 All crating, cable and conductor reels, packaging materials, conductor scraps, and other miscellaneous items are removed from the workplace. All holes resulting from removal of facilities shall be filled. If trees or bush have been cut or trimmed, all cuttings shall be removed. The worksites shall be left in clean natural conditions.

11.3 Site cleanup shall be an integral part of the Provisional Acceptance process, and no line section shall be provisionally accepted unless all cleanup work has been accomplished.

12. Tree Cutting and Trimming

12.1 Any tree cutting or tree trimming authorized and directed shall be accomplished by the Contractor under the direct supervision of Project.

12.2 All cutting shall be removed by the Contractor with disposition of cutting as specified by Project.

13. Interruptions to Existing Service

13.1 The Contractor shall arrange for interruptions of service to existing lines with Project. Every effort shall be made to limit such interruptions to the minimum.

Special Requirements for Construction of Works

1. Site Office Management

1.1 The Contractor and/or sub-contractors as per GCC shall establish and maintain throughout the period of the performance of the contract a site office to serve as a base for all the operations necessary to perform the works and shall maintain adequate store facilities for storing materials and equipment issued by the employer. In case the above-mentioned facilities and establishments are not found satisfactory during the site verification, the employer shall have right to instruct the contractor for rectification of the same.

2. Contractor's key personnel and workforce

2.1 The contractor shall have experienced and qualified administrative, accounting and store keeping staffs capable to undertake respective jobs. An office manager with adequate qualification and experience to run such establishment efficiently must head the site office. The contractor shall employ only experienced, competent and skilled office staff as required in the tender document.

2.2 The line construction and supervisory staff of the contractor shall be examined by the employer to ensure their capability to perform proper quality of work before commencement of the work.

2.3 The site and field staff as approved by the employer shall be made available for the entire construction period of the project. All the staff and workforce of the contractor shall be issued identity cards jointly certified by the contractor and the employer. Replacement of any such staff or site personnel must not be made without prior permission of the employer.

2.4 The contractor is required to pay salary and wages of his staff and workforce at an interval not exceeding a month. The rate of wages payable to the labours shall not be less than as prescribed by the labour law of Nepal.

3. Tools and Equipment

3.1 The Contractor shall have owned, leased or hired tools and equipment for successful execution of the work. Prior to beginning of the work the contractor shall show these items in his possession. In case of the heavy tools equipment and vehicles the contractor is required to submit the source of these items with credible documents such as contract papers conforming their availability at the time of the execution of the works.

3.2 The employer shall examine to verify the availability of all such tools and equipment before commencement of the work. The contractor shall be allowed to start his work only after verification of such tools and equipment in satisfaction of the employer. No tools and equipment shall be provided by employer.

The contractor shall have minimum of following tools and equipment for the smooth execution of the contract:

SN	Description of Tools and Equipment	Unit	Quantity
1	Crane Truck (Minimum 3 Ton lifting capacity)	Nos.	1
2	General Purpose Truck (Minimum 10 Ton capacity)	Nos.	1
3	Max or Rachet Puller suitable for HV/LV Cable Tensioning	Nos.	5
4	Come along Clamp suitable for HV/LV Cable Tensioning	No.	5
5	Crimping Device for jointing Cables	Nos.	2

4. Approval of Drawings

4.1 The contractor shall update and revise all plan and profile drawings provided to him by the employer after performing check survey of each of the segment of the scheme.

4.2 The contractor must get approval from the employer in writing before he starts execution of construction of any of the segment of work. If the contractor executes any work without the employer's prior approval, he may be asked to revise the same without paying any compensation to him.

5. Extra Work

5.1 Extra work and goods supply shall be performed in accordance with written directives as issued by the Project to the Contractor.

5.2 Extra work or goods supply for which there are applicable unit prices will be paid for at such unit prices.

5.3 Where there are no applicable contract unit prices, the price to be paid by the Project to the Contractor for extra works / goods supply shall be fixed through negotiation between Employer and the Contractor based on:

- the GoN norms and respective district rate approved by the District Rate Fixation Committee in case of extra works to be performed
- the prevailing market rate of the goods, in case of extra goods to be supplied.

In no case, such price shall exceed Project's cost estimates for the item.

5.4 Nothing in this Clause shall excuse the Contractor from proceeding with the extra work as directed in writing by the Project.

5.5 Any variation in the quantities of unit price construction units, within the ranges stated in the Special Conditions of Contract, Clause 1.3, from nominal bid quantities of such unit price construction units shall not be construed as Extra Work.

6. Materials

6.1 Major construction materials (Distribution Transformers, switches, insulators, poles, conductors, cables etc.), for installation of the Works shall be provided to the Contractor by the Project.

6.2 All materials and equipment of the Project shall be located at the Project's or such other areas where they are being stored. During issue and handing over of these materials it shall be the Contractor's responsibility to load all of them and provide all necessary lifting and handling equipment, labour and suitable transport as required to transport the various items of materials and equipment to the Contractor's site of storage and operations.

6.3 The listing of materials shall show the limiting allowance for breakage and scrap and material unit prices, which may be applied to the contractor's accountability to the Project for all materials and equipment issued by the Project. Allowances for such materials shall be as under:

- HV Covered Conductor	0.5 %
- ABC Cables	0.5 %

6.4 Accountability for all materials and equipment issued by the project shall be based on the material lists associated with the various construction drawings contained in the Standards of Nepal Electricity Authority and the allowances referenced in clause 3 above. At the time of final material accounting, any deficit in the Contractor's material account shall be charged to the Contractor at the unit price rates enlisted by the project during handing over of the materials to the Contractor.

6.5 If the Contractor fails to account for all materials and equipment issued by the Project as set forth in clause 4 above, the Contractor shall be charged for the missing materials or equipment. The Project shall have the right to withhold money due or to become due to the Contractor, as reimbursement for the deficit in the Contractor's material.

6.6 Prior to the rehabilitation work, representative of the NEA's local branch office, the Site Engineer and the Contractor shall jointly inspect the materials to be dismantled and list down such materials. It shall be the contractor's responsibility to pack those goods appropriately, transport them to the nearest NEA store and get receipt. Such receipts shall be enclosed with the subsequent invoices claimed by the contractor.

7. Local Materials

7.1 Certain minor items of materials, including civil materials, required by the Standards of Nepal Electricity Authority are designated Local Materials in the Standards and shall be furnished and installed by the Contractor as part of the completed unit of construction.

7.2 The contractor shall include the cost of such items of materials in his quoted construction unit prices and no other payments for such materials shall be made to the contractor.

7.3 The project, may, at it option, require the project's approval of any or all Local Materials prior to procurement of such items by the Contractor.

7.4 It shall be the Contractor's responsibility to determine his requirements for any items of Local Material in a timely manner and make procurement accordingly. No delays shall be allowed, and no exceptions shall be made to the required use of Local Materials due to the unavailability of such materials.

8. Construction Time Schedule

8.1 Before the commencement of construction works the contractor shall be required to submit a detail construction time schedule showing details of each event of construction of different components of works so as to complete the whole work within the time frame as per the requirement of the contract. The contractor's proposal shall be examined by the employer to ensure his ability to perform the work in time and approval shall be given with any modification, if necessary, in satisfaction of the employer.

8.2 If the contractor fails to execute the any component of work within the period specified in the construction schedule, the employer shall have right to warn the contractor to make up for such delay in time. In case the contractor fails to overcome delay in different components of the works instead of repeated reminders by the employer, he shall be made fully responsible for any delay in final time schedule and no consideration shall be made for any extension of construction period for the whole work.

9. Measurement of work and material

9.1 The contractor after completion of work of any segment of work as per approved drawing of the project shall submit detail work measurement in structure data sheet (SDS) provided.

9.2 Measurement of the work performed by the contractor shall be jointly checked by the contractor and the staff deputed by the employer. In case of any discrepancy or dissatisfaction of employer staff the contractor shall be notified for making corrections for the same and the contractor shall have to submit his revised measurement schedule.

10. Workmanship and quality of work

10.1 The contractor shall be attentive to maintain workmanship and quality of work while performing the work and shall obey to all the instructions of the field staff of the project time to time in this regard.

10.2 Special items such as concrete works, cable jointing works and transformer installation works etc. must be performed in presence of the project field staff. In case of the concrete works the project staff shall assess quantity of cement and steel to be used for each of the job and this must be followed for performing the job. Sand and aggregate must be supplied as per the standard specification of the tender document. The project field staff shall check quality of such materials and the contractor shall use the same after his approval. Curing of concrete works must be carried as per standard practice. The field staff shall have right to ask the contractor to repeat concrete works in case of his failure to execute the job as above or in his absence.

10.3 Each and every item of the standard data sheet (SDS) shall also be checked by the project staff for the satisfaction of quality of workmanship as per the prescribed specification of the tender document. In case of failure of the contractor to execute any item of the work as per proper workmanship or quality, the project shall have right to ask the contractor to revise or remedy such work at the cost of the contractor.

11. Commissioning of work

11.1 After completion of entire work of any village or load centre, the project after necessary tests shall arrange to electrically charge the same. In case of successful operation in satisfaction to

the project the contractor shall be issued a provisional certificate starting from the date of such commissioning.

11.2 The Project shall be authorized to change such date of commissioning in case of failure of the line due to any defect in the quality of construction.

11.3 Final acceptance of work shall be issued only after completion and satisfactory commissioning of whole work of the contract.

Structure Data Sheet (SDS)

Structure Data Sheets (SDS) shall be prepared to provide details of specific construction information necessary for erection of pole structures with hardware and accessories and conductor installation. The SDS shall be used in conjunction with the area plan drawing to document the works to be performed. A sample copy of the SDS format is attached herewith.

Abbreviations used in the preparation of SDS shall be defined as follows,

S.N.	Particular	Description	Code
1	Circuit Type	Single Circuit	SC
		Double Circuit	DS
2	Pole Type	Steel Telescopic Pole	TTP
		Steel Tubular Pole	STP
3	Conductor/ Cable Type	33 kV 300 mm^2 XLPE Power Cable	XLPE,300,33
		11 kV 300 mm^2 XLPE Power Cable	XLPE,300,11
		120 mm^2 XLPE insulated Covered Conductor for 11 kV line	Covered,120
		80 mm^2 XLPE insulated Covered Conductor for 11 kV line	Covered,80
		ACSR 'DOG' Conductor	DOG
		ACSR 'RABBIT' Conductor	RABBIT
		LT AB Cable (3x95+70)	ABC, 3x95+70
		LT AB Cable (4x70)	ABC,4x70
		LT AB Cable (4x50)	ABC,4x50
		LT AB Cable (4x25)	ABC,4x25
4	Pole Frame Type (33kV and 11 kV Line)	Single Arm (deviation 0-7 deg)	SA
		Single Arm (deviation 8-15 deg)	SA1
		Double Pole Double Arm (deviation 16-30 deg)	DPDA
		H-structure (deviation > 30deg)	HS
		Single Pole Double Dead End Structure	SPDDE
		Tap-Off structure (TO)	TO
		Dead End Structure (DE)	DE
		Transformer pole Dead End Type Structure (TR-DE)	TR-DE
		Transformer Pole Intermediate Structure (TR-IN)	TR-IN
5	Pole Frame Type (400 V Line)	Low voltage frame type A1	A1
		Low voltage frame type A2	A2
		Low voltage frame type B	B
		Low voltage frame type C	C
		Low voltage frame type D	D
		Low voltage frame type E	E
6	Stay Type	Single stay	S
		Double Stay	D
		Flying type stay	F
7	Load Break Switch	Load Break Switch	LB
8	Angle of Deflection	Angle of line deflection in degree	BA

Note:

a) Information for a single pole location need not be confined to a single row.
b) All works, whether new or on existing systems, shall be documented on the SDS.
c) Each SDS shall include the applicable "As Built" Plan Drawing number(s). Similarly each "As-Built" Plan Drawing shall include the applicable SDS number(s).

NEPAL ELECTRICITY AUTHORITY

Project Management Directorate

Distribution System Augmentation and Expansion Project
Rural Electrification and Distribution Network Improvement of Tanahu District

Structure Data Sheet (SDS) for 33 kV Line

Province: Contract No.: ICB-PMD-DSAEP-074/75-01-Tanahu

District: Contractor:

Municipality: Authorized Subcontractor:-

:

S.N	Pole No.		Span	Circuit Type	B A	Pole Type	Pole Frame									Stay			Conductor/Cable		Switch		Remarks
	From	To				11m TTP	SA	SA1	DPDA	HS	SPDDE	TO	DE	TR-DE	TR-IN	S	D	F	XLPE,300,33	DOG	DS	LB	
1																							
2																							
3																							
4																							
5																							
6																							
7																							
8																							
9																							
10																							

NEPAL ELECTRICITY AUTHORITY
Project Management Directorate

Distribution System Augmentation and Expansion Project
Rural Electrification and Distribution Network Improvement of Tanahu District

Structure Data Sheet (SDS) for 11 kV and 400 V Line

Province:
District:
Municipality:

Contract No.: ICB-PMD-DSAEP-074/75-01-Tanahu
Contractor:
Authorized Subcontractor:

S.N	Pole No.		Span	Circuit Type	BA	Pole			Pole Frame						Stay						Conductor/Cable						Distribution Transformer (kVA)		Switch		Remarks
									HT			LT			HT			LT			HT			LT							
	From	To				11m STP		9m STP																							
						HT	COM	LT																							
1																															
2																															
3																															
4																															
5																															
6																															
7																															
8																															
9																															
10																															

VOLUME – IIB OF III

SECTION – 2

SPECIFICATIONS OF LINE MATERIALS

FOR

LINE AND DISTRIBUTION TRANSFORMER CONSTRUCTION WORKS

Table of Contents

Distribution Transformer

1. Scope

These specifications cover the requirements of oil-immersed, natural-cooled single and three-phase distribution transformers suitable for outdoors installation on 11kV, 50 Hz distribution systems.

2. Service Condition

The transformers shall be designed and constructed for outdoor installation and operation under the following conditions:

Ambient temperature: -5 deg. C to 50 deg. C

Relative humidity: up to 99%

Altitude: up to 3000m above the mean sea level

3. Standards and Quality Certification

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

IEC 60076 Power transformers

IEC 60137 Insulating Bushings for alternating voltages above 1 kV

IEC 60156 Insulating liquids-Determination of the breakdown voltage at power frequency-test method

IEC 60296 Specification for unused mineral insulating oils for transformers and switchgear

IEC 60551 Determination of transformer and reactor sound levels

IEC 60616 Terminal and tapping materials for power transformer

IEC 60722 Guide to lightning and switching impulse testing of power transformers and reactors

IEC 60733 Determination of water in insulating oils.

3.2 The manufacturer of the offered transformers must have been accredited with the latest edition of ISO 9001 (including design in the scope of registration) quality certification.

4. Description

4.1 Technical details are provided in the tables below.

S.N.	Description	Unit	Required ratings/features
1	Type		Three-phase, 11/0.4 kV
2	Rated power	kVA	25, 50, 100, 200
3	Rated voltage		
3.1	Primary	kV	11
3.2	Secondary	V	400
4	Maximum system voltage		
4.1	Primary	kV	12
4.2	Secondary	V	440
5	Rated frequency	Hz	50
6	Connection		
6.1	Primary		Delta
6.2	Secondary		Grd. Wye
7	Cooling System		ONAN
8	Vector group		Dyn11
9	Rated impedance voltage		3.5 - 4.5%
10	BIL for windings and bushings for primary side	kV	75
11	Power frequency withstand voltage, 50 Hz, 60 Sec.		
11.1	Primary	kV	28
11.2	Secondary	kV	3
12	No load tap changer		+/- 2.5%, +/- 5% on HV side
13	Mounting		Platform

S.N.	Description	Unit	Required ratings/features
14	Insulation levels (IEC)		LI 75 AC 28/AC 3
15	Insulation temperature class A		A
16	Maximum allowable noise level at 3 metre hemispherical radius	dB	<44
17	Applicable standard		IEC

4.2 Tank

The tank shall be of welded construction and fabricated from mild steel of adequate thickness. All seams shall be properly welded to withstand requisite impact during short circuit without distortion. All welding shall be stress relieved. The tank cover shall be bolted on to the tank with weatherproof, hot-oil resistant, resilient gasket in between for complete oil tightness. Pressed-steel radiators shall be mounted on transformer-tanks of 50 kVA and higher rating transformers. The radiator shall be of pressed-steel of corrugated type design. Heat dissipation calculation in respect of the number, size and length of the radiators are to be satisfied by design calculation.

Each transformer shall be provided with a case of rigid construction, which shall be oil-tight and gas-tight. The thickness of all tank sides except the tank bottom and cover shall not less than 3.2 mm. The thickness of tank, the tank bottom and cover shall not be less than 4.0 mm. The tank shall be capable of withstanding, without leakage or permanent distortion, a pressure 25% greater than the maximum operating pressure. The tank cover shall be bolted. Each transformer shall be provided with earthing terminal with clamp type connector. The radiator shall be of pressed steel or corrugated type design.

4.3 Painting

All sheet steel works shall be phosphated in accordance with the following procedure and in accordance with ISO 2063 and ISO 12944.

The tank body shall be sand/shot blasted to remove the welding scales. Oil, grease, dirt shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying. After phosphating, thorough rinsing shall be carried out with clean water, followed by final rinsing with dilute dichromate solution and even drying. 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. 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. The color for the finishing paint shall be light gray or as approved by Employer. The final finished thickness of paint film on steel shall not be less than 60 microns. Finished painted surface shall present aesthetically pleasing appearance free from runs and drips. A small quantity of finishing paint shall be supplied for minor touching up required at site.

4.4 Core

The transformer shall be of core type. The cores shall be constructed with prime core-material of interleaved grade non-aging, low loss, high permeability, grain oriented and cold rolled silicon steel laminations, properly treated after being sheared to remove any burrs and shall be re-annealed to remove any residual stresses. The steel shall be thin in lamination.

The yoke laminations shall be in single piece instead of pieces to reduce chances of introducing more air gaps in the core construction. All steel sections used for the support of the core shall be thoroughly sand/shots blasted after cutting, drilling and welding.

All laminations shall be properly insulated with the materials that will not deteriorate due to pressure and hot oil. The core shall be rigidly clamped with positive locking device to ensure adequate mechanical strength. Core and coil assembly shall be capable of withstanding the vibrations and shock during transportation, installation, service and adequate provision shall be made to prevent movement of core and coil assembly relative to the tank during these conditions. The core shall be provided with lifting lugs suitable for lifting complete core and coil assembly of transformer.

<u>Permissible Flux Density and Over Fluxing</u>

Flux density at rated voltage and frequency shall not exceed 1.6 T. The no-load current at rated voltage and at 112.5% voltage shall not exceed the values given below with tolerance as indicated.

At 100% rated voltage 2% of rated full load current + 30% as tolerance.

At 112.5% rated voltage max 4% of rated full load current

The bidder shall submit the design calculation in support of flux density and no-load current at 100% and 112.5% voltage along with drawings of core-steps, limb diameter, window-height, limb-center, etc.

4.5 Winding

The design, construction and treatment of winding shall give proper consideration to all service factors. The winding shall be so designed that all coil assemblies are of identical voltage ratio and shall be interchangeable. All delta leads should be clamped tightly on to the special frame/bracket making pie (π) frame. The leads leading to the bushing terminals should be clamped to the horizontal support base of the pie frame so that vibration during short circuit is not passed on to the windings.

The completed assembly of core and coils shall be dried in a vacuum sufficient to ensure elimination of air and moisture within the insulating structure. After the drying process, the assembly shall be immediately impregnated with dry oil to develop full electrical strength in the windings. The windings of the transformer shall be fabricated from copper materials.

Current density for any part of the winding shall not exceed 2.5 amp/mm2 for copper winding transformers.

4.6 Oil Preservation System

The transformers up to 25 kVA of voltage rating 11/0.4kV shall be completely oil filled type. The transformers of higher ratings shall be provided with conservator. The conservator vessel shall have a capacity between highest and the lowest levels of not less than 7.5% of the total cold oil volume of the transformer.

Each conservator vessel shall be fitted with a sufficient-size breather in which silica gel shall be used as the drying agent. Windows in the silica-gel breathers shall be sufficiently large enough to allow crystal color change to be easily observed from a distance of 6 m. The position of the silica gel breather shall be such that maintenance can be carried out without the need to de-energize the transformer.

4.7 Short Circuit Capacity

The transformer shall be designed and constructed to withstand without injury the mechanical and thermal stress produced by short-circuit current limited by the impedance of the transformer only.

4.8 Tap Changer

An externally - operated tap changer shall be furnished with each transformer, to be operated only when the transformer is de-energized. The tap changer shall include an operating handle, visible indication of tap position and means for locking the tap changer in any desired position. The locking device shall be arranged to prevent locking the tap changer in an off position. Mechanical means shall be provided for limiting the maximum and minimum travelling of the extreme tap positions to be at the maximum and minimum position of the tap changer.

4.9 Insulating Oil

The insulating oil shall be refined mineral oil. Necessary quantity of oil for the transformer shall be furnished by the contractor.

4.10 Bushings

The bushings shall be made of homogeneous and well vitrified porcelain. The color of the insulator shall be brown and the surface shall have polished glaze.

The high voltage bushings shall have bolted terminal lugs (samples should be approved by NEA) suitable for terminating 30-120 mm2 stranded conductor.

The low voltage bushings shall have bolted terminal lugs (samples should be approved by NEA) suitable for terminating aluminum conductor compatible to the kVA rating (with 100% factor of safety) of the transformer.

The low voltage neutral bushings shall include a bolted terminal lug for terminating together an earth wire and an aluminum conductor of neutral circuit of the LV system.

4.11 Temperature rise

Maximum oil-temperature rise and maximum winding-temperature rise above ambient-temperature of 45 deg. C when carrying maximum continuous rated current shall

not exceed the following:

a) In oil by thermometer 50 deg. C

b) In winding by resistance 55 deg. C

The temperature rise of the insulating oil shall be measured near the top of the main tank.

4.12 Gaskets

All sealing washers/Gaskets shall be made of oil and heat resistance nitrile/neoprene/synthetic rubber bonded with cork gasket. Gasket made with natural rubber and cork shall not be acceptable. The thickness of the tank cover gasket shall not be less than 6 mm before compression.

4.13 Clearances

Minimum electrical clearances between the phases and phase to earth shall not be less than the values given below:

Voltage	Medium	Phase to phase, mm	Phase to earth, mm
11kV	Air	255	320
400V	Air	75	55

The clearances shall be maintained by fixing the bimetallic connectors in position.

4.14 Accessories

The following accessories shall be provided with each transformer.

- Lower oil filter and drain valve
- Liquid level gauge
- Lifting Lug
- Name plate
- Tank grounding terminal connector suitable for grounding cable
- Pressure relief device of explosion vent type for 25 kVA and higher ratings

4.15 Rating and Terminal Marking Plate

Each transformer shall be provided with a non-detachable rating and terminal marking plate of weather proof material, preferably of brass fitted in a visible position mentioning the following information:

- Guaranteed No Load Loss and Load loss
- Details of rating (rated output, voltage, phases, frequency etc.)
- Cooling
- Connection and vector diagram
- Weights (Total, weight of core, weight of winding and weight of oil)
- Name of manufacturer and year of manufacture
- Standards of manufacture
- Physical dimension of the transformer

— Any other relevant information

The face of the transformer body shall display the words “Property of Nepal Electricity Authority" on all four sides written in indelible paint.

5 Tests

Tests shall be performed in accordance with these specifications in line with the relevant IEC standards.

5.1 Type Tests

The Bidder shall submit, along with the Bid, type test reports (detail) on the following tests performed on identical units on each ratings of the transformer

— Temperature rise tests

— Dielectric Type Tests (Impulse Voltage Tests and Separate source AC withstand voltage test)

If the type test report for identical unit of transformer is not available, the type test report of similar type transformer may be considered acceptable during bid evaluation, provided that the bidder shall upon award of the Contract and prior to mass production of transformer, undertake to carry out type test on identical unit of each type (and rating) of transformer from an independent laboratory accredited by International Accreditation Corporation (ILAC) or International Accreditation Forum (IAF) or other reputed Accreditation Agencies acceptable to Nepal Electricity Authority in the presence of representative appointed by NEA at no extra cost to the NEA.

In this case, for purpose of evaluation, the values of no-load and load losses shall be considered from the values guaranteed by the bidder.

5.2 Routine Tests

The routine tests shall be performed on each unit of transformer by the manufacturer as per the IEC before dispatch and submit the test-reports to the Employer. The bidders are required to furnish the testing facilities available at the manufacturer’s premises for conducting the test

5.3 Tests to be witnessed by the Employer

To ensure about the quality of transformers, the following acceptance tests shall be carried out:

(i) If the type test report for identical unit of transformer is not available as mentioned above during bid evaluation, the bidder shall upon award of the Contract and prior to mass production of transformer, shall carry out type test on identical unit of each capacity of transformer in one of the testing laboratories as mentioned above in the presence of representative appointed by Nepal Electricity Authority at no extra cost to NEA.

(ii) Stage Inspection will be done when the raw material is received, and the assembly is in progress in the shop floor. After the main raw-materials i.e. core and winding materials and tanks are arranged and transformers are taken for production on shop floor and 20-25% under each lot of assembly has been completed, the supplier shall intimate NEA, so that an inspecting officer for carrying out such inspection could be deputed, as far as possible within fifteen days from the date of intimation. During the stage inspection, a few assembled cores shall be dismantled to ensure that the CRGO laminations used are of superior quality. During this stage inspection the Manufacturer shall provide the inspectors documentary evidence such as purchase order, bill of lading, delivery receipt, factory test certificate and type test report (from the independent laboratory accredited by International Accreditation Corporation (ILAC) or International Accreditation Forum (IAF) or other reputed Accreditation Agencies) of the core and winding materials to be used specifically for the manufacturing of Transformers under the subjected contract.

(iii) Pre-dispatch factory acceptance tests will be carried out at finished stage i.e. transformers are fully assembled and are ready for dispatch. As and when the transformers are ready for dispatch, an offer intimating about the readiness of transformers for pre dispatch inspection for carrying out

routine tests shall be sent by the manufacturer along with Routine Test Certificates as specified in Clause 5.2. The Pre-dispatch factory acceptance tests as per IEC shall be conducted on at least two (2) percent of the transformers to be supplied. In addition to above, the Employer's representative(s) shall also witness the temperature-rise test for each type (and rating) of transformer on at least one unit of each type (and rating) of transformer to be procured. The sample for routine and additional tests shall be selected by the Employer's representative(s) from the complete-lot ready for dispatch. The above mentioned tests shall be carried out in the premises of the Manufacturer.

(iv) The Contractor shall carry-out [which the Employer's representative(s) shall witness] the following tests in a laboratory owned or nominated by the Employer after delivery in Nepal.

a) Temperature rise test on at least one transformer of each rating.

b) No Load Loss and Load Loss test on hundred (100) percent of transformer

The sample shall be selected by the Employer's representative(s) from the completed lot of delivered transformers. **Cost for such tests shall be quoted in the Price Schedule and shall be paid by the Contractor/Manufacturer.**

6. Evaluation

6.1 The transformer no-load and load losses shall not exceed the following prescribed values. If the guaranteed no load and load losses exceed the prescribed values below, the offer shall be rejected.

S.N.	Transformer Rating	No Load Loss (W)	Load Loss (W)
1	11/0.4 kV, 25 kVA, 3-Phase	75	460
2	11/0.4 kV, 50 kVA, 3-Phase	120	750
3	11/0.4 kV, 100 kVA, 3-Phase	220	1210
4	11/0.4 kV, 200 kVA, 3-Phase	365	2100

6.2 Capitalization of Losses

Transformers shall be evaluated for the loss values (no-load losses and load losses) during bid evaluation based on the following loss capitalization formula:

$P_E = P_b + K_L L_L + K_{NL} N_{LN}$

Where,

P_E = Evaluated price

P_b = Bid price

K_{NL} =Value of no-load loss

K_L = Value of load loss

L_L = Guaranteed load losses at rated current

L_{NL}= Guaranteed no-load losses.

The transformer losses shall be capitalized as follows:

K_{NL}=Value of no-load loss = USD 4,684/ kW

K_L = Value of load loss = USD 1180/ kW

6.3 Penalty for Excessive losses:

During testing as per 5.3 above, if it is found that the actual measured losses are more than the values guaranteed by the bidder (provided that they are within the limit specified in Clause 6.1 above), a penalty shall be recovered from the bidder at double the loss capitalization rates arrived at clause 6.2 above. For fraction of a kW, proportionate penalty will be recovered.

6.4 For the purpose of this Specification type tests are defined as tests performed on similar transformers of the same general arrangements, same ratings and same mechanical and electrical characteristics.

6.5 If at any stage it is established that the type test report submitted by the bidder is not satisfactory, discrepant or ambiguous, the NEA reserves the right to ask the bidder/supplier to conduct the type test on the rating/s of transformers chosen by the NEA in presence of their representative to reputed national/international testing laboratory prior to its mass production and/or dispatch. The costs involved in organizing and conducting such tests shall be borne by the bidder/supplier.

7. Bid Documentation

7.1 The Bidder shall furnish with the Bid, the following documentation:

a) Copy of the IEC standards governing fabrication and testing of the transformers.

b) Certified copies of type tests carried out for each rating as required by the governing IEC standard and the specifications.

c) Certified outline drawings for each kVA rating showing dimensions, arrangements, and locations of all parts.

d) A clause-by-clause commentary on the specification, specifying compliance or deviations, if any.

GUARANTEED TECHNICAL PARTICULARS
(To be completed separately for each transformer rating)

(To be completed by the Bidder/Manufacturer)

Item: Distribution Transformer

S.N.	Description	Unit	NEA Requirement	To be filled by Bidder/Manufacturer
1	Manufacturer			
	Country of Origin			
2	Year of manufacturing experience			
3	Model No.			
4	Applicable Standards			
5	Winding material:			
6	Primary Winding BIL	kV		
7	Primary Bushing BIL	kV		
8	Accessories listed below furnished?			
8.1	Lower oil filter valve	Yes/No	Yes	
8.2	Liquid level gauge	Yes/No	Yes	
8.3	Lifting lugs	Yes/No	Yes	
8.4	Hand hole	Yes/No	Yes	
8.5	Tank earthing terminal	Yes/No	Yes	
8.6	Overload protection	Yes/No	Yes	
	If yes, details attached?	Yes/No	Yes	
9	Testing facilities available (mention name of the test equipment/facility below)			
9.1	Applied voltage test			
9.2	Induced voltage test			
9.3	No load loss and excitation current test			
9.4	Impedance voltage and load loss tests			
9.5	Resistance measurement			
9.6	Ratio tests			
9.7	Polarity and phase relation tests			
9.8	Leakage tests			
9.9	Insulation resistance tests			
10	Design Information			
10.1	Rated kVA (IEC rating)	kVA		
10.2	Number of phases	Number	3	
10.3	Frequency, Hz	Hz	50	
10.4	Voltage ratio at no-load	V/V	11000/400	
10.5	Winding connections		Dyn11	
10.6	Type of core sheet			
10.7	Magnetizing current at normal ratio:			
	in HV side	A		
	in LV side	A		

S.N.	Description	Unit	NEA Requirement	To be filled by Bidder/Manufacturer
10.8	Maximum flux density in core iron at normal voltage and frequency based on the net section of iron:			
	in Cores	T	1.6	
	in Yokes	T	1.6	
10.9	Type of winding:			
	HV winding			
	LV winding			
10.10	Maximum current density in winding at rated power:			
	in HV winding	A/mm^2	2.5	
	in LV winding	A/mm^2	2.5	
10.11	Type of insulation used for			
	HV winding			
	LV winding			
10.12	No-load loss at normal voltage ratio and 75°C	W		
10.13	Load loss at rated current and at 75°C	W		
10.14	Regulation at 75°C and rated power as a percentage of normal voltage			
	at power factor =1	%		
	at power factor =0.8	%		
10.15	Impedance voltage at 75°C and rated power			
	at normal tapping	%	7	
	at -5% tapping	%		
	at +5% tapping	%		
10.16	Efficiency			
	at 1 p.f and 125% of rated current	%		
	at 1 p.f and 110% of rated current	%		
	at 1 p.f and 100% of rated current	%		
	at 1 p.f and 75% of rated current	%		
	at 1 p.f and 50% of rated current	%		
	at 1 p.f and 25% of rated current	%		
10.17	Temperature rise at rated kVA by thermometer in oil	°C		
10.18	Temperature rise at rated kVA by resistance of windings	°C		
10.19	Permissible overload			
10.20	Transformer insulating oil specification			
10.21	Total volume of insulating oil at 20°C	L		
10.22	Effective expansion capacity of conservator.	L		
11	Approximate weight and dimensions			
11.1	Weight of transformer core	kg		
11.2	Weight of transformer windings	kg		
11.3	Weight of transformer tank and fittings	kg		
11.4	Weight of Oil	kg		
11.5	Total weight of transformer	kg		
11.6	Thickness of tank sides	mm		
11.7	Thickness of tank bottom	mm		
11.8	Thickness of radiator	mm		
11.9	Approximate dimensions including fittings			
11.9.1	Overall length	mm		
11.9.2	Overall width	mm		
11.9.3	Overall height	mm		
12	Delivery of equipment following award of contract and approval of drawing	months		
13	ISO 9001 holder (including design)	yes/no	yes	
13.1	ISO 9001 certificate submitted	yes/no	yes	
14	Type test certificate submitted	yes/no	yes	
14.1	Submitted for the required ratings	yes/no		
14.2	Type test certified by			
15	User's certificate submitted	yes/no	yes	
16	Has exported to third country	yes/no	yes	
17	Copies of relevant standards attached	yes/no	yes	
18	Outline Drawings and associated GA attached	yes/no	yes	

Signed by……..
Designation……..

As Representative for……..
Place……

Date…….
Seal of Bidder/Manufacturer …….

Transformer Platforms

1. **Scope**

1.1 This specification covers the fabrication and supply of transformer platforms used in overhead power line construction.

2. **Material**

2.1 The transformer platform shall be fabricated from hot-rolled channels, angles and steel members.

2.2 The steel channels and angles for transformer platform shall be fabricated in accordance with Indian Standards IS: 226 and IS: 808 or any revision thereof or other equivalent national or international standard provided that ensure at least equal or better quality to the standard mentioned above will also be acceptable. The minimum tensile strength of the steel shall be 4200 kg/cm2.

3. **Description**

3.1 The platform shall be fabricated out of galvanized steel members without any welded joints and field assembled by bolting.

3.2 The platform will support the transformer above the ground and will be supported by two-pole structures of tubular steel or pre-stressed concrete (PSC) poles. Transformers will be bolted to the platform at four (4) points. Provision should be made for the mounting of transformers of different physical dimensions and ratings up to 300 kVA.

3.3 The platform shall be designed by the supplier and fabricated, in general, in accordance with the conceptual configuration provided by the Employer. The design shall provide support for a transformer of a minimum of 1500 kg in weight with a minimum safety factor of 2.0. The Platform shall be stiff and shall be capable of withstanding horizontal forces and an overturning moment due to seismic effects on a transformer with center of gravity 0.5 meter above its base and seismic horizontal acceleration of 0.4g. The platform shall be stiff and shall not visibly deflect under static loading.

3.4 The platform shall be supplied disassembled, complete with all required members and fastenings. Packing may be made by banding structural members. Fastenings shall be separately packed. Structural members shall be clearly identified for ease of assembly in accordance with the assembly drawing furnished by the supplier.

3.5 The platform shall be suitable for fixing to support tubular poles of 100 to 200 mm diameter, and PSC poles of rectangular section with 250 to 350 mm in width and 140 to 180 mm depth.

4. Galvanizing

4.1 All ferrous parts of transformer platform shall be galvanized with minimum thickness of 90 microns after fabrication in accordance with IS: 2629 or any revision thereof or other equivalent national or international standard provided that ensure at least equal or better quality to the standard mentioned above will also be acceptable.

5. **Tests**

5.1 Apart from the tests indicated herein in the referenced standards, the transformer platform shall undergo following tests:

- Visual Inspection;
- Verification of Dimensions;

6**. Quality Assurance Program**

Along with the Bid the Bidder shall furnish quality assurance program of the manufacturer which includes the Quality System and the Quality Plans, which shall include, among others, information to meet the following requirement, failing which the Bid shall be liable for rejection.

i. The structure of the organization;
ii. The duties and responsibilities assigned to staff ensuring quality of works;
iii. The system for purchasing, taking delivery and verification of materials;
iv. The system for ensuring quality of workmanship;
v. The quality assurance arrangement shall conform to relevant requirements of ISO9001;
vi. Statement giving list of important raw materials, names of manufacturer for the raw materials, list of standards according to which the raw materials are tested, list of test normally carried out on raw materials;
vii. List of manufacturing facilities available;
viii. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections;
ix. List of testing equipment available with the manufacturer for final testing of equipment specified and the test plant limitation, if any the type, special, acceptance and routine tests specified in the relevant standards.

7. **Bid Documentation**

7.1 A preliminary design of the platform shall be submitted with the Bid. Data to be supplied with the preliminary design shall be:

a) Steel classification proposed to be used and the characteristics thereof;

b) Two copies of Preliminary detail drawings of the proposed platform;

c) Data regarding:

i) Vertical and horizontal loading on poles,
ii) Resultant safety factor,
iii) Resultant deflection,
iv) Resultant percent of allowable tension, compression, and shear limits for the steel selected and associated fastening,
v) Moments on pole due to seismic effects on the platform and transformers.

7.2 A clause-by-clause commentary on specification, specifying compliance and deviations, if any.

7.3 All data, drawings, catalogues and other technical documents shall be bound separately from the Bid documents.

GUARANTEED TECHNICAL PARTICULARS
(To be completed by the Bidder/Manufacturer)

Item: Transformer Platform

S.N.	Description	Unit	NEA Requirement	To be filled by Bidder/Manufacturer
1	**Manufacturer**			
2	Preliminary details drawing furnished?	Yes/No	Yes	
3	Steel Classification/ Characteristics furnished?	Yes/No	Yes	
4	Governing Standard for galvanization		IS: 2629 or ISO 1461	
5	Thickness of Galvanization		Min. 90 micron	
6	Vertical Load on pole			
7	Resultant Safety Factor			
8	Resultant Deflection at design load	mm		
9	% of allowable tension			
10	% of allowable compression			
11	% of allowable shear limits			

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer …….

Surge Arrester

1. SCOPE

This specification covers the general requirements of the design, manufacture, testing, supply and delivery of Surge Arrester of Gapless Metal-Oxide type commonly installed on overhead 11kV power lines of the Nepal Electricity Authority.

2. System Parameters

a)	Nominal Voltage	11kV
b)	System Highest Voltage	12kV
c)	System frequency	50Hz
d)	No. of Phases	3
e)	Neutral Earthing	Effective
f)	System fault current	20kA rms

3. Service Condition

a)	Ambient temperature	-5 to 55 deg. C
b)	Annual average ambient temperature	30 deg. C
c)	Maximum relative humidity	99%
d)	Environmental condition	Humid Tropical climate
e)	Operational altitude	Up to 3000m above msl
f)	Isokeraunic (Thunder day) level	90 days
g)	Solar Radiation	1.6kW/m2

4. Applicable Standards

The equipment and components supplied shall be in accordance with the latest editions of the standards specified below and amendments thereof and the NEA Specifications specified hereafter.

a)	IEC 60099-4 Part 4 Surge Arresters	Metal-oxide surge arresters without gaps for a.c. systems
b)	IEC 60099-5 Part 5	Selection and application recommendations
c)	IEC 61109	Composite insulator for a.c. over headlines with a nominal voltage greater than 1000V - Definitions, test methods and acceptance criteria
d)	IEC 60507	Artificial pollution tests on high voltage insulators to be used on a.c. Systems

5. Technical Parameters

5.1 Minimum Technical Requirements

S.N.	Description	Unit	Required ratings/features
1	Voltage rating	kV	9
2	Nominal system voltage	kV	11
3	Maximum system voltage	kV	12
4	System frequency	Hz	50
5	Nominal discharge current	kA	10
6	Type of Housing Insulator		Polymeric
7	Creepage distance (terminal to base)	mm	390
8	Minimum power-frequency withstand Voltage		
8.1	Wet	kV	50
8.2	Dry	kV	70
9	Impulse withstand (1.2/50μsec) Voltage	kV (Peak)	95
10	Maximum discharge (residual) voltage at 10kA lighting impulse current	kV (Peak)	29
11	Steep current residual voltage	kV (Peak)	32
12	Line Discharge Class		1
13	Energy absorption Capability with (4/10	kJ/kV	Not less than 3.2

	wave)		
14	Pressure relief class		B
15	High current		for 0.2s 20 kA
16	Low current		for 0.5s 0.8 kA
17	One Second TOV withstand capability	kV	>1.15x12

5.2 Power Frequency Voltage vs Time Characteristics

The manufacturer shall provide the power frequency voltage vs time characteristics, preheated to 60°C with no prior energy and with prior energy (specified by the manufacturer) in order to verify the TOV capability of the Arrester.

If a particular manufacturer is unable to meet the TOV condition of 1.15Ur (rated voltage of the Arrester) for 1 sec. duration, has the option of offering of an Arrester of a higher rating.

6. BASIC FEATURES

6.1 Design

The Surge Arresters shall be designed for outdoor service conditions stipulated above. They will be connected between phase and earth to protect distribution transformers and switchgear. It shall be complete with the following:

a) Clamps suitable to receive Copper/Aluminum (Line) Conductors from 4 mm-16mm
b) The mounting clamps suitable for bracket mounting on a structure made out of 100x50x6mm Channel Iron.

6.2 Manufacture

The Surge Arrester shall be of the non-linear metal-oxide resister type without spark gaps and the non-linear metal-oxide resister shall be housed in a hermetically sealed insulator casing to prevent ingress of moisture.

6.3 Insulator Details

The housing insulator of the surge arrester shall be of polymeric type and the insulator sheds shall be designed to minimize trapping of contamination.

The complete arrester shall withstand a 1000h salt fog test at continuous voltage as described in IEC 61109/IEC 60507. Additional cycle tests as described in IEC 61109 shall also be passed satisfactorily.

6.4 Moisture Sealing

The manufacturing procedure shall include an effective leak test and the manufacturers shall carry out the Special Thermal Stability Test as specified in IEC 60099-4.

6.5 Partial Discharge

Each surge arrester shall be tested to prove absence of partial discharge contact noise as specified in IEC 60099-4.

6.6 Arrester Disconnector

The Surge Arrester shall have a device for disconnecting it from the system in the event of arrester failure to prevent a persistent fault in the system and it shall give a visible indication when the arrester has failed. The arrester disconnector shall be tested as per IEC 60099-1.

6.7 Insulating Bracket

A robust insulating bracket together with suitable mounting clamps to mount the Surge Arrester to 100x50x6mm Channel Iron Cross Arms shall be supplied with the Surge Arrester. The power frequency withstand voltage of the insulating bracket shall not be less than 20kV.

7. ADDITIONAL REQUIREMENTS

7.1 Rating Plate Markings

The following ratings and data of the arresters shall be provided and it shall be weather proof and corrosion proof. The plate shall be positioned at the bottom flange base and visible from the ground level.

(a) Number and year of the standard adopted
(b) Rated voltage / frequency
(c) Continuous operating voltage
(d) Arrester type and discharge class
(e) Nominal discharge current
(f) Manufacturer's identification
(g) Year of manufacture
(h) Serial number
(i) Contract No.

7.2 Packing

Each set of Surge Arrester shall be packed in a suitable box. Number of these boxes shall be held together in a firm position and measures shall be taken to avoid damage against jerks and collision between adjacent units during transportation.

Each packing shall contain a copy of installation instruction in English Language. The voltage rating, manufacturer's name/identification, Country of Origin, and the quantity shall be clearly marked on each packing.

8. INSPECTION AND TESTING

8.1 Acceptance Test

The successful Bidder shall make necessary arrangements for pre-shipment inspection and tests by the nominated NEA Inspectors to carry out in his presence the necessary Sample/Acceptance tests conforming to the relevant IEC on equipment and materials offered. Routine test report for all the items shall be furnished for the observation of the Inspector.

The acceptance tests as per IEC shall be witnessed by the NEA Inspector.

(a) Power frequency reference voltage test
(b) Partial discharge test.
(c) Lightning Impulse Residual voltage test.
(d) Thermal Stability test

8.2 Routine Test

The Routine Tests shall be carried out on all the arresters as per the relevant IEC and the test report shall be made available for the observation of the NEA Inspector at the time of inspection.

(a) Power frequency reference voltage test.
(b) Residual voltage tests.
(c) Partial discharge test.
(d) Leakage test

9. BID DOCUMENTATION

9.1 The following shall be furnished with the offer.

(a) Product Catalogues/Technical literature describing the constructional features, materials used for components, operational feature of the equipment, indicating the model number etc.
(b) Energy withstand capability & a description of the test carried out to measure the same.
(c) Power frequency withstand voltage versus time characteristic curve covering the time range from 0.1 sec. to 24 minutes.
(d) Dimensional drawings of the bracket mounting base, live conductor clamps, earth lead and automatic earth disconnecting device and overall dimensional drawing.
(e) Drawing of name plate to scale incorporating the particulars called for.

(f) Completed Schedule of Guaranteed Technical Particulars
(g) A copy of the Manufacturer's ISO 9001 Certificate conforming to design and manufacture
(h) Type Test Certificates: The Type Test Certificates shall be from an Accredited Independent Testing Authority acceptable to the Purchaser.
(i) Copy of the Governing Standards
(j) Technical Literature in English Language on installation, operation and maintenance with necessary circuit diagrams and drawings.

9.2 Type Test Certificates

Following Type Test certificates conforming to IEC 60099-4, IEC 60507 and IEC 61109 shall also be submitted with the offer.

(a) Insulation withstand test,
(b) Residual voltage tests,
(c) Long duration current impulse
(d) Operation duty test
(e) Tests of arrester disconnector,
(f) Partial discharge test,
(g) Seal leakage test,
(h) Tracking & erosion test for polymeric insulation

Test Certificates shall clearly identify the equipment concerned showing the manufacturer's identity, Type, Model and Serial Number of the equipment tested. Type Test Report shall include a complete drawings and the model/type of the offered Arrester. Type Test Report shall be from a recognized accredited independent testing authority acceptable to the purchaser.

GUARANTEED TECHNICAL PARTICULARS
(To be filled by the Bidder/Manufacturer)

Item: Surge Arresters

S.N.	Description	Unit	NEA Requirement	To be filled by Bidder/Manufacturer
1	Manufacturer			
	Country of Origin			
	Year of manufacturing experience			
2	Model No.			
3	Applicable Standards		IEC	
4	Lightning arrester type		Gapless metal oxide	
5	Line Discharge Class		1	
6	Pressure relief class		B	
7	Type of Housing Insulator		Polymeric	
8	Voltage rating	kV	9	
9	Nominal system voltage	kV	11	
10	Maximum system voltage	kV	12	
11	System frequency	Hz	50	
12	Nominal discharge current	kA	10	
13	Creepage distance (terminal to base)	mm	390	
14	Minimum power-frequency withstand Voltage			
14.1	Wet	kV	50	
14.2	Dry	kV	70	
15	Impulse withstand (1.2/50μsec) Voltage	kV (Peak)	95	
16	Maximum discharge (residual) voltage at 10kA lighting impulse current	kV (Peak)	29	
17	Steep current residual voltage	kV (Peak)	32	
18	High current		for 0.2s 20 kA	
19	Low current		for 0.5s 0.8 kA	
20	One Second TOV withstand capability	kV	>1.15x12	
21	Energy absorption Capability with (4/10 wave)	kJ/kV	Not less than 3.2	
22	Ground lead disconnector provided?	Yes/No	Yes	
23	Delivery of equipment following award of contract and approval of drawing	months		
24	ISO 9001 holder (including design)	yes/no	yes	

S.N.	Description	Unit	NEA Requirement	To be filled by Bidder/Manufacturer
24.1	ISO 9001 certificate submitted	yes/no	yes	
25	Type test certificate submitted	yes/no	yes	
25.1	Submitted for the required ratings	yes/no		
25.2	Type test certified by			
26	User's certificate submitted	yes/no	yes	
27	Has exported to third country	yes/no	yes	
28	Copies of relevant standards attached	yes/no	yes	
29	Outline Drawings and associated GA attached	yes/no	yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer ……

Distribution Cutout (Drop-Out Fuses)

1 SCOPE

This Specification covers the general requirements of the design, manufacture, testing, supply and delivery of drop out fuse complete with fuse carriers and mounting brackets commonly used on the primary side of 11 kV distribution transformers as protective device.

2. System Parameters

a)	Nominal Voltage	11kV
b)	System Highest Voltage	12kV
c)	System frequency	50Hz
d)	No. of Phases	3
e)	Neutral Earthing	Effective
f)	System fault current	20kA rms

3. Service Condition

a)	Ambient temperature	-5 to 55 deg. C
b)	Annual average ambient temperature	30 deg. C
c)	Maximum relative humidity	99%
d)	Environmental condition	Humid Tropical climate
e)	Operational altitude	Up to 3000m above msl
f)	Isokeraunic (Thunder day) level	90 days
g)	Solar Radiation	1.6kW/m2

4. Applicable Standards

The equipment and components supplied shall be in accordance with the latest editions of the standards specified below and amendments thereof and the NEA Specifications specified hereafter.

a)	IEC 60282-2	H.V. Fuses - Expulsion and similar fuses
b)	IEC 60071-1	Insulation co-ordination.- Part I Definitions, principles and rules
c)	IEC 60071-2	Insulation co-ordination - Part 2 - Application guide
d)	IEC 60273	Characteristic of indoor & outdoor post insulators for systems with nominal voltages greater than 1000V
e)	IEC 60694	Common Specifications for high-voltage switchgear & control gear standards
f)	IEC 60060-2	High-voltage test techniques -Part 2 Measuring systems

5. Technical Parameters

5.1 Minimum Technical Requirements

S.N.	Description	Unit	Required ratings/features
1	Rated Voltage	kV	12
2	Rated Frequency	Hz	50
3	Rated Continuous Current	A	100
4	Dry Impulse withstand voltage (peak)		
4.1	Across isolating distance of the fuse base	kV	85
4.2	To earth and between poles	kV	75
5	Power Frequency withstand voltage (Wet 1min)		
5.1	Across isolating distance of the fuse base	kV	32
5.2	To earth and between poles	kV	28
6	Minimum power frequency withstand voltage		
6.1	Dry	kV	35
6.2	Wet	kV	30
7	Mounting Angle (to vertical plane)	deg	~15-20
8	Interrupting Rating		
8.1	Symmetrical Interrupting rating (min) rms	kA	8.0

8.2	Asymmetrical Interrupting rating (min) rms	kA	9.6
8.3	X/R ratio		4.0
9	Interrupting capacity	kA	10
10	Temperature Rise Limit (In air)		
10.1	Copper contacts silver faced	deg. C	40
10.2	Terminals	deg C	30

6. BASIC FEATURES

6.1 Design

The Dropout Fuse shall be of Class A as per IEC 60282-2. It shall be suitable for use in outdoor circuits under tropical conditions. The Dropout Fuse shall be complying with the minimum technical requirements stipulated above.

6.2 Manufacture

a) The Dropout Fuse shall be designed with a solid core, bird proof, one-piece Porcelain Insulator and should robust enough to withstand shocks due to frequent operations. The fuse carrier shall drop-out immediately following the blowing of the fuse.
b) Dropout Fuse within the same voltage class shall be so designed that fuse carrier together with mounting assembly shall be dimensionally compatible to facilitate the interchange of fuse carriers of the cutouts of corresponding rating.
c) The Dropout fuse shall be able to mount on a single channel iron cross arm (100mm x 50mm x 6mm) at an angle of 15 to 20 degrees to the vertical. The whole unit shall be complete with long mounting bracket, bolts, nuts & washers.
d) Fuse carrier shall be made of high strength fiberglass filament wound tube or suitable insulating material and it shall be protected from weather and environment by ultraviolet resistant coating. Inside liner of the fuse tube shall be constructed of a synthetic arc quenching material.
e) Copper Arc Shortening rod shall be attached to the cap of the fuse tube to obtain higher interrupting rating. A removable button head type fuse link having M6x1 thread shall be able to fix to the arc shortening tube.
f) The installation and removal of the fuse carrier shall be facilitated by inserting the operating rod into a lifting eye at the hinge end (lower) of the fuse carrier when it is in the dropped out position. An operating lever eye shall be provided at the top of the carrier to facilitate a downward pull by the operating rod to release the latch incorporated in the stationary upper contact
g) All castings such as upper and lower moving and fixed contacts, clamp type terminals, toggle mechanism shall be of phosphor bronze, silicon bronze, aluminum bronze or Silver-plated brass.

6.3 Stationary and Movable Contacts

a) The Stationary and Movable Contact surfaces shall be silver plated to minimize the contact resistance.
b) The upper stationary contact assembly shall be provided with a safety latch to prevent the fuse carrier from dropping due to vibration and The upper contacts shall be protected from any airborne contaminants.
c) A back up spring made out of stainless steel or phosphor bronze shall be provided to ensure constant pressure between the upper stationary contact and the upper movable contact of the fuse carrier.
d) The lower stationary contact support and the fuse carrier shall be machined at the swiveling or axle point to enable the fuse carrier with the fuse link to be correctly guided into the latching position by an operating rod. The hinge at the stationary contact shall be so designed to prevent the dropping off of the fuse carrier in the drop-out position, due to shock and vibration.
e) A suitable guiding arrangement shall be provided in the upper contact to ensure easy engagement of the fuse carrier.
f) The Asymmetrical breaking current ratings shall be permanently marked on the upper metal part.

6.4 Terminals

a) The upper and lower terminals shall be of Bi-metallic type, suitable to accommodate Copper/Aluminum Conductors of Sizes from 5mm to 14mm diameter.

b) The upper terminal shall be positioned to receive the conductor from either side or upward direction while the lower terminal shall be able to receive the conductor from either side or downward direction.
c) The maximum temperature rise for contacts (movable and stationary) shall not be more than 40°.C and, for terminals the temperature rise shall not be more than 30° C.

6.5 Galvanizing

All iron and steel parts such as mounting and support brackets, bolts and nuts, washers etc. shall be galvanized after processes such as sawing, shearing, drilling, punching, filling, bending and machining are completed. Galvanizing shall be the hot-dip process to comply with the standard ISO 1461.

7. ADDITIONAL REQUIREMENTS

7.1 Rating Plate Markings

The ratings and data of the Dropout Fuse shall be provided in the rating plate, which shall be weather and corrosion proof. The main rating plate near the supporting bracket of the insulator base shall carry the following information:

a) Number and year of the Standard adopted
b) Rated voltage/Rated maximum current
c) Class designation/Manufacturer's name or trademark,
d) Asymmetrical current rating/Symmetrical current rating/X/R Ratio.
e) Year of manufacture
f) Contract No.

The following information shall be marked on the fuse carrier.

a) Manufacturer's name or trademark
b) Rated Voltage/Rated frequency
c) Rated maximum current
d) Rated breaking capacity (Asymmetrical/Symmetrical current rating & X/R Ratio).

7.2 Packing

The pre-assembled dropout fuse unit (Dropout Fuse Base, Fuse Carrier and Mounting Bracket) shall be packed in a suitable hardboard box and the rated voltage of the unit shall be clearly marked on the box. Spare fuse carrier shall be supplied in suitable hardboard boxes, the quantity and the voltage rating applicable shall be clearly marked on the boxes.

8. INSPECTION AND TESTING

8.1 Acceptance Test

The successful Bidder shall make necessary arrangements for pre-shipment inspection and tests by the nominated NEA Inspectors to carry out in his presence the necessary Sample/Acceptance tests conforming to the relevant IEC on equipment and materials offered. Routine test report for all the items shall be furnished for the observation of the Inspector.

The acceptance tests as per IEC shall be witnessed by the NEA Inspector.

(a) Dimensional Verification
(b) Dielectric tests
(c) Mechanical Tests
(d) Measurement of resistance of fuse-links

9. BID DOCUMENTATION

9.1 The following shall be furnished with the offer.

(a) Product Catalogues/Technical literature describing the constructional features, materials used for components, operational feature of the equipment, indicating the model number etc.
(b) Energy withstand capability & a description of the test carried out to measure the same.
(c) Power frequency withstand voltage versus time characteristic curve covering the time range from 0.1 sec. to 24 minutes.
(d) Dimensional drawings of the bracket mounting base, live conductor clamps, earth lead and automatic earth disconnecting device and overall dimensional drawing.

(e) Drawing of name plate to scale incorporating the particulars called for.
(f) Completed Schedule of Guaranteed Technical Particulars
(g) A copy of the Manufacturer's ISO 9001 Certificate conforming to design and manufacture
(h) Type Test Certificates. The Type Test Certificates shall be from an Accredited Independent Testing Authority acceptable to the Purchaser.
(i) Copy of the Governing Standards
(j) Technical Literature in English Language on installation, operation and maintenance with necessary circuit diagrams and drawings.

9.2 Type Test Certificates

Following Type Test certificates conforming to IEC 60282-2, IEC 60060 at a reference frequency of 50 Hz. where applicable shall also be submitted with the offer.

a) Dielectric Tests
b) Temperature Rise Tests
c) Artificial Pollution Tests
d) Mechanical Tests
e) Breaking Tests
f) Interrupting Tests
g) Beam Strength of Porcelain Base

Test Certificates shall clearly identify the equipment concerned showing the manufacturer's identity, Type, Model and Serial Number of the equipment tested. Type Test Report shall include a complete drawings and the model/type of the offered Arrester. Type Test Report shall be from a recognized accredited independent testing authority acceptable to the purchaser.

GUARANTEED TECHNICAL PARTICULARS

(To be filled in by the Bidder/Manufacturer)

Item: Distribution Cutout (Drop Out Fuse)

S.N.	Description	Unit	NEA Requirement	To be filled by Bidder
1	Manufacturer			
	Country of Origin			
2	Year of manufacturing experience			
3	Model offered			
4	Applicable standard		IEC	
5	Rated Voltage	kV	12	
6	Rated Frequency	Hz	50	
7	Rated Continuous Current	A	100	
8	Dry Impulse withstand voltage (peak)			
8.1	Across isolating distance of the fuse base	kV	85	
8.2	To earth and between poles	kV	75	
9	Power Frequency withstand voltage (Wet 1min)			
9.1	Across isolating distance of the fuse base	kV	32	
9.2	To earth and between poles	kV	28	
10	Minimum power frequency withstand voltage			
11.1	Dry	kV	35	
11.2	Wet	kV	30	
12	Interrupting Rating			
12.1	Symmetrical Interrupting rating (min) rms	kA	8.0	
12.2	Asymmetrical Interrupting rating (min) rms	kA	9.6	
12.3	X/R ratio		4.0	
13	Temperature Rise Limit (In air)			
13.1	Copper contacts silver faced	deg.C	65	
13.2	Terminals	deg.C	50	
14	Mounting Angle (to vertical plane)	deg	~15-20	
15	Interrupting capacity	kA	10	
16	Clamp type terminals for copper/ aluminium cable 25-150 mm^2 size ?	Yes/No	Yes	
17	Steel mounting bracket provided?	Yes/No	Yes	
18	All the features are as mentioned in the specifications ?	Yes/No	Yes	
19	Delivery of equipment following award of contract and approval of drawing	months		
20	ISO 9001 holder (including design)	yes/no	yes	

20.1	ISO 9001 certificate submitted	yes/no	yes	
21	Type test certificate submitted	yes/no	yes	
21.1	Submitted for the required ratings	yes/no		
21.2	Type test certified by			
22	User's certificate submitted	yes/no	yes	
23	Has exported to third country	yes/no	yes	
24	Copies of relevant standards attached	yes/no	yes	
25	Outline Drawings and associated GA attached	yes/no	yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer ……

Fuse Link

1. Scope

This Specification covers the supply of button head fuse links commonly used in the protection of distribution transformers with the Distribution Cutouts above.

2. Description

The button-head fuse link shall be fabricated in full compliance with the relevant IEC, or latest revision thereof or any other international standards that ensures at least a substantially equal quality to the standard mentioned above, will also be acceptable.

The fuse link shall have fast characteristics and shall be suitable for protection of distribution transformers. The fuse link shall be supplied in accordance with the type and ratings shown in the bid package.

3. Tests

The distribution cutout and surge arrester shall be tested in accordance with the relevant provisions of the governing standard.

4. Bid Documentation

The Bidder shall furnish copies of governing standards for fabrication and testing of fuse links

The Bidder shall furnish copies of catalogue of fuse links.

The Bidder shall furnish a clause-by-clause commentary on specification, specifying compliance and deviations, if any.

The Bidder shall also furnish with the Bid copies of the following data with respect to the fuse links furnished:

a) Time-Current (TC) characteristic curves at 30°C, including minimum melting time and total clearing time.
b) Preloading adjustment factors or curves.
c) Ambient temperature adjustment factors or curve

All data, drawings, catalogues and other technical documents shall be bound separately from the Bid documents

GUARANTEED TECHNICAL PARTICULARS
(To be filled in by the Bidder/Manufacturer)

Item: Fuse Link

S.N.	Description	Unit	NEA Requirement	To be filled by

				Bidder
1	Manufacturer			
2	Country of Origin			
3	Model offered			
4	Governing Standard			
5	Minimum melting time			
6	Total clearing time			
7	Is the fuse link suitable to the Distribution Cutout supplied?	Yes/No	Yes	
8	Time Curve attached ?	Yes/No	Yes	
9	Preload adjustment data attached?	Yes/No	Yes	
10	All the features are as mentioned in the specifications ?	Yes/No	Yes	
11	Certification		ISO 9001 (including design)	
12	Copy of notarized ISO certificated attached	Yes/No	Yes	
13	Copy of Governing Standards attached?	Yes/No	Yes	
14	Copy of certified type test attached?	Yes/No	Yes	
15	Ambient temperature adjustment data attached?	Yes/No	Yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer ……

Grounding Rods, Clamps and Conductor

1. **Scope**

This Specification covers the fabrication and supply of galvanized steel ground rods, clamps and galvanized stranded steel grounding conductor for use in the neutral and body grounding for use in distribution transformers and overhead power line construction.

2. Description

2.1 Ground Rod

The ground rod shall be made of high carbon, open-hearth steel so as to achieve maximum strength. It shall be hot dip galvanized. The ground rod shall be 19mm in diameter and 4,000 mm in overall length. The driven end of the ground rod shall have a truncated cone point. The cone point shall be approximately 13mm long, measured along the axis of the ground rod. The driving head of the ground rod shall have an approximate 3 mm, 45-degree chamfer. The manufacturing process shall assure that ground rod does not bend when driven into hard soils.

2.2 Ground Rod Clamp

The ground rod clamp shall be heavy duty forged steel clamp provided with a hex head cup point set screw of high strength steel with machine-cut threads. It shall be so manufactured that it gives low resistance connection. The ground rod clamp shall be galvanized. The clamp shall suitably accommodate and clamp a 19 mm. ground rod and a stranded grounding conductor.

2.2 Ground Wire

The conductor shall be 7-wire stranded conductor and shall conform to the characteristics as specified herein. Stranded conductor shall be galvanized.

S.N.	Description	Unit	Required ratings/features
1	Diameter of Wire	SWG	7/12
2	Diameter of Single Strand	mm	2.67
3	Direction of Lay		Right
4	Weight	kg/km	299
5	Short time fusing current	kA	12
6	Resistivity	μΩcm	15

2.3 Galvanizing

The galvanization of ground rod, clamp and grounding conductor shall be in accordance with ISO 1461 or any revision thereof or other equivalent national or international standard provided that ensure at least equal or better quality to the standard mentioned above will also be acceptable. The minimum thickness of galvanization shall be 90 microns.

3. Applicable Standards

The equipment and components supplied shall be in accordance with the relevant IEC standards, or latest revision thereof or any other international standards and the NEA Specifications specified herein.

4. Tests

Grounds rods and clamps shall undergo type and routine tests in accordance with the relevant governing standards.

5. BID DOCUMENTATION

The following shall be furnished with the offer.

(a) Product Catalogues/Technical literature describing the constructional features, materials used for components, etc.
(b) Completed Schedule of Guaranteed Technical Particulars
(c) A copy of the Manufacturer's ISO 9001 Certificate conforming to design and manufacture
(d) Type Test Certificates. The Type Test Certificates shall be from an Accredited Independent Testing Authority acceptable to the Purchaser.
(e) Copy of the Governing Standards
(f) Technical Literature in English Language on installation, operation and maintenance with necessary circuit diagrams and drawings.

GUARANTEED TECHNICAL PARTICULARS
(To be filled in by the Bidder/Manufacturer)

Item: Ground Rods and Clamps

S.N.	Description	Unit	NEA Requirement	To be filled by Bidder/Manufacturer
1	Manufacturer			
2	Country of Origin			
3	Model offered			
4	Governing Standard for manufacturing and testing			
5	Governing Standard for galvanization		ISO 1461	
6	Material Grade Used for Ground Rod			
7	Dimensions of Ground Rod			
8.1	Length	mm	4000	
9.2	Diameter	mm	19	
10	Material Grade Used for Ground Rod Clamp			
11	Dimensions of Ground Rod Clamp	mm		
12	Material Description furnished	Yes/No	Yes	
13	All the features are as mentioned in the specifications ?	Yes/No	Yes	
14	Certification	Yes/No	ISO 9001 (Including design)	
15	Copy of notarized ISO Certificate attached?	Yes/No	Yes	
16	Copies of Standard attached ?	Yes/No	Yes	
17	Copy of certified type test attached ?	Yes/No	Yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date……
Seal of Bidder/Manufacturer ……

GUARANTEED TECHNICAL PARTICULARS
(To be filled in by the Bidder/Manufacturer)

Item: Grounding Conductor

S.N.	Description	Unit	NEA Requirement	To be filled by Bidder
1	Manufacturer			
2	Country of Origin			
3	Model offered			
4	Governing Standard for manufacturing and testing			
5	Governing Standard for galvanization		ISO 1461	
6	Diameter of Wire	SWG	7/12	
7	Diameter of single wire	mm	2.67	
8	Cross Section	sq.mm.		
9	Short time fusing current	kA	12	
10	Weight	kg/km	299	
11	Resistivity of Wire		15	
12	Resistance at 20 deg. C	ohms/km		
13	Direction of Lay			
14	All the features are as mentioned in the specifications ?	Yes/No	Yes	
15	Certification		ISO 9001 (Including design)	
16	Copy of notarized ISO Certificate attached?	Yes/No	Yes	
17	Copies of Standard attached ?	Yes/No	Yes	
18	Copy of certified type test attached ?	Yes/No	Yes	

Signed by……..

Designation……..

As Representative for……..
Place……
Date……
Seal of Bidder/Manufacturer ……

Distribution Panel Board

1. **Scope**

This Specification covers the design, fabrication, testing and supply of Distribution Panel Boards to be used in the Low Voltage Overhead Distribution system of the Nepal Electricity Authority (NEA) to provide overload and short circuit protection for Distribution lines up to Customer Distribution Panel.

2. **Description**

The panel board shall be pole-mounted and used in conjunction with pole-mounted distribution transformers to house moulded case circuit breaker (MCCB) feeding 400/230 Volt circuits.

The panel board shall be rectangular in shape with an entrance door in the front of the panel board. The panel board shall be equipped with interior standoffs suitable for mounting MCCB and for supporting cables. The panel board will be fixed to the pole by exterior mounting brackets attached to the back of the panel board. Details of these components shall be as specified in the following text.

The panel board shall be fabricated to prevent ingress of moisture due to rainfall and dripping. The panel board shall be provided with means for natural ventilation.

2.1 Material

The panel board case and door shall be fabricated out of steel sheet of minimum 2 mm. in thickness and pole mounting brackets shall be fabricated out of mild steel flat of 6 mm. in thickness. The interior standoffs shall be fabricated of steel sheet of sufficient thickness to support installed circuit breaker and cables without lateral movements.

2.3 Construction

The panel board case and all interior and exterior attachment shall be spot-welded. All welding shall be of the highest quality. The panel boards shall be formed and welded square and all attachments to the interior and exterior surfaces shall be welded square and perpendicular to the panel attached.

The panel board shall be so constructed as to be water tight from blowing of free-falling rain. There shall be no apertures in the panel board case other than those provided for the entrance door, cable fittings, or ventilation. The top extension and bottom shall be so formed to provide a drip edge and prevent water from flowing on the respective under-surfaces.

All individual pieces of metal shall be edge finished prior to assembly to provide surfaces and edges which are free from sharp points and edges. After welding in place, all welds shall be finished to smooth condition.

2.4 Panel board Front

The front panel shall be fabricated as a separate piece containing the panel board door and doorframe. The front shall be attached to the panel board housing by suitable bolting arrangements to provide a watertight and dust tight seal at the perimeter.

The door shall be equipped with a gasketed removable door, door-handle lock, and suitable hinges. The door and panel frame shall be so fabricated to provide an integrated structure which is warp-resistant and which will maintain dust-tight and watertight seal. Gasketing material shall be heat-resistant and shall retain its resilience over time to precluded degradation of dust-tight and watertight properties.

The insertable (and removable) door handle shall provide a door a locking function. The handle shall be insulated.

The door hinge may be continuous type or separate hinge units. However, the type of hinge furnished must accommodate, and not degrade, the dust-tight and watertight characteristics and must provide adequate door alignment and support over time.

2.5 MCCB Standoffs

The standoffs shall be shaped and dimensioned to accommodate the MCCBs as required by Bid Packages. The standoffs shall be precisely located.

2.6 Cable Standoffs

The cable standoffs shall be properly shaped and dimensioned. The standoff shall have the metal edges contoured and smoothed to prevent abrasion of applied cable serving. The standoff shall be located within the panel board to make allowance for cable bending radii and the location of other components.

2.7 Bus bars

The neutral and phase bus bars shall consist of copper bus bar insulated from the panel board by 600 V porcelain insulators. The copper bus bar shall be of proper size (ampere capacity) and properly dimensioned. The bus bars shall be located within the panel board to provide adequate clearance for the installation and correct functioning of all items.

If it is required to drill or penetrate the panel board back to install 600 V insulators, the outside of the panel board shall be permanently sealed over the attachment to retain water-tightness.

2.8 Cable Entrance Fittings and Knockouts

Knockouts for cable entrance fittings (bushings) shall be provided in the bottom of the panel board. All necessary cable entrance fittings shall be supplied for proper connection of all circuits to fulfil the requirement of the Bid Package. The fittings shall be designed to be suitable for exposed cables entering the panel board from below and shall secure the cable with inserts to prevent lateral and longitudinal movement of the cables.

The fittings shall be threaded multi-piece construction which when installed securely locks the fittings to the panel board. The fittings may be of metal or polymer material. Metal fittings shall be galvanized or plated as appropriate. The fitting inserts may be single or multi pieces and shall be of material sufficiently elastic and resilient to securely grip the PVC cable sheath without damage. The fitting components shall enable capturing of the inserts to preclude insert creep and fallout due to clamping pressure.

2.9 Ventilation

The panel board shall be provided with apertures for natural draft ventilation in the panel board bottom and in the top overhang. The ventilation apertures shall be covered with bronze screen materials of a mesh sufficiently to preclude passage of small insects. The edges of the bronze screening shall be surely fastened to the panel board by means of soldering or epoxy adhesive. The mesh shall be protected during panel board fittings to preclude clogging of mesh openings by finished materials.

2.10 Pole Mounting Bracket

The panel board shall be provided with two (2) pole mounting brackets. The size of poles will be confirmed by the purchaser before manufacturing.

2.11 Grounding Stud

The panel board shall be provided with a brass grounding stud located in an approved location. The grounding stud shall be fitted to the panel board to insure low resistivity and water tightness of the installation. The grounding stud shall be complete with pressure washer, lock washer, and nuts.

2.12 Finish

After fabrication, the panel board shall be thoroughly cleaned of all dirt, grease, mill scale, and weld slag on all interior and exterior surfaces and all surfaces of all component. After thorough cleaning of panel board one (1) coat of red oxide metal priming paint and two (2) finish coats of paint color shall be thoroughly applied. The paint color shall be of light grey (RAL 7032). The finish coats shall be of oil based or epoxy paint. Alternatively, powder coating of panel board may also be acceptable.

The bronzed screen ventilation holes, working surfaces of door hinge and door lock, and outside face of grounding stud shall be free from all finishing materials.

3. Bid Documentation

The following shall be furnished with the offer.

(a) The Bidder shall furnish fabrication drawings showing all views, section, and dimensions of individual components and assembled panel board.
(b) The Bidder shall furnish complete description of all materials to be used, including cable entrance fittings and finishing materials.
(c) The Bidder shall furnish a clause-by-clause commentary on specification, specifying compliance and deviations, if any.
(d) All data, drawings, catalogues and other technical documents shall be bound separately from the Bid documents.
(e) Completed Schedule of Guaranteed Technical Particulars
(f) A copy of the Manufacturer's ISO 9001 Certificate conforming to design and manufacture
(g) Technical Literature in English Language on installation, operation and maintenance with necessary circuit diagrams and drawings.

GUARANTEED TECHNICAL PARTICULARS

(To be filled in by the Bidder/Manufacturer

Item: Distribution Panel Board

S.N.	Description	Unit	NEA Requirement	To be filled by Bidder/Manufacturer
1	Manufacturer			
	Country of Origin			
2	Year of manufacturing experience			
3	Model offered			
4	Governing Standard for fabrication, manufacturing and testing			
5	Governing Standard for Materials Used			
6	Description of cable entrance fittings attached?	Yes/No	Yes	
7	Description of all materials attached?	Yes/No	Yes	
8	Copy of Fabrication Drawings Attached?	Yes/No	Yes	
9	All the features are as mentioned in the specifications ?	Yes/No	Yes	
10	Delivery of equipment following award of contract and approval of drawing	months		
11	ISO 9001 holder (including design)	yes/no	yes	
11.1	ISO 9001 certificate submitted	yes/no	yes	
12	Type test certificate submitted	yes/no	yes	
12.1	Submitted for the required ratings	yes/no		
12.2	Type test certified by			
13	User's certificate submitted	yes/no	yes	
14	Has exported to third country	yes/no	yes	
15	Copies of relevant standards attached	yes/no	yes	
16	Outline Drawings and associated GA attached	yes/no	yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date……
Seal of Bidder/Manufacturer ……

Moulded-Case Circuit Breakers (MCCB)

1. Scope

This specification covers the design, manufacture and testing of Moulded Case Circuit Breakers (MCCB) used with Distribution Panel Board in the Low Voltage Overhead Distribution system of the Nepal Electricity Authority (NEA) to provide overload and short circuit protection for Distribution lines up to Customer Distribution Panel.

2. System Parameters

a)	Nominal Voltage	400/230V, 3 Phase and Neutral
b)	System Highest Voltage	440/250V, 3 Phase and Neutral
c)	System frequency	50Hz
d)	Method of Earthing	Solidly earthed neutral
e)	System fault current	25kA

3. Service Condition

a)	Ambient temperature	-5 to 55 deg. C
b)	Annual average ambient temperature	30 deg. C
c)	Maximum relative humidity	99%
d)	Environmental condition	Humid Tropical climate
e)	Operational altitude	Up to 3000m above msl
f)	Isokeraunic (Thunder day) level	90 days
g)	Solar Radiation	1.6kW/m2

4. Applicable Standards

The equipment and components supplied shall be in accordance with the latest editions of the standards IEC 60947 and amendments thereof and the NEA Specifications specified hereafter.

5. Technical Parameters

5.1 Minimum Technical Requirements

S.N.	Description	Unit	Requirements
1	No. of Poles		3
2	Rated frequency	Hz	50
3	Rated operational voltage (Ue)	V	400/230
4	Rated insulation voltage (Ui)	V	750
5	Impulse withstand voltage (Uimp)	kV	8
6	Continuous Current Rating (In)	A	16, 32, 75, 150, 300, 500
7	Ultimate Short Circuit Breaking Capacity (Icu) (up to 100 A)	kA	25
8	Ultimate Short Circuit Breaking Capacity (Icu) (above 100 A)	kA	50
9	Operating Short Circuit Breaking Capacity (Ics)		50 % of Icu
10	Utilization Category		A
11	Rated duty		uninterrupted
12	Trip device		Thermal adjustable magnetic
13	Rated current adjustment		(0.8-1)In
14	Instant opening current adjustment		10 x In
15	Mechanical Life Operation		>15000
16	Electrical Life Operation		>10000
17	Line load reversibility features		Yes
18	Interrupting Capability		(IEC category P2)
19	Thermal Rating declared at 50 deg C		Yes
20	Operating Range		-5 to 55 deg. C
21	Creepage distance suitable for		Pollution Degree 3 and suitable for isolation
22	Suitable for isolation		Yes

23	Trip Characteristics		inverse time and instantaneous
24	Universal Accessory Fitting		Yes
25	External Accessory		Rotary Operating Handle (Extended for >200A) Suitable Extended Terminals Phase Barriers Mounting Screws

6. BASIC FEATURES

6.1 Design

The circuit breakers shall be of three poles with moulded case design, suitable for operation at a maximum relative humidity of 99% and at maximum ambient temperature of 55 deg. C. The maximum permissible temperature- rise of various components of the breaker shall not exceed the values stipulated in IEC 60947.

The MCCB shall be completely enclosed in a moulded case and shall be factory sealed. The case shall be moulded from insulated material possessing high thermal stability and good mechanical strength, able to withstand robust use without fracture or permanent distortion.

The MCCB shall have a quick make, quick break, over current switching mechanism that is mechanically trip-free for simultaneous tripping of all poles. Tripping due to overload or short circuit shall be clearly indicated by the position of the handle. The ON and OFF positions shall be clearly marked on the breaker case.

The case should be stamped with the letters “NEA” for the purpose of identification. The Moulded Case Circuit Breaker shall be of surface mounting type and shall be suitable for mounting in an enclosure for outdoor application. It shall be possible to reverse feed the breaker without any reduction in performance.

6.2 Construction

6.2.1 Operation Mechanism

The circuit breaker shall be provided with trip free features for manual ON-OFF operation.

The operating mechanism shall be quick make and break type, with the speed of operation independent of the operator, and mechanically trip free from the operating handle so as to prevent the contacts from being held closed against short circuit and overload conditions.

The operating mechanism shall be constructed to operate all poles of the breaker simultaneously during, opening, closing and tripping conditions.

The breaker shall be operated by a toggle, which shall clearly indicate the 3 positions ON, OFF and TRIPPED.

The breaker shall have current-limiting function which works according to the opposite magnetic force principle.

The MCCB shall be of inverse time and instantaneous trip type. The trip device shall be of thermal-magnetic type.

6.2.2 Contacts

The MCCB shall be of the uninterrupted duty type and the contacts shall be of Silver alloy or Silver faced Copper having high current carrying capacity with good arc resistance property.

6.2.3 Overload Release

Each pole of the MCCB shall be provided with bimetallic Thermal Element type of overload protection with the tripping time decreasing with increasing tripping current characteristic (inverse time delay).

6.2.4 Short Circuit Release

An electromagnetic element type instantaneous short circuit protection shall be fitted in each pole assembly affecting immediate tripping of the circuit breaker if the current exceeds the breaking ratings.

6.2.6 Terminals

The terminals of the breaker shall be suitable for front connection of cables and insulated phase barriers shall be provided for all poles. All breaker terminals, compression terminals, stacking spacers, and bolting shall be compatible with Aluminum conductors to avoid bimetallic reaction.

6.2.7 Mounting Bolts

The circuit breakers shall be suitable for mounting in outdoor distribution panels and each breaker shall be furnished complete with one (1) set of bolt fastenings, complete with nuts and lock washers of the correct diameter for the mounting hole and of a length equal to the depth of the MCCB body plus approximately two (2) centimeters.

7. Additional Requirement

7.1 Rating Plate Markings

Each Circuit Breaker shall be marked in a durable manner with the following data as stipulated in IEC 60947 and shall be visible and legible when the circuit breaker is installed.

(a) Rated current
(b) Suitability for isolation, with symbol
(c) Indication of the open and closed positions

Ultimate breaking capacity (Icu) for various values of the rated operational voltage (Ue) shall be recorded on the device.

The following data should be marked externally on the breaker and they need not visible when the breaker is installed.

(a) Manufactures identification (Name or Trade Mark)
(b) Type designation or serial number
(c) Number and Year of the standard adopted
(d) Utilization category
(e) Rated operational Voltage and Frequency
(f) Rated service short-circuit breaking capacity
(g) Rated ultimate short-circuit breaking capacity
(h) Rated short-time withstand current/duration

7.2 Packing and Transportation

The MCCB shall be suitably packed in biodegradable material (cardboard boxes) to prevent damage during transport, handling and storing.

All relevant drawings, technical literature, product catalogue, hand-books etc. required for installation, operation and maintenance of the equipment shall be supplied with the equipment. Routine test report shall also be supplied with the equipment.

7.3 Storing

The moulded case circuit breakers of different current ratings shall be stored according to the serial number and rating in batches of 100 separately so as to select breakers for acceptance inspection and testing by random sampling method.

8. Inspection and Testing

8.1 Routine Tests

The following routine tests as per IEC 60947 shall be carried out on all the MCCB and routine test report shall be made available for the observation of the inspector at the time of inspection.

(a) Mechanical operation tests
(b) Dielectric Tests

(c) Verification of the calibration of releases
(d) Temperature rise test

8.2 Inspection

The successful Bidder shall make necessary arrangements for pre-shipment inspection by Inspecting engineers sent by the NEA or by an authority acceptable to the NEA to carry out the necessary acceptance tests of the equipment offered.

8.3 Acceptance/Sample Tests

The following Tests as per IEC 60947 shall be witnessed by the inspecting Engineers.

(a) Mechanical operation tests
(b) Dielectric Tests
(c) Verification of the calibration of releases
(d) Temperature rise test

8.4 Selection of Test Samples

The number of moulded case circuit breakers to be selected by random sampling method for acceptance inspection and testing shall be as indicated below.

S. N.	No. of units	No. of samples to be selected
1	Less than 100	5
2	100-500	15
3	500-1000	50
4	1000-1500	100
5	Above 1500	150

9. Bid Documentation

9.1 The following shall be furnished with the offer.

(a) Catalogues describing the equipment and indicating the model number and the literature describing the operational features of the equipment.
(b) Constructional features, materials used for components and relevant technical literature and complete dimensional drawings.
(c) Completed Schedule of Guaranteed Technical Particulars.
(d) Quality Assurance Certificate conforming to ISO 9001
(e) The Characteristics
(f) The tripping time-current characteristics curves covering both thermal and magnetic current settings for each type of circuit breaker offered.
(g) If over-current and instantaneous releases are of static type, then the manufacture shall furnish evidence that the components used are tropicalised, (suitable for the climatic conditions stipulated in Clause 3.0 above) and the field tests on the equipment have been satisfactory.
(h) Discriminating table indicating proper coordinating shall be submitted.

9.2 Type Test Certificates

Following Type Test certificates for each rating of MCCBs shall also be submitted with the offer.

a) Verification of constructional requirements
b) Verification of temperature-rise
c) Verification of dielectric-properties
d) Verification of making and breaking capacities
e) Verification of short-circuit breaking and making capacities
f) Verification of operating limits
g) Verification of operational performance
h) Verification of degree of protection of enclosed equipment

The Type Test Certificates referred to above shall be issued from the reputed independent Testing Authority acceptable to NEA.

Test Certificates, Performance Curves and Tables etc., of the Type Test performed shall conform to the standard specified, at a reference frequency of 50 Hz where applicable. The Test Certificates should clearly identify the equipment concerned, showing the manufacturer's identity, Type No. and basic technical parameters.

GUARANTEED TECHNICAL PARTICULARS

(To be filled in by the Bidder/Manufacturer)

Item: Moulded Case Circuit Breaker

S.N.	Description	Unit	NEA Requirement	To be filled by Bidder/Manufacturer
1	Manufacturer			
	Country of Origin			
2	Year of manufacturing experience			
3	Model offered			
4	Governing Standard for manufacturing and testing		IEC 60947	
5	No. of Poles		3	
6	Rated frequency	Hz	50	
7	Rated operational voltage (Ue)	V	400/230	
8	Rated insulation voltage (Ui)	V	750	
9	Impulse withstand voltage (Uimp)	kV	8	
10	Continuous Current Rating (In)	A		
11	Ultimate Short Circuit Breaking Capacity (Icu) (up to 100 A)	kA	25	
12	Ultimate Short Circuit Breaking Capacity (Icu) (above 100 A)	kA	50	
13	Operating Short Circuit Breaking Capacity (Ics)		50 % of Icu	
14	Utilization Category		A	
15	Rated duty		uninterrupted	
16	Trip device		Thermal adjustable magnetic	
17	Rated current adjustment		(0.8-1)In	
18	Instant opening current adjustment		10 x In	
19	Mechanical Life Operation		>15000	
20	Electrical Life Operation		>10000	
21	Line load reversibility features	Yes/No	Yes	
22	Interrupting Capability		(IEC category P2)	
23	Thermal Rating declared at 50 deg C	Yes/No	Yes	
24	Operating Range		-5 to 55 deg. C	
25	Creepage distance suitable for		Pollution Degree 3 and suitable for isolation	
26	Suitable for isolation		Yes	
27	Trip Characteristics		inverse time and instantaneous	
28	Contacts Type			
29	Universal Accessory Fitting	Yes/No	Yes	
30	External Accessory provided			
31	Dimensions (lxbxh)	mm		
32	Weight	kg		
33	Type of Mounting Arrangement			
34	All the features are as mentioned in the specifications ?	Yes/No	Yes	
35	Copies of time - current characteristic trip curves for each breaker rating attached?	Yes/No	Yes	
36	Copies of outline drawings attached?	Yes/No	Yes	
37	Delivery of equipment following award of contract and approval of drawing	months		
38	ISO 9001 holder (including design)	yes/no	yes	
38.1	ISO 9001 certificate submitted	yes/no	yes	
39	Type test certificate submitted	yes/no	yes	
39.1	Submitted for the required ratings	yes/no		
39.2	Type test certified by			
40	User's certificate submitted	yes/no	yes	

41	Has exported to third country	yes/no	yes	
42	Copies of relevant standards attached	yes/no	yes	

Signed by……
Designation……..

As Representative for……..
Place……
Date……
Seal of Bidder/Manufacturer ……

Steel Telescopic Pole

1. **Scope**

1.1 This Specification covers the design, fabrication, testing and supply of Steel Telescopic Poles to be used to support overhead electric lines and equipment.

2. **Description**

2.1 The poles shall be telescopic, uniformly tapered circular in cross-section. The poles shall be fabricated in sections as specified in Table 2 out of welded tubes of suitable lengths. The diameters of the top and the bottom end of the completely assembled pole shall be as specified therein.

2.2 The sections of the steel poles shall be designed such that the butt end of the top section fits on the top end of the second section, the butt end of the second section fits on the top end of the third section and so on. The various sections shall be fitted together by pressed friction joints. The completely assembled telescopic pole shall have the design loads as specified in Table 1. The separate pole cap shall be provided with top section of the pole. The bottom section of the pole shall be provided with a base plate.

3. **Material**

3.1 The telescopic pole sections and fittings shall be manufactured from standard steel as per BS 4360 Grades 43 C, D, E or 50 C, D, E or equivalent national/ international standards.

3.2 The steel tubes shall confirm to the requirements of BS 6323 Parts 1 to 8 Steel Tubes.

4. **Manufacture**

4.1 The pole shall be erected by friction joint without involvement of through bolt, site welding or any type of additional device of joint at the time of erection.

4.2 It shall be the responsibility of the Bidder to determine the thickness of the tubing adequate to sustain the load and test requirements. The Bidder shall determine the thickness of the tubing to develop the required pole strength in accordance with the Bidder's method of fabrication. However, the thickness of the tubing shall not be less than **2.5 mm**, and the following tolerances shall be maintained:

a) Tolerance on diameter: +/- 1% from Bidder's data sheet.
b) Tolerance on telescopic poles: After assembly the telescopic poles shall not exceed +/-75 mm of their stated length in the Technical data sheet.
c) The out-of-straightness of the assembled pole shall not exceed 1/600 of the height.
d) Negative tolerances are not acceptable on Thickness and Weight.

4.3 All welding of the poles shall be carried out at the manufacturers' plant.

4.4 Welds parallel to the longitudinal axis of the poles shall be fillet welds. No circumferential joints/welds of the tubes are permitted. All welds shall be capable of withstanding, without failure or cracking, the stresses in a pole when subjected to its ultimate design loads.

4.5 Each section of the pole shall have only one longitudinal weld.

4.6 All seam welds on joint mating surfaces shall be ground flush. All high spots in the galvanizing on the mating surface shall be ground and if the galvanizing is damaged in the process, it shall be repaired.

5. **Corrosion Protection**

All sections of the pole shall be hot dip galvanized both internally and externally in accordance with ISO 1461 or IS 2629, IS 4736 or equivalent national or international standard. After galvanizing, the external surface of poles below ground level and 500 mm above ground level shall be painted as follows:

a) Thorough clean brush and solvent degrease, then one coat of phosphoric acid based etch primer both inside and outside followed by,
b) One coat airless spray of epoxy based bituminous black paint of 1x100 microns dry film thickness inside of the pole base.
c) Two successive coat airless spray of epoxy based bituminous black paint of 2x100 microns dry film thickness outside of the pole base.

The minimum thickness of the zinc coating shall not be less than 500 g/m^2 (equivalent to 70 microns) of zinc for all surfaces of steel including the base plate and the pole cover.

6. **Marking of Pole**

The pole shall have an identification marked with indelible paint on the pole at a position approximately 3.5 m. from the butt end, which is clearly and indelibly marked with:

a) Date of manufacture and identification mark of manufacture.
b) Length of pole in meters and its design working loads as defined in this specification.
c) Contract Number.
d) Name of the Employer

The pole shall be marked with a permanent horizontal line at a point 1/6th of the pole height from the butt end of the assembled pole. The mating depth of the relevant sections of pole shall also be indelibly marked.

The finished pole shall be marked with the circumferential line for the indication of the overlapping length during the assembly.

7. **Earthing Lug, Base Plate and Pole Cap**

Each pole shall be provided with earthing lug at 300 mm below the ground level. Separate pole cap shall be provided for each pole. The plate for pole cap shall be of 3 mm. minimum thickness. The dimension of the base plate shall be as per drawing.

8. **Design**

8.1 The standard overall length of pole manufactured under this contract shall be as per table 1 below. The plantation depth of the pole shall be 1/6th of the overall length of that pole. **The Bidder shall submit a detailed description of the methods of pole manufacture and detailed calculations for all aspects of design of the pole for NEA approval prior to manufacture**.

8.2 The design working loads in transverse and vertical direction shall be as follow:

Table 1: Design Working Load

S.No.	Pole Length(m)	Design Working Load (kgf)	
		Transverse	Vertical
1.	11	350	350

The design working load shall be the yield strength reduced by factor of safety of 2.0.

9. **Tests**

9.1 The following test(s) shall be performed for the pole furnished. All testing shall be fully documented and certified test reports shall be provided to the Project.

Permanent set test

9.2 Poles selected for testing shall be a representative sample from each lot.

S.N.	Lot size	No. of poles
1.	Up to 500	5
2.	501-1000	8
3.	1001-2000	13
4.	2001-3000	18
5.	3001 and above	20

9.3 **Testing Arrangement:** The pole shall be rigidly supported in vertical position for a distance from the butt end equal to the specified depth of planting of that pole. It shall then be loaded

horizontally with a load applied at the distance from the pole top as specified in Table 2, and the deflection recorded. Alternatively, for convenience the pole may be fixed horizontally in a testing arrangement. The testing arrangement shall be provided with sufficient supports to ensure that bending moments developed by the self-weight of the pole are minimal. These supports shall be detailed to give no horizontal resistance to the applied loads. The accuracy of load and deflection measuring equipment shall not be less than +/-2 percent.

9.4 The load shall be gradually and uniformly applied in increments of 10 percent of the design-working load up to 120 percent of the design-working load. At each increment of load deflection of the pole tip shall be measured. The 120% loading shall be maintained for 5 minutes. The load shall then be gradually reduced to zero and the amount of permanent deflection of the pole tip shall be recorded.

The test load shall be gradually reapplied up to the design working load and the deflection shall be recorded. The load shall then be increased in 10 percent increments until failure occurs. At each load increment, the load and deflection shall be recorded.

The following particulars shall be recorded:

a. Manufacturer's name and plant location;
b. Batch No. of steel plate or tubing;
c. Test date;
d. Pole type;
e. Dimensions of pole;
f. Increments of load and the deflections at each increment of load;
g. Permanent deflection;
h. Load of failure;

9.5 The pole shall be considered acceptable if:

a) The permanent deflection of the tip of the pole does not exceed 4 mm per meter of pole length for 11 m pole. (The permanent deflection is the deflection of tip of the pole on removal of load equal to 120% of design working load of pole after 5 minutes of the application of that load. Clause 9.4)

b) The failure load of the pole tested equals or exceeds 200% of design working load.

9.6 Should any of the poles first selected fail to pass any of the tests specified above two further poles shall be selected for testing from the same batch i.e. same pole length manufactured on the same day from the same steel plate or tubing in respect of each failure. Should one or both these additional poles fail, the test material represented by the test samples shall be deemed as not complying with this specification.

10. **Bid Documentation**

10.1 The Bidder shall provide with the Bid two (2) clear copies of the governing standards for selection of tubings, fabrication and testing of Steel Telescopic Poles and two (2) clear copies of all other relevant standards referenced therein.

10.2 The Bidder shall provide a complete design, description and certified dimensional drawings of each type of pole.

10.3 Two (2) clear certified copies of all type tests performed on similar type of poles and similar working loads.

10.4 A clause-by-clause commentary on specification, specifying compliance and deviations, if any.

Table 2: Pole Attributes

S.N.	Description	Unit	Value
1	Overall Length of the assembled pole	m	11
2	Total Number of Sections	Nos.	5
3	Diameter of the assembled pole		
3.1	Top Diameter	mm	170
3.2	Bottom Diameter	mm	402
4	Thickness (Minimum)	mm	2.5
5	Application of load from top of pole	m	0.6

6	Depth of Planting	m	1.8

GUARANTEED TECHNICAL PARTICULARS

(To be completed by Bidder/Manufacturer)

Item: 11 m Long Steel Telescopic Pole

S.N.	Description	Unit	NEA Requirement	To be filled by Bidder
1	Manufacturer			
	Country of Origin			
	Years of Manufacturing Experience			
2	Governing Standard for Tubing, Manufacturing and Testing			
3	Governing Standard for Galvanization		EN ISO 1461 or IS:4736 or an equivalent international standard	
4	Copies of Standards Attached?	Yes/No	Yes	
5	Overall Length	m	11	
6	No. of sections	Nos.	5	
7	Section Details (Sections starting from the top)			
7.1	Section-1			
7.1.1	Length	m		
7.1.2	Thickness	mm		
7.1.3	Top Dia. (Outer)	mm		
7.1.4	Butt Dia. (Outer)	mm		
7.1.5	Weight	kg		
7.2	Section-2			
7.2.1	Length	m		
7.2.2	Thickness	mm		
7.2.3	Top Dia. (Outer)	mm		
7.2.4	Butt Dia. (Outer)	mm		
7.2.5	Weight	kg		
7.3	Section-3			
7.3.1	Length	m		
7.3.2	Thickness	mm		
7.3.3	Top Dia. (Outer)	mm		
7.3.4	Butt Dia. (Outer)	mm		
7.3.5	Weight	kg		
7.4	Section-4			
7.4.1	Length	m		
7.4.2	Thickness	mm		
7.4.3	Top Dia. (Outer)	mm		
7.4.4	Butt Dia. (Outer)	mm		
7.4.5	Weight	kg		
7.5	Section-5			
7.5.1	Length	m		
7.5.2	Thickness	mm		
7.5.3	Top Dia. (Outer)	mm		
7.5.4	Butt Dia. (Outer)	mm		
7.5.5	Weight	kg		
8	Weight of the Pole	kg		
9	Guaranteed minimum Transverse Failure Load	kgf		
10	Guaranteed Permanent Deflection	mm		
11	Delivery of equipment following award of contract and approval of drawing	months		
12	ISO 9001 holder (including design)	yes/no	yes	
12.1	ISO 9001 certificate submitted	yes/no	yes	
13	Type test certificate submitted	yes/no	yes	
13.1	Submitted for the required ratings	yes/no		
13.2	Type test certified by			
14	User's certificate submitted	yes/no	yes	
15	Has exported to third country	yes/no	yes	

16	Copies of relevant standards attached	yes/no	yes	
17	Outline Drawings and associated GA attached	yes/no	yes	

Signed by……
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer …….

Steel Tubular Pole

1. **Scope**

1.1 This Specification covers the design, fabrication, testing and supply of swaged type galvanized steel tubular poles to be used to support overhead electric lines and equipment.

2. **Description**

2.1 The steel tubular pole shall be manufactured and tested in accordance with IS:2713. The poles shall be fabricated of seamless tubes of suitable lengths as specified in **Table 1** made out of welded tubes, swaged and joined together. The diameters of various sections of the fabricated pole shall be as specified therein. A bid not conforming to the requirements of **Table 1** shall be rejected as being non responsive.

2.2 There are some numbers of poles which shall be of folding type. The folding type poles shall be fabricated in such a way that the bottom section and middle section of the poles could be securely fixed by two sets of galvanized nuts/bolts of suitable size and length at 90^0 each other. All other design requirements and parameters for folding type poles shall be as per section above and IS:2713.

2.3 The separate galvanized steel pole cap shall be provided with top section of the pole. The bottom section of the pole shall be provided with a base plate. The base plate shall be square of size 300x300 mm and 10 mm thick and it shall be welded at the bottom of the pole. The base plate shall have a hole of dia. approx. 50 mm in the center, for draining out of water.

2.4 The total supply quantity of steel tubular poles (total of non-folding type and folding type) are given in the Price Schedule. Supply quantity of folding type poles shall be finalized after pre-construction survey.

3. **Material**

3.1 The poles shall be fabricated from steel having tensile strength not less than 410 N/mm^2. The pole shall be composed of three sections in diminishing diameters and minimum diameter and thickness and lengths of poles shall be as shown in **Table below.**

3.2 The steel tubes shall confirm to the requirements of IS:2713, or latest revision thereof or other recognized international standards that ensures at least a substantially equal quality to the standard mentioned above.

4. **Manufacture**

4.1 All tubes forming the part of the pole shall be made from hot finished seamless or continuously welded steel in accordance with IS 2713, or equivalent international standards. Following tolerances shall be maintained.

a) Tolerance on outside diameter: +/- 1%
b) Tolerance on length: +/- 40mm on any section
+/-25mm on overall length
c) Tolerance on weight: No negative tolerance
d) Tolerance on thickness: No negative tolerance
e) The out-of-straightness of the finished pole shall not exceed 1/600 of its length.

4.2 All welding of the poles shall be carried out at the manufacturers' plant.

4.3 Each section of the pole shall have only one longitudinal weld. No circumferential joints/welds of the tubes are permitted. All welds shall be capable of withstanding, without failure or cracking the stresses in a pole when subjected to its ultimate design loads.

4.4 The pole shall have hole configurations and sizes as shown in the drawings attached to this specification. The hole sizes and the locations of the hole must however be confirmed with the Project prior to manufacture.

5. **Corrosion Protection**

5.1 All sections of the pole shall be galvanized both internally and externally. Galvanizing shall be applied by the hot dip process, and shall be done in single bath (single dip) to result in a uniform thickness both internally and externally. Galvanizing of the poles shall be done after completion of fabrication process. Drilling, punching, cutting, bending and removal of burrs shall be completed before galvanizing. The preparation for galvanizing and the galvanizing process shall not adversely affect the mechanical properties of the material being coated. All galvanizing shall be in accordance with ISO 1461 or IS:4736 or an equivalent international

standard, and shall result in uniform thickness galvanization and be free from defects. The pole cap and the base plate shall also be galvanized.

5.2 The minimum thickness of the zinc coating shall not be less than 500 g/m^2 (equivalent to 70 microns) of zinc for all surfaces of steel including the base plate and the pole cover.

6. **Marking of Pole**

6.1 The pole shall have an identification marked with indelible paint on the pole at a position approximately 3.5 m. from the butt end, which is clearly and indelibly marked with:

a) Date of manufacture and identification mark of manufacture.
b) Length of pole in meters and its design working loads as defined in this specification.
c) Name of the Employer
d) Contract Number.

6.2 The pole shall be marked with a permanent horizontal line at a point 1/6th of the pole height from the butt end of the assembled pole.

7. Earthing Lug, Base Plate and Pole Cap

Each pole shall be provided with earthing lug at 300 mm above the ground level. Separate pole cap shall be provided for each pole. The plate for pole cap shall be of 3 mm. minimum thickness.

8. Tests

8.1 The following test(s) shall be performed on finished poles. All testing shall be fully documented and certified test reports shall be provided to the Project.

- Test for dimensional and structural properties, and for the physical requirements of the finished poles
- Test for galvanization
- Tensile test and chemical analysis test
- Deflection test
- Permanent set test, and
- Drop test.

8.2 Poles selected for tests shall be a representative sample from each lot. The number of poles selected for conducting deflection, permanent set and drop tests shall be as follows.

S.N.	Lot size	No. of poles
1.	Up to 500	5
2.	501-1000	8
3.	1001-2000	13
4.	2001-3000	18
5.	3001 and above	20

8.3 The number of poles selected for conducting tensile test and chemical analysis tests shall be as follows:

S.N.	Lot size	No. of poles
1.	Up to 500	1
2.	501-1000	2
3.	1001-2000	3
4.	2001-3000	4
5.	3001 and above	5

8.4 The above test shall be performed as per IS:2713 or other recognized international standards. The following particulars shall be recorded:

a) Manufacturer's name and plant location;
b) Batch No. of steel plate or tubing;
c) Test date;
d) Pole type;
e) Dimensions of pole;
f) Increments of load and the deflections at each increment of load;
g) Permanent deflection;
h) Load of failure;

8.5 For deflection test, each pole shall be rigidly supported for a distance from the butt end equal to the length the depth to which it to be planted in the ground. It shall then be loaded as cantilever and the appropriate deflection load applied at right angle of the axis of pole 300 mm from the top of the poles for poles up to 9m length and 600 mm for poles over 9m length. The temporary deflection at the point of application of the applied load shall not exceed 157.5 mm

8.6 The permanent set test shall be carried out immediately after the deflection test, on the same test sample. After application of the proper load, the permanent set measured from the zero position at the point of application of load after the release of the applied load shall not exceed 13 mm.

8.7 To perform the drop test, the pole shall be dropped vertically with the bud end downward, three times in succession from a height of 2 m onto a hardwood block 150 mm thick laid on a concrete foundation. The pole shall not show any signs of telescoping or loosening of joints.

8.8 Should any of the poles first selected fail to pass any of the tests specified above, two further poles shall be selected for testing from the same batch i.e. same pole length manufactured on the same day from the same steel plate or tubing in respect of each failure. Should one or both these additional poles fail, the test material represented by the test samples shall be deemed as not complying with this specification.

9. Quality Assurance Program

9.1 Along with the Bid the Bidder shall furnish quality assurance program of the manufacturer which includes the Quality System and the Quality Plans, which shall include, among others, information to meet the following requirement, failing which the Bid shall be liable for rejection.

i. The structure of the organization;
ii. The duties and responsibilities assigned to staff ensuring quality of works;
iii. The system for purchasing, taking delivery and verification of materials;
iv. The system for ensuring quality of workmanship;
v. The quality assurance arrangement shall conform to relevant requirements of ISO9000;
vi. Statement giving list of important raw materials, names of manufacturer for the raw materials, list of standards according to which the raw materials are tested, list of test normally carried out on raw materials;
vii. List of manufacturing facilities available;
viii. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections;
ix. List of testing equipment available with the manufacturer for final testing of equipment specified and the test plant limitation, if any, vis-à-vis the type, special, acceptance and routine tests specified in the relevant standards.

9.2 The manufacturer shall perform, among others, the following inspections/test on each consignment of raw steel, prior to fabrication. A certificate shall be provided to the Employer showing the test results:

i. Visual, dimensional and mechanical tests, to identify the steel meets the required strength/grade ensure compliance with the relevant Standards, and to ensure the absence of rust and surface imperfections. If the steel does meet the strength or grade required, the batch shall be rejected.

ii. Dimensional tests to ensure that the material is within the production tolerances of IS 2713 or BS 4360 and BS 6323 or equivalent Standards. One sample shall be taken from each batch for which a certificate is provided. If the first sample fails the test, a second sample shall be taken. If the second sample fails the test, the batch shall be rejected.

10. Packing

Poles shall be stacked together and banded securely to ensure that each individual bundle does not break or the shifting of individual poles does not take place during transportation and

handling. Any loose items shall be suitably banded together or packed to avoid loss during transportation and storage.

11. Bid Documentation

11.1 The Bidder shall provide with the Bid copies of the governing standards for selection of tubing, fabrication and testing of Steel Tubular Poles and copies of all other relevant standards referenced therein.

11.2 The Bidder shall provide a complete design, description and certified dimensional drawings of each type of pole.

11.3 A clause-by-clause commentary on specification, specifying compliance and deviations, if any.

11.4 All data, drawings, catalogues and other technical documents shall be bound separately from the Bid documents.

Table 1: Pole Attributes

S.N.	Description	Unit	Value	
			For 11m Pole	For 9m Pole
1	Overall Length	m	11	9
2	Pole Designation		410 SP-52	410 SP-31
3	Section Length			
3.1	Top (h1)	m	2.7	2.0
3.2	Middle (h2)	m	2.7	2.0
3.3	Bottom (h3)	m	5.6	5.0
4	Outside Diameter			
4.1	Top (h1)	mm	114.3	114.3
4.2	Middle (h2)	mm	139.7	139.7
4.3	Bottom (h3)	mm	165.1	165.1
5	Thickness			
5.1	Top (h1)	mm	3.65	3.65
5.2	Middle (h2)	mm	4.50	4.50
5.3	Bottom (h3)	mm	4.50	4.50
6	Crippling Load	kgf	307	367
7	Approximate Weight (excluding the weight of galvanization, base plate and pole cap)	kg	175	147
8	Application of load from top of pole	m	0.6	0.3
9	Planting Depth	m	1.8	1.5

GUARANTEED TECHNICAL PARTICULARS

(To be completed by Bidder/Manufacturer)

Item: 11m Steel Tubular Poles

S.N.	Description	Unit	NEA Requirement	To be filled by Bidder/Manufacturer
1	Manufacturer			
	Country of Origin			
2	Years of Manufacturing Experience			
3	Governing Standard for Tubing, Manufacturing and Testing			
4	Are the poles fully Galvanized?	Yes/No	Yes	
5	Governing Standard for Galvanization		ISO 1461 or IS:4736 or an equivalent international standard	
6	Number of Sections	Number	3	
7	Overall Length	m	11	
8	Pole Designation		410 SP-52	
9	Section Length			
9.1	Top (h1)	m	2.7	

S.N.	Description	Unit	NEA Requirement	To be filled by Bidder/Manufacturer
9.2	Middle (h2)	m	2.7	
9.3	Bottom (h3)	m	5.6	
10	Outside Diameter			
10.1	Top (h1)	mm	114.3	
10.2	Middle (h2)	mm	139.7	
10.3	Bottom (h3)	mm	165.1	
11	Thickness			
11.1	Top (h1)	mm	3.65	
11.2	Middle (h2)	mm	4.50	
11.3	Bottom (h3)	mm	4.50	
12	Crippling Load	kgf	307	
13	Approximate Weight (excluding the weight of galvanization, base plate and pole cap)	kg	175	
14	Application of load from top of pole	m	0.6	
15	Planting Depth	m	1.8	
16	Delivery of equipment following award of contract and approval of drawing	months		
17	ISO 9001 holder (including design)	yes/no	yes	
17.1	ISO 9001 certificate submitted	yes/no	yes	
18	Type test certificate submitted	yes/no	yes	
18.1	Submitted for the required ratings	yes/no		
18.2	Type test certified by			
19	User's certificate submitted	yes/no	yes	
20	Has exported to third country	yes/no	yes	
21	Copies of relevant standards attached	yes/no	yes	
22	Outline Drawings and associated GA attached	yes/no	yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer ……

GUARANTEED TECHNICAL PARTICULARS

(To be completed by Bidder/Manufacturer)

Item: 9m Steel Tubular Poles

S.N.	Description	Unit	NEA Requirement	To be filled by Bidder
1	Manufacturer			
	Country of Origin			
2	Years of Manufacturing Experience			
3	Governing Standard for Tubing, Manufacturing and Testing			
4	Are the poles fully Galvanized?	Yes/No	Yes	
5	Governing Standard for Galvanization		EN ISO 1461 or IS:4736 or an equivalent international standard	
6	Number of Sections	Number	3	
7	Overall Length	m	9	
8	Pole Designation		410 SP-31	
9	Section Length			
9.1	Top (h1)	m	2.0	
9.2	Middle (h2)	m	2.0	
9.3	Bottom (h3)	m	5.0	
10	Outside Diameter			
10.1	Top (h1)	mm	114.3	
10.2	Middle (h2)	mm	139.7	
10.3	Bottom (h3)	mm	165.1	
11	Thickness			
11.1	Top (h1)	mm	3.65	
11.2	Middle (h2)	mm	4.50	

S.N.	Description	Unit	NEA Requirement	To be filled by Bidder
11.3	Bottom (h3)	mm	4.50	
12	Crippling Load	kgf	367	
13	Approximate Weight (excluding the weight of galvanization, base plate and pole cap)	kg	147	
14	Application of load from top of pole	m	0.3	
15	Planting Depth	m	1.5	
16	Delivery of equipment following award of contract and approval of drawing	months		
17	ISO 9001 holder (including design)	yes/no	yes	
17.1	ISO 9001 certificate submitted	yes/no	yes	
18	Type test certificate submitted	yes/no	yes	
18.1	Submitted for the required ratings	yes/no		
18.2	Type test certified by			
19	User's certificate submitted	yes/no	yes	
20	Has exported to third country	yes/no	yes	
21	Copies of relevant standards attached	yes/no	yes	
22	Outline Drawings and associated GA attached	yes/no	yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date……
Seal of Bidder/Manufacturer ……

Steel Lattice Towers

1. Scope:

1.1 The specification covers the design, fabrication, testing, supply and erection of steel Lattice Towers complete set as per the design data provided in the specification.

1.2 The towers shall be self-supporting, hot dip galvanized, latticed steel type & designed to carry the line conductors with necessary insulators, earth wires and all fittings under all loading conditions.

1.3 The tower shall be fully galvanized using mild steel or/and high tensile steel sections as specified in the Specifications. Bolts and nuts with spring washer are to be used for connections.

2. Material:

IS Steel Sections of tested quality of conformity with IS: 2062:2011 grade E250 (Designated Yield Strength. 250 MPa) and/ or grade E350 (Designated Yield Strength 350 MPa) are to be used in towers, extensions, stubs and stub setting templates. For Snow Zone towers MS & HT Steel Sections shall conform to E250 Grade-C & E350 Grade-C respectively. The Contractor can use other equivalent grade of structural steel angle sections and plates conforming to latest International Standards viz BSEN 10025. However, use of steel grade having designated yield strength more than that of EN 10025 grade S355 JR/JO (designated yield strength 355 MPa) is not permitted, unless otherwise indicated in this specification.

The material of towers must be galvanized steel conforming to BS; 4360 Gr-43A or equivalent standard.

3. Design:

3.1 The towers are intended to be used for very long spans which cannot be crossed by normal poles arrangement like valley and river crossings etc. The angle towers shall be proposed. These Towers shall be developed as per the site requirement. Additional weight of tower due to strengthening shall be paid on pro-rata basis derived from the quoted price and final weight of the standard (+/- 0) tower after successful testing.

3.2 Design Criteria

Towers shall be designed based on spans and clearances as per as per the standards and requirements and loading conditions as per the site.

3.3 Design Temperatures

The following temperature range for the conductors and ground wires shall be adopted for line design:

i)	Minimum Temperature	:	0 deg.C
ii)	Every day temperature of conductor	:	32 deg.C
iii)	Max. temperature of		
	a) Conductor	:	80 deg.C
	b) Earthwire exposed to sun	:	53 deg.C

3.4 The following data must be incorporated in the design of the Towers. A detail design and drawing of tower and that of the foundation must be submitted to the Employer for prior approval. The exact site requirements shall be identified during the pre-construction survey and approval of SDS and route.

S.N.	Description	Data
1	Factor of safety	2
2	Design span or normal ruling span of Towers	Minimum 400m

3	Wind span and weight span of Conductor	1.5 times of span
4	Minimum ground clearance from the bottom conductor	7m
5	Wind zone	4
6	Circuit on Towers	Single or double
7	Angle of Deviation	As per site condition
8	Phase to Phase clearance Horizontal Vertical	 2.7m 1.75m
9	Disc insulator	As necessary
10	Conductor	ACSR-DOG or WOLF

3.5 Thickness of Members

The minimum thickness of angle sections used in the design of towers, unless otherwise specified elsewhere in this Specification**,** shall be kept not less than the following values:

a) Main corner leg members including the earthwire peak and main cross arm : 5 mm

b) For all other members : 4 mm

3.6 Vibration Dampers

Each tower set should be provided with the vibration dampers suitable

3.7 SLENDERNESS RATIO

Slenderness ratio for members shall be computed in accordance with the relevant standards. The following maximum limit of the slenderness ratio i.e. the ratio of unsupported length of the section in any plane to the appropriate radius of gyration will be adopted:

		VALUE OF KL/R
a)	For main corner leg members including the corner members of earthwire peak and the lower corner members of the cross-arms	120
b)	For other members having calculated stresses	200
c)	For redundant members	250
d)	For members having tensile stress only	375

3.8 Earthing

Each tower should be provided with earthing set complete. The earthing set is 2-inch diameter galvanized pipe of length 3 meters with suitable connector and wire of sufficient length to connect to the Tower footing.

GUARANTEED TECHNICAL PARTICULARS

(To be completed by Bidder/Manufacturer)

Item: Steel Lattice Towers

S.N.	Description	Unit	NEA Requirement	To be filled by Bidder
1	Manufacturer			
	Country of Origin			
	Years of Manufacturing Experience			
2	Governing Standard for Steel			
3	Are the poles fully Galvanized?	Yes/No	Yes	
4	Governing Standard for Galvanization		EN ISO 1461 or IS:4736 or an equivalent international standard	
5	Overall Length	m		
6	Design Working Load	kg		
7	Factor of Safety			
8	Minimum Breaking Load	kg		

S.N.	Description	Unit	NEA Requirement	To be filled by Bidder
9	Overall Height	m		
10	Center to center between 2 tower legs	M		
11	Tower width at Ground Level	M		
12	Maximum width of tower(Foundation width per leg)	M		
13	Complete Earthing set as per specification provided	yes/no	yes	
14	Delivery of equipment following award of contract and approval of drawing	months		
15	ISO 9001 holder (including design)	yes/no	yes	
15.1	ISO 9001 certificate submitted	yes/no	yes	
16	Type test certificate submitted	yes/no	yes	
16.1	Submitted for the required ratings	yes/no		
16.2	Type test certified by			
17	User's certificate submitted	yes/no	yes	
18	Has exported to third country	yes/no	yes	
19	Copies of relevant standards attached	yes/no	yes	
20	Outline Drawings and associated GA attached	yes/no	yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer ……

Pole Accessories (Cross Arms and Braces)

1. Scope

This Specification covers the fabrication and supply of galvanized overhead power line accessories commonly used in overhead power line construction of 33kV and 11kV System. The items used are

- steel cross-arms and bracing members
- pole clamps
- steel bolts and nuts.

2. Material and Description

2.1 Steel Cross Arms and Bracing Angles & Flats

The steel cross-arms and bracing angles and flats shall be fabricated from hot-rolled channels and angles.

The steel channels, angles and flats shall be fabricated and tested in accordance with Indian Standards IS: 226-1975 and IS-808-1964 or any revision thereof or other equivalent national or international standard provided that ensure at least equal or better quality to the standard mentioned above will also be acceptable. The minimum tensile strength of the steel shall be 4200 kg/cm2.

The steel cross-arms and bracing angles shall be of sizes shown in the Table 1: Cross-arms, bracing angles and flats, contained herein.

Conceptual hole pattern and size of holes on cross-arm channels are shown in appropriate drawings herein, however, the Supplier must confirm with the Project the locations and sizes of holes prior to the manufacture.

The surface of the steel shall be flat after drilling or (punching) and free of dimpling or imperfections. The hole edges shall be broken by reaming. The holes shall be full dimension after galvanizing and no minus tolerance of specified hole size will be accepted.

The steel cross-arm and bracing angles & flats shall be furnished reasonably smooth on all surfaces and free of burrs or sharp projections.

The brace shall have a minimum tensile strength of 3182 kg at the bolt-hole and bolt slot.

The brace shall be capable of being bent 10 degrees at the bolt hole or slot and 140 degrees at any point between hole and slot without cracking of the base metal on the outside of bent portion.

2.2 Pole Clamps

The pole clamp shall be fabricated out of hot-rolled steel flat.

The steel flat for pole clamp shall be fabricated and tested in accordance with IS: 226-1975, and IS-1731-1971 or any revision thereof or other equivalent national or international standard provided that ensure at least equal or better quality to the standard mentioned above will also be acceptable. The minimum tensile strength of the steel shall be 4200 kg/cm2.

Outline details of pole clamps are to be approved by the Employer. Dimensions may be changed to comply with the final pole sizes selected. Therefore, the dimensions must be confirmed with the Employer prior to manufacture.

The fittings shall be free of burrs, splinters, splits, sharp points and edges, which may damage conductors or show evidence of poor workmanship.

The surface of the steel shall be flat after drilling or (punching) and free of dimpling or imperfections. The hole edges shall be broken by reaming. The holes shall be full dimension after galvanizing and no minus tolerance of specified hole size will be accepted.

The pole clamps shall have a minimum tensile strength of 3182 kg at the bolt-hole and bolt slot.

2.3 Steel Bolts and Nuts

The bolts and nuts shall be manufactured and tested in accordance with IS: 1363 (Part I)-1984 or the latest version thereof or any other national or international standards that ensures at least equal or better quality to the standard mentioned above, will also be acceptable.

Bolts and nuts shall be furnished in the types, strength, diameters and lengths as specified and required for fixing the cross-arms, bracing angle & flats and pole clamps. However, the dimensions and length of threading of bolt must be confirmed with the Project prior to manufacture.

Thread forms shall be consistent with all material/items listed herein and shall not strip or slip under sustained tensile loading equal to the design tensile strength of the threaded material item.

3 Galvanizing

The pole accessories shall be galvanized with minimum thickness of 90 microns after fabrication in accordance with IS: 2629-1985 or any revision thereof or other equivalent national or international standard provided that ensure at least equal or better quality to the standard mentioned above will also be acceptable.
Spring washers shall be electro galvanized.

4. Tests

Apart from the tests indicated herein in the referenced standards, the pole accessories shall undergo following tests:
- Visual Inspection;
- Verification of Dimensions;
- Verification of Galvanization thickness

5. Quality Assurance Program

Along with the Bid the Bidder shall furnish quality assurance program of the manufacturer which includes the Quality System and the Quality Plans, which shall include, among others, information to meet the following requirement, failing which the Bid shall be liable for rejection.

i. The structure of the organization;
ii. The duties and responsibilities assigned to staff ensuring quality of works;
iii. The system for purchasing, taking delivery and verification of materials;
iv. The system for ensuring quality of workmanship;
v. The quality assurance arrangement shall conform to relevant requirements of ISO 9000;
vi. Statement giving list of important raw materials, names of manufacturer for the raw materials, list of standards according to which the raw materials are tested, list of test normally carried out on raw materials;
vii. List of manufacturing facilities available;
viii. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections;
ix. List of testing equipment available with the manufacturer for final testing of equipment specified and the test plant limitation, if any, vis-à-vis the type, special, acceptance and routine tests specified in the relevant standards.

6. Bid Documentation

7.1 The Bidder shall provide with the Bid two (2) clear copies of the governing standards for fabrication and testing of channels and angles and two (2) clear copies of all other relevant standards referenced therein.

7.2 The Bidder shall provide a complete description, catalogue and certified dimensional drawings of all channels and angles.

7.3 A clause-by-clause commentary on specification, specifying compliance and deviations, if any.

7.4 All data, drawings, catalogues and other technical documents shall be bound separately from the Bid documents.

Table 1: Steel Cross-arm Channels and Angle Braces

S.No.	Description	Type	Dimension in mm
1	**33kV Line Single Pole**		
1.1	Cross Arm Pole Top	ISMC 100	300
1.2	Cross Arm Standard	ISMC 100	1900
1.3	Brace	Flat	40x6x760
2	**33kV Line H Pole**		
2.1	Cross Arm Standard	ISMC 100	3300
2.2	Bracing angle	ISA	50x50x6x2872
2.3	Bracing angle	ISA	50x50x6x2416
3	**11kV Line Single Pole**		
3.1	Cross Arm Pole Top	ISMC 100	300

3.2	Cross Arm Standard	ISMC 100	1200
3.3	Brace	Flat	40x6x660
4	**11kV Line H Pole**		
4.1	Cross Arm Standard	ISMC 100	2390
4.2	Bracing angle	ISA	50x50x6x2723
4.3	Bracing angle	ISA	50x50x6x2071
5	**11kV Line Offset**		
5.1	Cross Arm	ISMC 100	1700
5.2	Brace	Flat	40x6x877

GUARANTEED TECHNICAL PARTICULARS

(To be completed separately for each items)

(To be completed by the Bidder/Manufacturer)

Item: Cross-arm and bracing angle & flats
Item: Pole Clamps
Item: Steel Bolts and Nuts

S.N.	Description	Unit	NEA Requirement	To be filled by Bidder/Manufacturer
1	Manufacturer			
2	Country of Origin			
3	Years of Manufacturing Experience			
4	Governing Standard		IS: 226-1975 and IS-808-1964	
5	Governing Standard for galvanizing			
6	Steel Classification			
7	Minimum tensile strength of steel	kg/cm2.	4200	
8	Is the cross arm and angles fabricated from hot-rolled steel sections?	Yes/No	Yes	
9	Delivery of equipment following award of contract and approval of drawing	months		
10	ISO 9001 holder (including design)	yes/no	yes	
10.1	ISO 9001 certificate submitted	yes/no	yes	
11	Type test certificate submitted	yes/no	yes	
11.1	Submitted for the required ratings	yes/no		
11.2	Type test certified by			
12	User's certificate submitted	yes/no	yes	
13	Has exported to third country	yes/no	yes	
14	Copies of relevant standards attached	yes/no	yes	
15	Outline Drawings and associated GA attached	yes/no	yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer ……

ACSR Conductor

1. **Scope**

This Specification covers the fabrication and supply of aluminum conductors, steel reinforced (ACSR) commonly used on overhead power line construction.

2. **Description**

2.1 The manufacturer of the ACSR conductor must have been accredited with ISO quality certification.

2.2 The ACSR conductor shall be a concentrically stranded right-hand lay conductor.

2.3 The ACSR conductor shall be fabricated in accordance with IS: 398 or any other international standards that ensures a substantially equal quality to the standard mentioned above, will also be acceptable.

2.4 The following types of conductors shall be supplied:

S.N.	Description	Unit	Conductor	
			ACSR 'DOG' Conductor	ACSR 'RABBIT' Conductor
1	Nominal Aluminum Area	mm^2	100	50
2	Stranding	Al/Steel	6/7	6/1
3	Wire Diameter			
	Aluminum	mm	4.72	3.35
	Steel	mm	1.57	3.35
4	Overall Sectional Area			
	Aluminum	mm^2	105.0	52.88
	Steel	mm^2	13.50	8.82
	Total	mm^2	118.5	61.70
5	Overall Diameter of Conductor	mm	14.15	10.05
6	Approximate Mass	kg/km	394	214
7	Calculated Resistance at 20°C	Ω/km	0.27	0.55
8	Breaking Load	kN	32.41	18.25

3. **Packaging**

3.1 The packaging of goods shall be in accordance with IS:398. All conductors shall be furnished on non-returnable steel drums/reels. Protective external lagging of sufficient thickness shall be provided and fitted closely on the reels. Binder consisting of steel straps shall be provided over the external laggings. The reel shall be new and sufficiently sturdy in construction to withstand ocean shipping, road transport, several loading and unloading, storage in tropics, hauling and field erection of conductor without distortion or disintegration.

3.2 Each reel/drum of the conductors furnished shall contain only one (1) length of conductor.

3.3 All reels shall be legibly marked in paint with the following information:

a) Size of conductor
b) Type of conductor
c) Length in meters
d) Net weight of conductor
e) Direction of rolling

3.4 The standard non-joined length of the completed conductor in each drum/reel shall be as below:

Conductor	ACSR 'DOG'	ACSR 'RABBIT'
Standard non-joined Length in each drum (m)	500	1000

4. **Tests**

4.1 The manufactured conductor shall be tested in full compliance with the governing standard including following routine tests:

Aluminum wire

a) Tensile test
b) Wrapping test
c) Resistivity test

Steel wire

a) Determination of stress at 1% elongation

b) Tensile test
c) Torsion test or elongation test as appropriate
d) Wrapping test
e) Galvanization test
f) Ductility test

5. **Bid Documentation**

5.1 The Bidder shall provide with the Bid two (2) clear copies of the governing standards for fabrication and testing of the ACSR conductor and two (2) clear copies of all other relevant standards referenced therein.

5.2 The Bidder shall provide certified type test results of all types of ACSR conductor as required by governing standards.

5.3 A clause-by-clause commentary on specification, specifying compliance and deviations, if any.

5.4 All data, drawings, catalogues and other technical documents shall be bound separately from the Bid documents.

GUARANTEED TECHNICAL PARTICULARS

(To be completed by the Bidder/Manufacturer)

Item: ACSR Conductor

S.N.	Description	Unit	NEA Requirement	To be Filled by Bidder/Manufacturer	NEA Requirement	To be Filled by Bidder/Manufacturer
			"ACSR DOG Conductor"	"ACSR DOG Conductor"	"ACSR RABBIT Conductor"	"ACSR RABBIT Conductor"
1	Manufacturer					
2	Country of Origin					
3	Years of Manufacturing Experience					
4	Governing Standard		IS 398 or Equivalent		IS 398 or Equivalent	
5	Nominal Aluminum Area	mm^2	100		50	
6	Stranding	Al/Steel	6/7		6/1	
7	Wire Diameter					
7.1	Aluminum	mm	4.72		3.35	
7.2	Steel	mm	1.57		3.35	
8	Overall Sectional Area					
8.1	Aluminum	mm^2	105.0		52.88	
8.2	Steel	mm^2	13.50		8.82	
8.3	Total	mm^2	118.5		61.70	
9	Overall Diameter of Conductor	mm	14.15		10.05	
10	Approximate Mass	kg/km	394		214	
11	Calculated Resistance at 20°C	Ω/km	0.27		0.55	
12	Breaking Load	kN	32.41		18.25	
13	Delivery of equipment following award of contract and approval of drawing	months				
14	ISO 9001 holder (including design)	yes/no	yes		yes	
14.1	ISO 9001 certificate submitted	yes/no	yes		yes	
15	Type test certificate submitted	yes/no	yes		yes	
15.1	Submitted for the required ratings	yes/no				
15.2	Type test certified by					
16	User's certificate submitted	yes/no	yes		yes	
17	Has exported to	yes/no	yes		yes	

S.N.	Description	Unit	NEA Requirement	To be Filled by Bidder/Manufacturer	NEA Requirement	To be Filled by Bidder/Manufacturer
			"ACSR DOG Conductor"	"ACSR DOG Conductor"	"ACSR RABBIT Conductor"	"ACSR RABBIT Conductor"
	third country					
18	Copies of relevant standards attached	yes/no	yes		yes	
19	Outline Drawings and associated GA attached	yes/no	yes		yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer ……

Parallel Groove (PG) Clamps

1. **Scope**

1.1 This Specification covers design fabrication testing and supply of universal parallel groove (PG) clamps and fittings commonly used in overhead electric power lines.

2. **Description**

2.1 The PG clamp shall be designed and manufactured to achieve full compatibility between clamps and conductors and produce uniform and electrically efficient connections between conductors for the class of connection intended.

2.2 The manufacturer of PG Clamp must have been accredited with ISO 9001 with design and manufacturing quality certification.

2.3 The PG clamp is intended to be used for ACSR to ACSR conductor.

2.4 The body of PG clamp shall be made of aluminum alloy from a permanent mould process and hardware consisting of nuts, bolts and washer shall be made of hot dip galvanized steel. The PG clamps shall have sufficient mass and contact area to provide the thermal capacity required for load cycling and fault current. The clamps shall be designed to provide the distributed current density necessary to prevent hot spots, and current carrying rating of the conductors for which they are designated. PG clamp shall have oxide inhibiting compound and contact aid.

2.5 The clamps shall be manufactured to accommodate ACSR conductors as shown in Table 1.

2.6 The grooves on the clamps shall be open-edged on two (2) edges for easy installation over a run conductor and insertion of tap conductor.

2.7 The clamp shall be tested in accordance with the relevant ANSI standard or other equivalent national or international standard specifying the performance requirement for the electrical and mechanical characteristics of clamps. The clamps shall conform to all testing requirements of that standard for the classes of clamps considered.

2.8 Each clamp shall be marked with the type and size of conductor, which will correctly fit each groove.

3. Tests

The PG clamps shall undergo type and routine tests in accordance with the relevant governing standard.

4**. Quality Assurance Program**

Along with the Bid the Bidder shall furnish quality assurance program of the manufacturer which includes the Quality System and the Quality Plans, which shall include, among others, information to meet the following requirement, failing which the Bid shall be liable for rejection.

i. The structure of the organization;
ii. The duties and responsibilities assigned to staff ensuring quality of works;
iii. The system for purchasing, taking delivery and verification of materials;
iv. The system for ensuring quality of workmanship;
v. The quality assurance arrangement shall conform to relevant requirements of ISO9000;
vi. Statement giving list of important raw materials, names of manufacturer for the raw materials, list of standards according to which the raw materials are tested, list of test normally carried out on raw materials;
vii. List of manufacturing facilities available;
viii. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections;
ix. List of testing equipment available with the manufacturer for final testing of equipment specified and the test plant limitation, if any, vis-à-vis the type, special, acceptance and routine tests specified in the relevant standards.

5. **Bid Documentation**

5.1 The Bidder shall provide with the Bid two (2) clear copies of the governing standards for fabrication and testing of PG clamp.

5.2 The Bidder shall provide a complete description, and catalogue/drawing of PG clamp.

5.3 The Bidder shall provide certified type test results of PG clamp as required by governing standards.

5.4 A clause-by-clause commentary on specification, specifying compliance and deviations, if any.

5.5 All data, drawings, catalogues and other technical documents shall be bound separately from the Bid documents.

GUARANTEED TECHNICAL PARTICULARS

(To be completed by the Bidder/Manufacturer)

Item: Parallel Groove (PG) Clamps

S.N.	Description	Unit	NEA Requirement	To be Filled by Bidder/Manufacturer	NEA Requirement	To be Filled by Bidder/Manufacturer
			ACSR DOG-DOG	ACSR DOG-DOG	ACSR RABBIT-RABBIT	ACSR RABBIT-RABBIT
1	Manufacturer					
2	Country of Origin					
3	Years of Manufacturing Experience					
4	Governing Standard					
5	Type/Model No.					
6.1	Main Conductor		DOG		RABBIT	
6.2	Branch Conductor		DOG		RABBIT	
7	Current Rating	A	400		200	
8	Type of Connection					
9	Construction					
9.1	Body Material					
9.2	Screw Material					
10.1	Bolts size	mm				
10.2	Tightening torque	Nm				
11.1	Size	mm				
11.2	weight	Kg				
12	Markings					
13	Delivery of equipment following award of contract and approval of drawing	months				
14	ISO 9001 holder (including design)	yes/no	yes		yes	
14.1	ISO 9001 certificate submitted	yes/no	yes		yes	
15	Type test certificate submitted	yes/no	yes		yes	
15.1	Submitted for the required ratings	yes/no				
15.2	Type test certified by					
16	User's certificate submitted	yes/no	yes		yes	
17	Has exported to third country	yes/no	yes		yes	
18	Copies of relevant standards attached	yes/no	yes		yes	
19	Outline Drawings and associated GA attached	yes/no	yes		yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer ……

Mid-Span Compression Connectors

1. **Scope**

This Specification covers the design, testing, manufacture and supply of mid-span joints of compression type commonly used in overhead electric power line construction,

2. **Description**

2.1 Compression connectors shall be manufactured and tested in accordance with the relevant national or international standard.

2.2 The compression connectors shall be designed and manufactured to achieve full compatibility between connectors and tools and produce uniform and electrically efficient connections between conductors for the class of connection intended. Conductor sizes are nominal and allowance shall be made for the actual conductor sizes to be supplied.

2.3 The compression connectors shall be tested in accordance with the applicable national or international standard specifying the performance requirements for the electrical and mechanical characteristics of connectors under operating conditions, and shall conform to all testing requirements of that Standard for the classes of connectors concerned.

2.4 The compression connectors for ACSR conductor to ACSR conductor shall be made of electrical grade aluminum. The connectors shall have sufficient mass and contact area to provide the thermal capacity required for load cycling and fault current. The connector shall be designed to provide the distributed current density necessary to prevent hot spots, and conductivity shall exceed the full load current rating of the conductors for which they are designed.

2.5 The joints shall be so designed that when installed no air space is left within the finished joints. The joints shall have the conductivity as specified in relevant Clause.

3. General Requirements

The full tension sleeve connectors shall be dual tension (2-piece) for use with ACSR conductors furnished in accordance with Table 1.

For ACSR conductors, the steel sleeve for the conductor core shall be heavily plated for resistance to corrosion and compatibility with aluminum and shall be abrasive lined for maximum holding strength.

For ACSR conductors, the aluminum outer sleeve for 100 sq. mm. ACSR conductor shall have a filler hole to permit entering over the steel sleeve and permit inhibitor application. An aluminum hole plug shall be furnished.

The conductor shall achieve the same mechanical strength that of undamaged conductor at connecting point.

4. Tests

The compression connectors shall undergo type and routine tests in accordance with the relevant governing standard.

5**. Quality Assurance Program**

Along with the Bid the Bidder shall furnish quality assurance program of the manufacturer which includes the Quality System and the Quality Plans, which shall include, among others, information to meet the following requirement, failing which the Bid shall be liable for rejection.

i. The structure of the organization;
ii. The duties and responsibilities assigned to staff ensuring quality of works;
iii. The system for purchasing, taking delivery and verification of materials;
iv. The system for ensuring quality of workmanship;
v. The quality assurance arrangement shall conform to relevant requirements of ISO9000;
vi. Statement giving list of important raw materials, names of manufacturer for the raw materials, list of standards according to which the raw materials are tested, list of test normally carried out on raw materials;
vii. List of manufacturing facilities available;
viii. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections;
ix. List of testing equipment available with the manufacturer for final testing of equipment specified and the test plant limitation, if any, vis-à-vis the type, special, acceptance and routine tests specified in the relevant standards.

6. **Bid Documentation**

6.1 The Bidder shall provide with the Bid two (2) clear copies of the governing standards for fabrication and testing of compression connectors.

6.2 The Bidder shall provide a complete description, and catalogue/drawing of compression connectors.

6.3 The Bidder shall provide certified type test results of compression connectors as required by governing standards.

6.4 A clause-by-clause commentary on specification, specifying compliance and deviations, if any.

6.5 All data, drawings, catalogues and other technical documents shall be bound separately from the Bid documents.

TABLE 1

Connector Type	Conductors
Full Tension Sleeve Full Tension Sleeve	100 sq. mm. ACSR "DOG" 50 sq. mm ACSR "RABBIT"

GUARANTEED TECHNICAL PARTICULARS

(To be completed by the Bidder/Manufacturer)

Item: Mid-Span Compression Connectors

S.N.	Description	Unit	NEA Requirement	To be Filled by Bidder/Manufacturer	NEA Requirement	To be Filled by Bidder/Manufacturer
			ACSR DOG	ACSR DOG	ACSR RABBIT	ACSR RABBIT
1	Manufacturer					
	Country of Origin					
2	Years of Manufacturing Experience					
3	Governing Standard					
4	Model No.					
5	Type		Compression		Compression	
6	Current Rating	A	400		200	
7	Material					
7.1	Outer Sleeve					
7.2	Inner Sleeve					
8	Dimension of Compression Joint for Aluminum part					
8.1	Outer	mm				
8.2	Inner	mm				
9	Dimension of Compression Joint for Steel part					
9.1	Outer	mm				
9.2	Inner	mm				
10	Minimum Failing Load	kN				
11	Electrical Resistance at 20 deg. C					
12.1	Size	mm				
12.2	weight	Kg				
13	Markings					
14	Delivery of equipment following award of contract and approval of drawing	months				
15	ISO 9001 holder (including design)	yes/no	yes		yes	
15.1	ISO 9001 certificate submitted	yes/no	yes		yes	
16	Type test certificate	yes/n	yes		yes	

S.N.	Description	Unit	NEA Requirement	To be Filled by Bidder/Manufacturer	NEA Requirement	To be Filled by Bidder/Manufacturer
			ACSR DOG	ACSR DOG	ACSR RABBIT	ACSR RABBIT
	submitted	o				
16.1	Submitted for the required ratings	yes/no				
16.2	Type test certified by					
17	User's certificate submitted	yes/no	yes		yes	
18	Has exported to third country	yes/no	yes		yes	
19	Copies of relevant standards attached	yes/no	yes		yes	
20	Outline Drawings and associated GA attached	yes/no	yes		yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer ……

Porcelain Insulators and Fittings

1. Scope

This Specification covers the Type Test, fabrication and supply of pin insulators, disc insulators stay insulators, disc insulator fittings and insulator pins as herein specified for use on overhead power line construction.

2. General

1.1 General Requirements of Insulators

Insulators shall be fabricated and tested in accordance with the Standards referenced for each type of insulator or equivalent standards.

The Type Test shall be conducted in the recognized laboratory.

Porcelain shall be sound, free from defects, thoroughly vitrified and smoothly glazed. The glaze shall be brown in color. The glaze shall cover all exposed parts of the insulators.

The design of insulators shall be such that stresses due to expansion and contraction in any part of the insulator shall not lead to deterioration. The porcelain shall not engage directly with hard metal.

The cement used in construction of insulators shall not give rise to chemical reaction with metal fittings and its thickness shall be as uniform as possible.

The insulators should be manufactured in automatic temperature-controlled kilns to obtain uniform baking and better electrical and mechanical properties.

The preferred make of disc, pin and stay insulators and fittings are Allied Ceramics Pvt. Ltd., BHEL, Aditya Birla Insulators Ltd., Hindustan Chemicals Ltd. or equivalent reputed.

1.2 General Requirements of Disc Insulators fittings

The disc insulator fittings shall be designed, manufactured and tested in accordance with IS: 2486 or any other national or international standards that ensures at least equal or better quality to the standard mentioned above, will also be acceptable.

The disc insulator fittings shall be supplied with ball and socket couplings and twisted straps. The insulator fittings shall conform to the shape and dimension as per the governing standards

Disc insulator fittings like ball and socket, nuts and bolts shall be made of hot rolled steel and the twisted cross arm strap shall be made of MS sheet metal. Cotter bolts and U-bolts shall be of galvanized steel. Cotter pins shall be of stainless steel.

All forgings and castings shall be of good finish and free from flaws and other defects. The edges on the outside of fittings, such as the ball socket and holes, shall be rounded. The nominal dimensions of the ball and socket, ball eye and twisted cross arm straps, shall be as per the governing standards.

All ferrous fittings and the parts other than those of stainless steel, shall be hot dip galvanized as per IS: 2629 or equivalent international standards.

1.3 General Requirements of Insulator Pins

The insulator pins specified herein shall be fabricated from hot rolled steel. The pin shall be a single piece obtained preferably by the process of forging. It shall not be made by jointing, welding, shrink fitting or any other processes from more than one piece of material. It shall be of good finish free from flaws and other defects. The finish of the collar shall be such that a sharp angle between the collar and the shank is avoided.

All ferrous pins, nuts and washers except those made of stainless steel shall be hot dip galvanized. The threads of nuts shall be cut after galvanizing and shall be well oiled and greased. The galvanizing shall conform to IS 2629-1985 or equivalent national or international standard.

All insulator pins shall be reasonably smooth on all surfaces and free of sharp projections.

3. Specific Requirements

3.1. Pin Insulator

The pin insulator shall be manufactured and tested in accordance with IS: 731 and IS:3188 or the latest version thereof or any other national or international standards that ensures at least

equal or better quality to the standard mentioned above, will also be acceptable. The lead thread shall be compatible with the insulator pin specified in these documents.

The pin insulator shall have following ratings and features:

S.N.	Description	Unit	11 kV pin insulator	33 kV pin insulator
1	Highest system voltage	kV	12	36
2	Rated voltage	kV	11	33
3	Creepage distance (minimum)	mm	265	580
4	Wet power frequency withstand voltage	kV	35	75
5	Impulse withstand voltage	kV	75	170
6	Puncture power frequency voltage (minimum)	kV	105	180
7	Visible discharge voltage (Effective)	kV	9	27
8	Cantilever strength	kN	5	10
9	GI pin head		Small	Large

3.2 Disc Insulator

The disc insulator shall be manufactured and tested in accordance with IS: 731 or latest version thereof or any other national or international standards that ensures at least equal or better quality to the standard mentioned above, will also be acceptable.
The disc insulator shall be ball and socket fitting type. The disc insulator shall have the following ratings and features:

S.N.	Description	Unit	Value
1	Highest system Voltage	kV	12
2	Rated Voltage	kV	11
3	Porcelain Diameter (minimum)	mm	255
4	Spacing	mm	145
5	Creepage Distance (minimum)	mm	280
6	Power Frequency Puncture withstand Voltage		1.3 x Actual dry flashover voltage
7	Wet Power Frequency Withstand Voltage	kV	35
8	Impulse Withstand Voltage	kV	75
9	Puncture Power Frequency Voltage (minimum)	kV	105
10	Visible Discharge Voltage	kV	9
11	Mechanical Strength	kN	45
12	Ball and Socket Size		16 mm B
13	Applicable Standard for Special Characteristics		IS: 3188

3.3 Shackle Insulator

The shackle insulator shall be manufactured and tested in accordance with IS: 1445 or the latest version thereof or any other national or international standards that ensures at least equal or better quality to the standard mentioned above, will also be acceptable.
The shackle insulator to be furnished shall have following ratings and features:

S.N.	**Description**	**Unit**	**Value**
1	Highest system voltage	kV	1
2	Rated voltage	V	500

3	Power frequency withstands voltage, 1 minute:		
3.1	Dry	kV	23
3.2	Wet	kV	10
4	Power frequency puncture withstand voltage, 1-minute	kV	1.3 X actual dry flashover voltage
5	Leakage distance (min)	mm	75
6	Mechanical strength	kN	16

3.4 Stay Insulator

The stay insulator shall be manufactured and tested in accordance with IS: 5300 or latest version thereof or any other national or international standards that ensures at least equal or better quality to the standard mentioned above, will also be acceptable.

The stay insulator shall have the following ratings and features:

S.N.	Description	Unit	Stay Insulator for	
			11 kV and 400V Line	33 kV Line
1	IS Designation		A	C
2	Length	mm	90	140
3	Diameter	Mm	65	85
4	Cable Hole Diameter	mm	16	25
5	Creepage Distance (minimum)	mm	41	57
6	Minimum failing load	kN	44	88
7	Power Frequency Withstand Voltage			
7.1	Dry	kV	18	27
7.2	Wet	kV	8	13

3.5 Insulator Pins

The insulator pins to be supplied shall conform to IS: 2486 or equivalent international standards and to the shape and dimensions shown in the drawings contained in this specification. The insulator pin shall be furnished with a spring steel split lock washer and nut assembled on the insulator pin. The ratings and features of the insulator pins shall be as follows:

S.N.	**Description**	**Unit**	**Required ratings/features**	
			For 11 kV	**For 33 kV**
1	Head type		Small S165P	Large L300N
2	Total length	mm	315	450
3	Stalk length	mm	165	300
4	Shank length	mm	150	150
5	Minimum failing load	kN	5	10
6	Applicable standard		IS: 2486 or equivalent international standard.	

The insulator pins shall be compatible with the insulators specified above.

3.6 Disc Insulator Fittings

Disc insulator fittings like Ball and socket, nuts, bolts shall be made of hot rolled steel and the twisted cross arm strap shall be made of MS sheet metal. Cotter bolts and U-bolts shall be of galvanized steel. Cotter pins shall be of stainless steel.

All forgings and castings shall be of good finish and free from flaws and other defects. The edges on the outside of fittings, such as the ball socket and holes, shall be rounded. The

nominal dimensions of the ball and socket, ball eye and twisted cross arm straps, are given in Drawings. The ultimate strength of the fittings shall not be less than 41 KN.

All ferrous fittings and the parts other than those of stainless steel, shall be hot dip galvanized as per IS: 2629-1985 or equal internationally recognized standards.

3.7 SHACKLE INSULATOR FITTINGS

The shackle insulator fittings shall be of D-Iron type and shackle strap required for shackle insulators for use in overhead low voltage line construction.
The shackle fittings shall be free of burrs, splinters, splits, sharp points and edges which may damage conductors or show evidence of poor workmanship. All ferrous fittings and parts other than stainless steel shall be galvanized as per IS: 2629-1985 or equivalent national or international standard. The minimum coating thickness shall be not less than 90 micron.

D-iron type shackle fittings shall consists of the following main components:

- Mild steel D-iron;
- 1 no. of mild steel bolt and nut;
- 1 no. of spring washer.

The shackle strap consists of:

- 2 nos. of mild steel straps;
- 1 no. of mild steel bolt and nuts;
- 1 no. of spring washer.

The shackle strap shall be compatible with the type of shackle insulator intended to be used with it.

4. Marking

Each insulator shall be legibly and indelibly marked to show the following:

a) Name or trademark of manufacturer.
b) Year of manufacture.
c) Minimum failing load in Newton
d) Name of Employer

Markings on porcelain shall be printed and shall be applied before firing.

5. Tests

The insulators and fittings shall comply with the type tests and routine tests as per relevant governing standards.

6. BID DOCUMENTATION

The Bidder shall provide with the Bid two (2) clear copies of the governing standards for fabrication and testing of pin insulator and insulator pin and two (2) clear copies of all other relevant standards referenced therein.

The Bidder shall provide certified type test results of pin insulator and insulators pin as required by governing standards.

The Bidder shall provide standard catalogue and certified dimensional drawings of pin insulator and insulator pins.
A clause-by-clause commentary on specification, specifying compliance and deviations, if any.

All data, drawings, catalogues and other technical documents shall be bound separately from the Bid documents.

GUARANTEED TECHNICAL PARTICULARS

(To be completed by the Bidder/Manufacturer)

Item: Pin Insulator

			11 kV Pin Insulator		33 kV Pin Insulator	
S.N.	Description	Unit	NEA Requirement	To be filled by Bidder/Manufacturer	NEA Requirement	To be filled by Bidder/Manufacturer
1	Manufacturer					
2	Country of Origin					
3	Years of Manufacturing Experience					
4	Model No.					
5	Governing Standards		IS: 731; IS:3188		IS: 731	
6	Marking as per specifications	Yes/No	Yes		Yes	
7	Highest system voltage	kV	12		36	
8	Rated voltage	kV	11		33	
9	Creepage distance (minimum)	mm	265		580	
10	Wet power frequency withstand voltage	kV	35		75	
11	Impulse withstand voltage	kV	75		170	
12	Puncture power frequency voltage (minimum)	kV	105		180	
13	Visible discharge voltage (Effective)	kV	9		27	
14	Cantilever strength	kN	5		10	
15	GI pin head		Small		Large	
16	Delivery of equipment following award of contract and approval of drawing	months				
17	ISO 9001 holder (including design)	yes/no	yes		yes	
17.1	ISO 9001 certificate submitted	yes/no	yes		yes	
18	Type test certificate submitted	yes/no	yes		yes	
18.1	Submitted for the required ratings	yes/no				
18.2	Type test certified by					
19	User's certificate submitted	yes/no	yes		yes	
20	Has exported to third country	yes/no	yes		yes	
21	Copies of relevant standards attached	yes/no	yes		yes	
22	Outline Drawings and associated GA attached	yes/no	yes		yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer ……

GUARANTEED TECHNICAL PARTICULARS

(To be completed by the Bidder/Manufacturer)

Item: 11 kV Disc Insulator

S.N.	Description	Unit	NEA Requirement	To be filled by Bidder
1	Manufacturer			
2	Country of Origin			
3	Years of Manufacturing Experience			
4	Model No.			

S.N.	Description	Unit	NEA Requirement	To be filled by Bidder
5	Governing Standards		IS: 731-1971	
6	Marking as per specifications	Yes/No	Yes	
7	Highest system Voltage	kV	12	
8	Rated Voltage	kV	11	
9	Porcelain Diameter (minimum)	mm	255	
10	Spacing	mm	145	
11	Creepage Distance (minimum)	mm	280	
12	Power Frequency Puncture withstand Voltage		1.3 x Actual dry flashover voltage	
13	Wet Power Frequency Withstand Voltage	kV	35	
14	Impulse Withstand Voltage	kV	75	
15	Puncture Power Frequency Voltage (minimum)	kV	105	
16	Visible Discharge Voltage	kV	9	
17	Mechanical Strength	kN	45	
18	Ball and Socket Size		16 mm B	
19	Applicable Standard for Special Characteristics		IS: 3188-1980	
20	Delivery of equipment following award of contract and approval of drawing	months		
21	ISO 9001 holder (including design)	yes/no	yes	
21.1	ISO 9001 certificate submitted	yes/no	yes	
22	Type test certificate submitted	yes/no	yes	
22.1	Submitted for the required ratings	yes/no		
22.2	Type test certified by			
23	User's certificate submitted	yes/no	yes	
24	Has exported to third country	yes/no	yes	
25	Copies of relevant standards attached	yes/no	yes	
26	Outline Drawings and associated GA attached	yes/no	yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer ……

GUARANTEED TECHNICAL PARTICULARS

(To be completed by the Bidder/Manufacturer)

Item: **Stay Insulator**

S.N.	Description	Unit	Stay Insulator for 11 kV and 400 V Line		Stay Insulator for 33 kV Line	
			NEA Requirement	To be filled by Bidder/Manufacturer	NEA Requirement	To be filled by Bidder/Manufacturer
1	Manufacturer					
2	Country of Origin					
3	Years of Manufacturing Experience					
4	Model No.					
5	Governing Standard		IS: 5300-1969		IS: 5300-1969	
6	Marking as per specification?	Yes/No	Yes		Yes	
7	IS Designation		A		C	
8	Length	mm	90		140	
9	Diameter	Mm	65		85	
10	Cable Hole Diameter	mm	16		25	
11	Creepage Distance (minimum)	mm	41		57	
12	Minimum failing load	kN	44		88	
13	Power Frequency Withstand Voltage					
13.1	Dry	kV	18		27	
13.2	Wet	kV	8		13	
14	Delivery of equipment following award of contract and approval of	months				

S.N.	Description	Unit	Stay Insulator for 11 kV and 400 V Line		Stay Insulator for 33 kV Line	
			NEA Requirement	To be filled by Bidder/Manufacturer	NEA Requirement	To be filled by Bidder/Manufacturer
	drawing					
15	ISO 9001 holder (including design)	yes/no	yes		yes	
15.1	ISO 9001 certificate submitted	yes/no	yes		yes	
16	Type test certificate submitted	yes/no	yes		yes	
17.1	Submitted for the required ratings	yes/no				
17.2	Type test certified by					
18	User's certificate submitted	yes/no	yes		yes	
19	Has exported to third country	yes/no	yes		yes	
20	Copies of relevant standards attached	yes/no	yes		yes	
21	Outline Drawings and associated GA attached	yes/no	yes		yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer ……

GUARANTEED TECHNICAL PARTICULARS
(To be completed by the Bidder/Manufacturer)

Item: Disc Insulator Fittings

S.N.	Description	Unit	NEA Requirement	To be filled by Bidder/Manufacturer
1	Manufacturer			
2	Country of Origin			
3	Years of Manufacturing Experience			
4	Model No.			
5	Governing Standard		IS: 2486	
6	Steel Classification		As per specification	
7	Ferrous parts are galvanized As per IS 2629 – 1985?	Yes/No	Yes	
8	Thickness of Galvanizatiioin	micron		
9	Cotter Pins are Stainless Steel?	Yes/No	Yes	
10	Ultimate Strength of Fittings	kN		
11	Delivery of equipment following award of contract and approval of drawing	months		
12.1	ISO 9001 holder (including design)	yes/no	yes	
12.2	ISO 9001 certificate submitted	yes/no	yes	
13.1	Type test certificate submitted	yes/no	Yes	
13.2	Submitted for the required ratings	yes/no		
13.3	Type test certified by			
14	User's certificate submitted	yes/no	Yes	
15	Has exported to third country	yes/no	Yes	
16	Copies of relevant standards attached	yes/no	Yes	
17	Outline Drawings and associated GA attached	yes/no	yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer ……

GUARANTEED TECHNICAL PARTICULARS
(To be completed by the Bidder/Manufacturer)

Item: Insulator Pins

S.N.	Description	Unit	11 kV Insulator Pin		33 kV Insulator Pin	
			NEA Requirement	To be filled by Bidder/Manufacturer	NEA Requirement	To be filled by Bidder/Manufacturer
1	Manufacturer					
2	Country of Origin					
3	Years of Manufacturing Experience					
4	Model No.					
5	Governing Standard		IS: 2486		IS: 2486	
6	Type of steel used		Hot rolled steel		Hot rolled steel	
7	Head type		Small S165P		Large L300N	
8	Total length	mm	315		450	
9	Stalk length	mm	165		300	
10	Shank length	mm	150		150	
11	Minimum failing load	kN	5		10	
12	Delivery of equipment following award of contract and approval of drawing	months				
13.1	ISO 9001 holder (including design)	yes/no				
13.2	ISO 9001 certificate submitted	yes/no				
14.1	Type test certificate submitted	yes/no				
14.2	Submitted for the required ratings	yes/no				
14.3	Type test certified by					
15	User's certificate submitted	yes/no				
16	Has exported to third country	yes/no				
17	Copies of relevant standards attached	yes/no				
18	Outline Drawings and associated GA attached	yes/no				

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer ……

GUARANTEED TECHNICAL PARTICULARS
(To be completed by the Bidder/Manufacturer)

Item: Shackle Insulator

S.N.	Description	Unit	NEA Requirement	To be filled by Bidder
1	Manufacturer			
2	Country of Origin			
3	Years of Manufacturing Experience			
4	Model No.			
5	Governing Standards		IS: 1445	
6	Marking as per specifications	Yes/No	Yes	
7	Highest system voltage	kV	1	
8	Rated voltage	V	500	

S.N.	Description	Unit	NEA Requirement	To be filled by Bidder
9	Power frequency withstands voltage, 1 minute:			
9.1	Dry	kV	23	
9.2	Wet	kV	10	
10	Power frequency puncture withstand voltage, 1-minute	kV	1.3 X actual dry flashover voltage	
11	Leakage distance (min)	mm	75	
12	Mechanical strength	kN	16	
13	Delivery of equipment following award of contract and approval of drawing	months		
14.1	ISO 9001 holder (including design)	yes/no		
14.2	ISO 9001 certificate submitted	yes/no		
15.1	Type test certificate submitted	yes/no		
15.2	Submitted for the required ratings	yes/no		
15.3	Type test certified by			
16	User's certificate submitted	yes/no		
17	Has exported to third country	yes/no		
18	Copies of relevant standards attached	yes/no		
19	Outline Drawings and associated GA attached	yes/no		

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer ……

GUARANTEED TECHNICAL PARTICULARS

(To be completed by the Bidder/Manufacturer)

Item: Shackle Insulator Fittings

S.N.	Description	Unit	NEA Requirement	To be filled by Bidder/Manufacturer
1	Manufacturer			
2	Country of Origin			
3	Years of Manufacturing Experience			
4	Model No.			
5	Governing Standards			
6	Steel classification			
7	Governing standard for galvanization		IS: 2629	
8	Thickness of galvanization	µm	90	
9	Delivery of equipment following award of contract and approval of drawing	months		
10.1	ISO 9001 holder (including design)	yes/no		
10.2	ISO 9001 certificate submitted	yes/no		
11.1	Type test certificate submitted	yes/no		
11.2	Submitted for the required ratings	yes/no		
11.3	Type test certified by			
12	User's certificate submitted	yes/no		
13	Has exported to third country	yes/no		
14	Copies of relevant standards attached	yes/no		
15	Outline Drawings and associated GA attached	yes/no		

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer ……

Preformed Wire Products

1. **Scope**

This Specification covers the fabrication and supply of pin insulator ties and wire strand grips for stay set commonly used in overhead power line construction.

2. **Requirements**

The design of the preformed wire products specified herein shall be appropriate for the optimum combination of conductor strand diameter, inside diameter, rod diameter, pitch diameter, number of pitch lengths, direction of lay, and raw materials of the specific application.

The preformed wire product shall be so designed to grip the designated surface evenly, with evenly-spaced gaps, and shall not bridge the gripped surface due to excessive number of strands in the grip or tie.

All pin insulator ties shall be suitable for use on the ACSR conductors “DOG”100 mm2;and “RABBIT” 50 mm2;

3. **Pin Insulator Top Tie**

The top tie shall be designed for use with C-Neck Pin insulators specified in SPECIFICATION: SP3.1.1 (IS: 731-971) and ACSR bare conductors shown in Table 1. However, details of neck diameter and other details of the pin insulator shall be provided before manufacturing of ties.

The tie shall be manufactured of aluminum-clad steel wire. It shall be furnished with a semi conductive-rubber tie pad so as to protect insulator against abrasion. The top tie shall be right-hand lay. Applied length of tie shall not be less than 800 mm.

The tie shall be color-coded for conductor size and insulator head-style. The tie shall have an, identification tag attached showing manufacturer's catalog number and applicable conductor identification.

4. **Double-Support Top Tie**

The double-support top tie shall be designed for use with C-Neck Pin insulators specified in SPECIFICATION: SP3.1.1 (IS: 731-971) and ACSR bare conductors shown in Table 1. However, details of neck diameter and other details of the pin insulator shall be provided before manufacturing of ties.

The tie shall be manufactured of aluminum-clad steel wire. It shall be furnished with a semi conductive-rubber tie pad so as to protect insulator against abrasion. The top tie shall be right-hand lay. Applied length of tie shall not be less than 800 mm.

The tie shall be color-coded for conductor size and insulator head-style. The tie shall have an identification tag attached showing manufacturer's catalog number and applicable conductor identification.

5. **Pin Insulator Side Tie**

The side tie shall be designed for use with C-Neck Pin insulators specified in SPECIFICATION: SP3.1.1 (IS: 731-971) and ACSR bare conductors shown in Table 1. However, details of neck diameter and other details of the pin insulator shall be provided before manufacturing of ties.

The tie shall be manufactured of aluminum-clad steel wire. It shall be furnished with a semi conductive-rubber tie pad so as to protect insulator against abrasion. The top tie shall be right-hand lay. Applied length of tie shall not be less than 800 mm.

The side tie shall be color-coded for conductor size and insulator head-style. The side tie shall have an identification tag attached showing manufacturer's catalog number and applicable conductor identification.

6. **Double Side Tie**

The double side tie shall be designed for use with C-Neck Pin insulators specified in SPECIFICATION: SP3.1.1 (IS: 731-971) and ACSR bare conductors shown in Table 1. However, details of neck diameter and other details of the pin insulator shall be provided before manufacturing of ties.

The tie shall be manufactured of aluminium-clad steel wire. It shall be furnished with a semi conductive-rubber tie pad so as to protect insulator against abrasion. The top tie shall be right-hand lay. Applied length of tie shall not be less than 800 mm.
The double side tie shall be color-coded for insulator neck size and crossover point and for insulator identification. The double side tie shall have an identification tag attached showing manufacturer's catalogue number and applicable conductor identification.

7. **Steel Wire Strand Grip for Stay Set**

The steel wire strand grip shall be designed for use with thimble eye or double eye stay rod and tightner fabricated in accordance SPECIFICATION: SP3.2.1, stay wire fabricated in accordance with SPECIFICATION: SP3.2.2 (B.S. 183 1972/(1983)) and stay insulator fabricated in accordance with SPECIFICATION: SP3.1.1 (IS:5300-1969).
The steel wire strand grip shall be furnished for strand size and grade in accordance with Table 2.
The steel wire strand grip shall be manufactured of a galvanized steel wire in cabled loop form with long and short legs. The grip shall have a left-hand lay. Galvanizing shall be equivalent to Class C zinc coating per ASTM A-475.
The steel wire strand grip shall be color-coded for strand size and length and shall have one (1) or two (2) crossover marks for different diameter fittings. An identification tag shall be attached showing the manufacturer's catalogue number and applicable strand size.

8. Tests

The performs shall undergo type and routine tests in accordance with the relevant governing standard.

9**. Quality Assurance Program**

Along with the Bid the Bidder shall furnish quality assurance program of the manufacturer which includes the Quality System and the Quality Plans, which shall include, among others, information to meet the following requirement, failing which the Bid shall be liable for rejection.

i. The structure of the organization;
ii. The duties and responsibilities assigned to staff ensuring quality of works;
iii. The system for purchasing, taking delivery and verification of materials;
iv. The system for ensuring quality of workmanship;
v. The quality assurance arrangement shall conform to relevant requirements of ISO9000;
vi. Statement giving list of important raw materials, names of manufacturer for the raw materials, list of standards according to which the raw materials are tested, list of test normally carried out on raw materials;
vii. List of manufacturing facilities available;
viii. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections;
ix. List of testing equipment available with the manufacturer for final testing of equipment specified and the test plant limitation, if any, vis-à-vis the type, special, acceptance and routine tests specified in the relevant standards.

10. **Bid Documentation**

The Bidder shall provide with the Bid two (2) clear copies of the governing standards for fabrication and testing of preformed wire products and two (2) clear copies of all other relevant standards referenced therein.
The Bidder shall provide certified type test results of preformed wire products as required by governing standards.
The Bidder shall provide complete description, and catalogue of preformed wire products.
A clause-by-clause commentary on specification, specifying compliance and deviations, if any.
All data, drawings, catalogues and other technical documents shall be bound separately from the Bid documents.

TABLE 1

INSULATOR TIES

Tie Application	***Identification Tag and Color Code***					
	100 sq. mm. "Dog"		50 sq. mm. "Rabbit"		30 sq. mm. "Weasel"	
Top Tie	TT-1	Red	TT-2	Yellow	TT-3	Blue
Double Support Top Tie	DTT-1	Red	DTT-2	Yellow	DTT-3	Blue
Side Tie	ST-1	Green	ST-2	Black	ST-3	Pink
Double Side Tie	DST-1	Green	DST-2	Black	DST-3	Pink

Note: All designations shown are used for product identification for the purpose of this IFB.

TABLE 2

STEEL WIRE STRANDED GRIPS

Tie Application for Strand Size	*Identification Tag and Color Code*	
7/8 SWG	*GS-1*	*Red*
7/12 SWG	GS-2	Blue

Note: All designations shown are used for product identification for the purpose of this IFB.

GUARANTEED TECHNICAL PARTICULARS

(To be completed by the Bidder/Manufacturer)

Item: Preformed Wire Products

S.N.	Description	Unit	NEA Requirement	To be filled by Bidder
1	Manufacturer			
2	Country of Origin			
3	Years of Manufacturing Experience			
4	Model No.			
5	Governing Standards			
6	**Pin Insualtor Tie**			
6.1	Material Description furnished?	yes/no	yes	
6.2	Aluminum clad steel wire			
6.3	Bidder Certitifies that all items offered are suitable for use with ACSR "DOG" and "RABBIT" conductors?	yes/no	yes	
6.4	Bidder Certitifies that all items offered are suitable for use with insulators specified in specifications?	yes/no	yes	
6.5	Holding Rating of Top tie for "DOG"	kg		
6.6	Holding Rating of Double support Top tie for "DOG"	kg		
6.7	Holding Rating of Side tie for "DOG"	kg		
6.8	Holding Rating of Double support Side tie for "DOG"	kg		
6.9	Holding Rating of Top tie for "RABBIT"	kg		
6.10	Holding Rating of Double support Top tie for "RABBIT"	kg		
6.11	Holding Rating of Side tie for "RABBIT"	kg		
6.12	Holding Rating of Double support Side tie for "RABBIT""	kg		
7	**Steel Wire Strand Grip**			
7.1	Material Description furnished?	yes/no	yes	
7.2	Bidder Certitifies that steel strand grip offered is suitable for use with insulator; stay set and stay wire specified in specifications?	yes/no	yes	
7.3	Holding Rating of Grip for 7/8 SWG	kg		
7.4	Holding Rating of Grip for 7/8 SWG	kg		
8	Delivery of equipment following award of contract and approval of drawing	months		
9	ISO 9001 holder (including design)	yes/no	yes	
9.1	ISO 9001 certificate submitted	yes/no	yes	
10	Type test certificate submitted	yes/no	yes	
10.1	Submitted for the required ratings	yes/no		
10.2	Type test certified by			

S.N.	Description	Unit	NEA Requirement	To be filled by Bidder
11	User's certificate submitted	yes/no	yes	
12	Has exported to third country	yes/no	yes	
13	Copies of relevant standards attached	yes/no	yes	
14	Outline Drawings and associated GA attached	yes/no	yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date……
Seal of Bidder/Manufacturer ……

Stay Sets

1. Scope

This Specification covers the fabrication and supply of adjustable threaded, galvanized, ferrous, stay sets and nuts for use in overhead line construction.

2. Description

2.1 The stay set shall consist of mild steel; galvanized stay rod; stay tightener or adjustable head complete with stay plate a thimble of suitable dimensions

2.2 The stay rod shall be fabricated of mild steel of minimum tensile strength of 4200 kg/sq.cm. The other technical features and dimensions are given in table attached herewith.

2.3 The stay tightener shall be made of mild steel of minimum ultimate tensile strength of 42,000kg/sq.cm. The thimbles shall be made of 1.219mm (18 SWG) GI sheet, and shall be suitable for terminating steel stay wire with a preformed grip.

2.4 The stay plate shall be square type MS plate of dimensions as mentioned in Table herewith. The plate shall have a matching hole at the center to fit the end of the stay rod.

3. Fabrication

3.1 The stay rod and nut shall be fabricated to the shape and dimensions shown in table attached herewith.

3.2 The thread form at the threaded end of the rod, and that of the accompanying nut, shall be optional with the supplier. However, it shall be the responsibility of the Supplier to supply the stay rod with a thread form that shall sustain the rated loads specified in table without creep or stripping over the full life of the rod material at specified diameter.

3.3 After fabrication, the stay rod and nut shall be hot-dip zinc galvanized in accordance with IS 2629-1985, latest edition, or to an equivalent hot-dip galvanizing standard which produces equal or superior result.

3.4 After galvanizing, the nut and rod threading shall be such that the nut may be run the full length of the thread without the use of tools.

4. Tests

4.1 Apart from the tests indicated in the relevant referenced standard of steel , the stay set shall undergo following tests:

-Visual Inspection.

-Verification of dimensioned.

–Tensile strength: The stay set assemblies shall withstand a minimum tensile loads specified in Table 1.

-Bend test: The stay rod shall be bend-tested over a mandrel of 19 mm millimeter through an angle of 90 degrees at any point in the un-threaded section of the rod without fracture of the steel. Temperature of the test shall be 68 degrees Fahrenheit (22.5 deg Celsius).

5. Bid Documentation

5.1 The Bidder shall furnish with the Bid a complete description of the stay sets proposed to be supplied including, but not limited to, steel classification of base metal, detailed drawings showing shape, dimensions, and threading certified type test results as required by paragraph 4 herein, the identity of the proposed manufacturer, and manufacturers catalogue number, plus catalogue cuts. The technical data furnished shall be bound separately from the Bid Document.

Table 1 : Ratings and Features of Stay Sets

S.N.	Description	Unit	Values	
			Stay Sets for 33 kV line	Stay Sets for 11 kV and 0.4 kV line
1	Length of stay rod	m	2.44	1.8
2	Diameter of stay rod	mm	19	16
3	Ultimate tensile strength of stay rod and turn-buckle	kg/cm^2	4200	4200
4	Minimum breaking load	kg	10,454	6,433
5	Length of threaded portion	mm	300	300

S.N.	Description	Unit	Values	
			Stay Sets for 33 kV line	Stay Sets for 11 kV and 0.4 kV line
6	Thimble shape		Suitable for 7/8 mm stay wire	Suitable for 7/12 mm stay wire
7	Thimble section		18 SWG min.	18 SWG min.
8	Stay plate section	mmxmmxmm	600x600x6	300x300x6
9	Eyebolt length	mm	300	300
10	Eyebolt diameter	mm	16	16

GUARANTEED TECHNICAL PARTICULARS

(To be completed by Bidder/Manufacturer)

Item: Stay set

			For 33 kV Line		For 11 kV and 0.4 kV Line	
S.N.	Description	Unit	NEA Requirement	To be filled by Bidder/Manufacturer	NEA Requirement	To be filled by Bidder/Manufacturer
1	Manufacturer					
	Country of Origin					
	Years of Manufacturing Experience					
	Model No.					
3	Governing Standards					
6	Marking as per specifications	Yes/No	Yes		Yes	
7	Length of stay rod	m	2.44		1.8	
8	Diameter of stay rod	mm	19		16	
9	Ultimate tensile strength of stay rod and turn-buckle	kg/cm^2	4200		4200	
10	Minimum breaking load	kg	10,454		6,433	
11	Length of threaded portion	mm	300		300	
12	Thimble shape		Suitable for 7/8 mm stay wire		Suitable for 7/12 mm stay wire	
13	Thimble section		18 SWG min.		18 SWG min.	
14	Stay plate section	mm	600x600x6		300x300x6	
15	Eyebolt length	mm	300		300	
16	Eyebolt diameter	mm	16		16	
17	Delivery of equipment following award of contract and approval of drawing	months				
18	ISO 9001 holder (including design)	yes/no	yes			
18.1	ISO 9001 certificate	yes/no	yes			

			For 33 kV Line		For 11 kV and 0.4 kV Line	
S.N.	Description	Unit	NEA Requirement	To be filled by Bidder/Manufacturer	NEA Requirement	To be filled by Bidder/Manufacturer
	submitted					
19	User's certificate submitted	yes/no	yes			
20	Has exported to third country	yes/no				
21	Copies of relevant standards attached	yes/no	yes			
22	Outline Drawings and associated GA attached	yes/no	yes			

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer ……

Stay Wire

1. Scope

This Specification covers the fabrication and supply of zinc-coated steel wire for use in overhead power line as stay wire ropes for line supports (poles).

2. Description of Strands

The steel strand shall be fabricated in accordance with B.S. 183 1972/ (1983) or an equivalent national or international standard. The wires shall be 45-ton quality fully galvanized by hot dip process to British Standards or equivalent. The steel wire strand shall have a left-hand lay. The steel wires shall have no joint throughout the whole length. Strands shall be uniform and shall have no defects such as cracks, dust encapsulation or crevices. Further details are given in Table herein.

3. Packing

The steel wire strand shall be furnished in reels holding approximately 300m (1000ft). Each reel shall have a weather-resistant tag securely attached showing the length, nominal diameter, number of individual wires, grade of the strand, and the class of zinc coating.

4. Bid Documentation

4.1 The Bidder shall furnish the following technical data with the Bid:

a) If the material to be offered is to be manufactured in accordance with the specified B.S. standard, full technical data for the material and the identification of the manufacturer.

b) If the material offered to be manufactured in accordance with an equivalent standard, two (2) clear copies of that standard shall be furnished in addition to the data required in

(a) above.

All technical data furnished shall be bound separately from the Bids.

5. Tests

The testing of individual wires and complete conductor shall be in accordance with the nominated standards.

Table: Ratings and Features of stay wire

S.N.	Description	Unit	Values	
			Stay Wire for 33 kV Line	Stay Wire for 11 kV and 0.4 kV Line

S.N.	Description	Unit	Values	
1	Steel Wire Size	(Nos of wire/SWG)	7/8	7/12
2	No. of Wire	Nos	7	7
3	Diameter of Each wire	mm	4	2.6
4	Strand Diameter (Overall)	mm	12	7.8
5	Overall Cross Sectional Area	mm^2	88	37.15
6	Steel Quality		Gr.700	Gr.700
7	Minimum Tensile Strength of Steel	N/mm^2	700	700
8	Ultimate Tensile Strength	N/mm^2	700	700
9	Min. Breaking load of single wire	kN	8.8	3.71
10	Min. Breaking load of strand	kN	61.6	26
11	Approximate Weight	kg/km	720	300
12	Length of Wire in each reel	m	300	300
13	Left hand Lay	Yes/No	Yes	Yes
14	Minimum Thickness of Zinc Coating	µm	70	70

GUARANTEED TECHNICAL PARTICULARS

(To be completed by Bidder/Manufacturer)

Item: Stay Wire

			For 33 kV Line		For 11 kV and 0.4 kV Line	
S.N.	**Description**	**Unit**	**NEA Requirement**	**To be filled by Bidder/Manufacturer**	**NEA Requirement**	**To be filled by Bidder/Manufacturer**
1	Manufacturer					
	Country of Origin					
	Years of Manufacturing Experience					
2	Applicable Standard		B.S. 183		B.S. 183	
3	Governing Standard for galvanization		B.S. 443		B.S. 443	
4	Steel Wire Size	(Nos of wire/SWG)	7/8		7/12	
5	No. of Wire	Nos	7		7	
6	Diameter of Each wire	mm	4		2.6	
7	Strand Diameter (Overall)	mm	12		7.8	
8	Overall Cross Sectional Area	mm^2	88		37.15	
9	Steel Quality		Gr.700		Gr.700	
10	Minimum Tensile Strength of Steel	N/mm^2	700		700	
11	Ultimate Tensile Strength	N/mm^2	700		700	
12	Min. Breaking load of single wire	kN	8.8		3.71	
13	Min. Breaking load of strand	kN	61.6		26	
14	Approximate Weight	kg/km	720		300	
15	Length of Wire in each	m	300		300	

			For 33 kV Line		For 11 kV and 0.4 kV Line	
S.N.	**Description**	**Unit**	**NEA Requirement**	**To be filled by Bidder/Manufacturer**	**NEA Requirement**	**To be filled by Bidder/Manufacturer**
	reel					
16	Left hand Lay	Yes/No	Yes		Yes	
17	Minimum Weight of Zinc Coating	µm	70		70	
18	Delivery of equipment following award of contract and approval of drawing	months				
19	ISO 9001 holder (including design)	yes/no				
19.1	ISO 9001 certificate submitted	yes/no				
20	Type test certificate submitted	yes/no				
21.1	Submitted for the required ratings	yes/no				
21.2	Type test certified by					
23	User's certificate submitted	yes/no				
24	Has exported to third country	yes/no				
25	Copies of relevant standards attached	yes/no				
26	Outline Drawings and associated GA attached	yes/no				

Signed by……..
Designation……..

As Representative for……..
Place……
Date……
Seal of Bidder/Manufacturer ……

11 kV Air Break Switch

1 SCOPE

This specification provides for manufacture, testing at works and delivery for supply of 11 kV AB switches. The 11 kV AB switches shall conform to IS: 9920 (Part-I to IV)

2 AB SWITCHES

The 11KV Air Break Switches are required with two poles in each phase. The AB Switches shall be supplied complete with phase coupling shaft, operating rod and operating handle. It shall be manually gang operated and vertically break and horizontal mounting type.

The AB Switch shall be designed for a normal current rating of 400 Amps and for continuous service at the system voltage specified as under: 11 KV AB Switch: 11KV + 10% continuous 50 C/s solidly grounded earthed neutral system. The length of break in the air shall not be less than 400 mm for 11KV AB Switches.

The 11KV AB Switches are required with post insulators. The AB switches should be suitable for mounting on the structure. The mounting structure will be arranged by the purchaser separately. However, the AB Switches shall be supplied with base channel for mounting on the structure which will be provided by the purchaser. The phase to phase spacing shall be 750mm in case of 11KV AB Switches.

3 POST INSULATORS

The post insulators should conform to the latest applicable Indian standards IS: 2544. Creepage distance should be adequate for highly polluted outdoor atmosphere in open atmosphere. The porcelain used for manufacture of AB Switches should be homogeneous and free from flaws or imperfections that might affect the mechanical dielectric quality. They shall be thoroughly vitrified, tough and impervious to moisture. The glazing of the porcelain shall be of uniform brown in color, free from blisters, burns and other similar defects. Insulators of the same rating and type shall be interchangeable. The porcelain and metal parts shall be assembled in such a manner that any thermal expansion differential between the metal and porcelain parts through the range of temperature variation shall not loose the parts or create undue internal stresses which may affect the electrical or mechanical strength. Cap and base of the insulators shall be interchangeable with each other. The cap and base shall be properly cemented with insulators to give perfect grip. Excess cementing must be avoided.

The bidder shall in variably enclose with the offer, the type test certificate and other relevant technical guaranteed particulars of insulators offered by them. Please note that AB Switches without type test certificates will not be accepted.

Each 11kV Post Insulators should have technical particulars as detailed below:

S.N.	Particular	Value
1	Nominal system voltage KV (rms)	11
2	Highest system voltage KV (rms.)	12
3	Dry Power Frequency one minute withstand voltage (rms) in kV	35
4	Wet Power frequency one minute withstand voltage (rms) in kV	35
5	Power Frequency puncture KV (rms) voltage	1.3 times the actual dry flashover voltage
6	Impulse withstand voltage KV (Peak)	75
7	Visible discharge voltage KV (rms)	9
8	Creepage distance in mm (minimum)	320

4 The rated insulation level of the AB Switches shall not be lower than the values specified below:

S.N.	Standard declared Voltage	Rated voltage of the AB switch	Standard impulse withstand voltage (positive & negative polarity Isolating distance		One Minute power frequency withstand voltage KV (rms)	
			Across the Isolating distance	To earth & between poles	Across the Isolating distance	To earth & between poles
1	11KV	12kV	85kV	75kV	32kV	28 kV

5 TEMPERATURE RISE:

The maximum temperature attained by any part of the equipment when in service at site under continuous full load conditions and exposed to the direct rays of Sun shall not exceed 45 degree above ambient.

6 MAIN CONTACTS:

AB Switches shall have heavy duty self-aligning type contacts made of hard drawn electrolytic copper/brass. The various parts should be accordingly finished to ensure inter changeability of similar components. The moving contacts of the switch shall be made from hard drawn electrolytic copper brass. This contact shall have dimensions as per drawing attached so as to withstand safely the highest short-circuit currents and over voltage that may be encountered during service. The surface of the contact shall be rounded smooth and silver-plated. In nut shell the male and female contact assemblies shall ensure.

a. Electro-dynamic withstands ability during short circuits without any risk of repulsion of contacts.

b. Thermal withstands ability during short circuits.

c. Constant contact pressure even when the lower parts of the insulator stacks are subjected to tensile stresses due to linear expansion of connected bus bar of flexible conductors either because of temperature variations or strong winds. Wiping action during closing and opening.

d. Fault alignment assuring closing of the switch without minute adjustments

7 CONNECTORS:

The connectors shall be made of hard drawn electrolytic copper or brass suitable for DOG/RABBIT ACSR conductor for both 11KV AB Switches. The connector should be 4 -bolt type.

8 OPERATING MECHANISM:

All AB Switches shall have separate independent manual operation. They should be provided with ON/OFF indicators and padlocking arrangements for locking in both the end positions to avoid unintentional operation. The isolating distances should also be visible for the AB Switches.

The AB Switch will be supplied with following accessories:

S.N.	Item	Size of 11 kV AB Switch
1	Operating Rod (GI dia)	Length 5.50 meter, dia 25 mm
2	Phase coupling square rod (GI)	Length 1800 mm, Size 25x25 mm
3	Hot dip galvanized Operating handle (GI)	1 No.

The AB Switches shall be capable to resist any chance of opening out when in closed position. The operating mechanism should be of robust constructions, easy to operate by single person and to be located conveniently for local operation in the switchyard. The GI pipe shall conform to ISS: 1239-68 and the vertical down rod should be provided with adequate joint in the mid section to avoid bending or buckling. Additional leverage should be provided to maintain mechanical force with minimum efforts. All iron parts should be hot dip galvanized. All brass parts should be silver Plated and all nuts and bolts should be hot dip galvanized

9 ARCING HORNS:

It shall be simple and replaceable type. They should be capable of interrupting line charging current. They shall be of first make and after break type.

10 BUSH:

The design and construction of bush shall embody all the features required to withstand climatic conditions specified so as to ensure dependable and effective operations specified even after long periods of inaction of these Air Break Switches. They shall be made from highly polished Bronze metal with adequate provision for periodic lubrication through nipples and vent.

11 DESIGN, MATERIALS AND WORKMANSHIP:

The successful tenderers shall assume full responsibility for co-ordination and adequate design. All materials used in the construction of the equipment shall be of the appropriate class, well finished and of approved design and material. All similar parts should be accurately finished and interchangeable.

Special attention shall be paid to tropical treatment to all the equipment, as it will be subjected during service to extremely severe exposure to atmospheric moisture and to long period of high ambient temperature. All current carrying parts shall be of non- ferrous metal or alloys and shall be designed to limit sharp points/edges and similar sharp faces. The firm should submit the following type test certificate along with the certified copy of the drawing. The type test should not be older than 5 years from the date of opening of tender.

1. Test to prove capability of rated peak short circuit current and the rated short time current. The rated short time current should correspond to minimum of 10kA and the peak short circuit current should correspond to minimum of 25kA.
2. Lightning impulse voltage test with positive & negative polarity.
3. Power Frequency voltage dry test and wet test.
4. Temperature rise test.
5. Mill volt drop tests.

12. Dimension of 11 kV AB Switches in (Max.) Tolerance 5%.

S.N.	Particular	11KV AB Switch
1	MS Channel	450x75x40
2	Creepage distance of Post Insulator	320mm (Min)
3	Highest of Port shell	254 mm
4	Fixed contact assembly	
	i) Base	165x36x8
	ii) Contact	70x30x6
	iii) GI cover	110X44
5	Spring	6nos
6	Moving contract assemble	
a	Base Assembly	135x25x8

b	Moving	180x25x9
c	Bush	Bronze Metal
d	Thickness of Grooves	7

13 CONNECTORS:

The bidder should provide AB Switches with terminal connectors, set of insulators, mechanical inter works and arcing horns sets. The base channel for the mounting of AB Switches shall also be included in the scope of AB Switches. The operating mechanisms together with down pipe operating handle etc. are also included in the scope of supply.

14. ROUTINE TEST CERTIFICATE: -

The Routine test certificate should invariably be submitted in duplicate of each lot offered for inspection as per IS: 9920 (part-I to IV). The offers received without Routine test certificate shall not be entertained.

15 ACCEPTANCE TEST: -

At the time of inspection following test shall be carried out: -

a. Physical verification and measurement of dimension.

b. Power frequency high voltage test.

c. Temperature rise test.

d. Mechanical endurance test / operation test.

e. Milli volt drop test.

f. Galvanising test

16 NAME PLATE: -

The name plate in the following design shall be fixed on each AB Switch.

a. Name of supplier :

b. Name of purchaser :

c. Rating :

d. Serial number of unit :

The size of name plate shall be 2" x 1" for 11 KV AB Switch.

GUARANTEED TECHNICAL PARTICULARS

(To be completed by Bidder/Manufacturer)

Item: 11 kV Air Break Switch

SNo	Particular	NEA Requirement	To be filled by Bidder/Manufacturer
1	Manufacturer		
2	Country of Origin		
3	Years of Manufacturing Experience		
4	Type		
5	Applicable Standard		
6	Maximum permission continuous service voltage (KV)	12 kV	
7	Length of the Break/Phase (Min.)	400 mm	
8	Phase to Phase Spacing	750 mm	
9	Power Frequency withstand test voltage for		

SNo	Particular	NEA Requirement	To be filled by Bidder/Manufacturer
	completely assembled switches		
9.1	Against ground		
9.1.1	Dry KV	28 kV	
9.1.2	Wet KV	28 kV	
9.2	Across open contact		
9.2.1	Dry KV	32 kV	
9.2.2	Wet KV	32 kV	
9.3	Between Phases		
9.3.1	Dry KV	28 kV	
9.3.2	Wet KV	28 kV	
10	Impulse withstand test voltage of completely assembled switch without arcing horns with 1.2/50 micro second impulse wave KV (Peak)	85 kV	
11	100% impulse flashover voltage of completely assembled switch with arcing horns with 1.2/50 micro second impulse wave KV (Peak)	85 kV	
12	Particulars of the main contacts i.e. fixed contacts and moving contacts		
12.1	Type	Spring loaded fixed & knife type moving contacts	
12.2	Material	Hard drawn electrolytic copper alloy	
12.3	Surface Treatment & Thickness of Silver Coating	Silver plated of thickness of 5 micron	
12.4	Contact Pressure	25 kg	
13	Continuous Current Rating, Amps	400 A	
14	Short Time Current Rating KA (rms) min. for1 sec	16 kA	
15	Rated Peak Short Circuit Current (KA Peak)	25 kA	
16	No. of operations which the switch can withstand without deterioration of contacts	2000	
17	Type of Mounting	Horizontal up right mounting	
18	Type & Material used in connector	Brass/ Bronze strips	
19	Location and Type of Bushing	Bush bearing at rotating insulator	
20	Particulars of Post Insulators		
20.1	Make	To be indicated	
20.2	Type	11 KV Post insulator type	
20.3	Strength	10 kN	
20.4	Weight	5 kg /unit	
20.5	No. of units per stack	one	
20.6	Height of stack	254 mm	
20.7	Creepage distance mm	320 mm	
20.8	One Minute Power Frequency Dry withstand voltage KV (rms)	65 kV	
20.9	Power Frequency Flashover voltage KV (rms)	70 kV	
20.10	Impulse flashover voltage KV (Peak)	85 kV	
20.11	Impulse withstand voltage KV (Peak)	80 kV (peak)	
20.12	Puncture voltage (KV)	105 kV	
21	Delivery of equipment following award of contract and approval of drawing	months	
22.1	ISO 9001 holder (including design)	yes/no	
22.3	ISO 9001 certificate submitted	yes/no	
23.1	Type test certificate submitted	yes/no	
23.2	Submitted for the required ratings	yes/no	
23.3	Type test certified by		
24	User's certificate submitted	yes/no	
25	Has exported to third country	yes/no	
26	Copies of relevant standards attached	yes/no	
27	Outline Drawings and associated GA attached	yes/no	

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer ……

33 kV Air Break Switch

1 This specification covers manufacturing testing and supply of 33 KV, 50HZ Air Break Switches for outdoor installation in horizontal configuration. The switches are suitable for operation under off load conditions only and are intended for use on tapping sectionalizing points of 33 KV lines.

2. Applicable Standards:

The AB Switch Set shall conform to the following standards: -

a) IS-9920 (Part-I to V)

b) IS-2544/1973 (for porcelain post insulators)

c) IS-2633, (for galvanization of ferrous parts.) or its latest amendments if any.

3. Description of the materials: -

The 33 KV A.B. Switch sets shall confirm to the following parameters: -

a) Number of poles : 3

b) Number of Post insulator per pole: 4 nos 22/24 KV post insulator.

c) Nominal system voltage: 33kV

d) Highest system voltage : 36KV

e) Rated frequency :50Hz

f) Rated nominal current : 400 A

The post insulators used in the A.B. Switches shall have the following ratings:

a) Power frequency withstand voltage (dry) : 95 KV (RMS)

b) Power frequency withstand voltage(wet) : 75 KV (RMS)

c) Impulse withstand voltage(dry): 170 KV

d) Power frequency puncture withstand 1.3 times of actual dry flash over voltage.

4. Insulator make:

22/24 KV post insulators complete with post and cap duly cemented to be used in the AB Switch Set conforming to IS-2544/1973. The bidder shall furnish the type test certificate of the post insulators from their manufacturer for reference and scrutiny. The bidder shall mention make, type of insulation materials, metal fittings, Creepage distance, protected Creepage distance, tensile Strength, compressing strength, torsion strength and cantilever strength.

5. Other technical details: -

5.1 General:

The 33 KV A.B. Switch Set shall be the gang operated rotating single air break type having 4 no's of post insulators per phase. The operating mechanism shall be suitable for manual operation from the ground level and shall be so designed that all the three phases shall open or close simultaneously. The Switches shall be robust in construction, easy in operation and shall be protected against over travel or staining that might adversely affect any of its parts. The required base M.S. Channel (hot dip galvanized) phase coupling rod, operation rod with intermediate guide braided with flexible electrolytic copper, tail piece of required current carrying capacity and operation mechanism with 'ON' & 'OFF 'positions shall be provided. The operation rod shall be medium gage of 32 mm diameter nominal bore G.I. pipe single length 6 meters. The phase coupling rod for gang operation shall be of medium gauge 25 mm dia. nominal bore G.I pipe. The Rating of post insulators shall be provide with suitable bearing mounted on a base channel with 8mm dia thrust collar and 6mm split pin made out of stainless steel. The operating down rod shall be coupled to the spindle (minimum) dia - 32mm. for gang operation through another suitable

bearing by two numbers of 10mm dia stainless steel bolts with double nuts. All the bearings shall be provided with grease nipple. All metal (ferrous) parts shall be galvanized. The pipe shall be galvanized in accordance with relevant IS standard. The post insulators should be fixed with the base channel using Galvanized Nuts and Bolts.

5.2 Mounting:

The A.B. Switches shall be suitable for horizontal mounting in double pole substation structures. MS Galvanized base Channel & base support channel should be of min. size 75x40x6 mm.

5.3. Switching Blades:

It shall be made out of electrolytic copper with silver plated. The approximate size shall be 250mmX50X8 mm. The Switch shall have such a spring mechanism so as to ensure that the speed of the opening of contact is independent of speed of manual operation.

5.4. Fixed Contacts:

The fixed Jaw type female contacts shall be made of electrolytic copper (minimum 95% copper composition) of size (80X50X8)mm duly silver coated. Each contact is riveted with 3 No.s copper rivets with bunch of copper foils of thickness of 0.25/0.5 mm of each foil and the thickness of copper foil per jaw is 6mm and controlled by stainless steel high pressure spring housed in robust G.I. Cover. It is essential that provision shall be made in fixed female contacts to take the shock arising from the closing of move contract blade without the same being transmitted to the post insulator. The arrangement made in this regard shall be specifically shown in the drawing.

5.5 Arcing Horn:

As the switches are generally meant for isolating transmission line and power transformers, suitable arcing horns shall be provided for breaking the charging current. The horn shall be made of 10mm dia G.I. Rod with spring assisted operation.

5.6 Terminal Connectors:

Terminal connectors shall be robust in design. The size of fixed connector shall be (80 X 50 X 8 mm) and size of movable connector shall be of (80 X 50) X (80 X 50) X 8 mm of copper casting with uniform machine finishing duly silver plated made out of minimum 95% copper composition with 2 nos. 12mm dia holes provided with suitable brass bolts and double nuts, flat washers & 2nos. bimetallic solder less sockets suitable upto 80 mm^2 /100 mm^2 conductor.

5.7 Spacing:

The phase clearance i.e. center-to-center distance between the insulators of adjacent phases in the assembled position of the isolator shall be 1200 mm. The center-to- center distance between the insulators of adjacent poles of the same phase in the assembled position of the switch shall be 400 mm.

5.8 Sample, Drawing & Literatures:

Sample of each items 33 KV 400 amps. A.B. Switch shall be furnished and three copies of drawings item similar to the sample shall be furnished along with the tender.

6. The details of construction and materials of different parts of the A.B. Switch shall clearly be indicate in the tender and illustrative pamphlet / literature for the same shall be submitted along with the tender.

7.0 TEST & TEST CERTIFICATE:

7.1 Type Test:

Certificate for the following type tests conducted (within five years proceeding to the date of opening of the tender) on a prototype set of A.B. Switch shall have to be submitted along with offer.

- Dielectric Test (impulse and one minute were power frequency withstand voltage test.)
- Temperature rise test (for contracts and terminals)
- Shorts Time current and peak withstand current test.
- Mainly active load breaking capacity test.
- Transformer off-load breaking capacity test.
- Line charging breaking capacity test.
- Cable charging breaking test.
- Operation and mechanical endurance test.
- Mechanical strength test for post insulator, as per IS-2444/1937 shall be furnished.
- Test for galvanization of metal (ferrous) parts.

7.2 Routine /Acceptance Test:

The inspection may be carried out by the Purchaser at any stage of manufacture. The successful bidder shall grant free access to the Purchaser's representative at a reasonable time when the works is in progress. The following routine tests shall have to be conducted on each set and results are to be furnished for consideration of deputing inspecting officer for inspection and conduction testing of the materials at the works of the manufacturer. The supplier shall give fifteen days advance intimation to the Purchaser to enable him to depute his representative for witnessing the tests.

1) Power frequency voltage dry test.
2) Measurement of resistance of main circuit.
3) Tests to prove satisfactory operation.
4) Dimension Check
5) Galvanization test.
6) Operational test.

8 Completeness of Equipment:

All fittings, accessories of apparatus which may not have been specifically mentioned in this specification but which are usual or necessary in equipment of similar plat shall be deemed to be included in the specification and shall be supplied by the Tender without extra charge. All plant and equipment shall be completed in all details whether such details are mentioned in the specification or not.

GUARANTEED TECHNICAL PARTICULARS
(To be completed by Bidder/Manufacturer)

Item: 33 kV Air Break Switch

SN	Particular	NEA Requirement	To be filled by Bidder/Manufacturer
1	Manufacturer		
2	Country of Origin		
3	Years of Manufacturing Experience		
4	Type		
5	Applicable Standard		
6	Suitable for mounting	Horizontal only	

SN	Particular	NEA Requirement	To be filled by Bidder/Manufacturer
7	Type of switch	Rotating type	
8	No. of Post Insulators per 4nos. of 22KV/24 KV per phase		
8	**Post Insulator**		
8.1	Maker's Name & Country of Reputed make .		
8.2	Type of cementing	Original Cementing only.	
8.3	1 minute Power frequency withstand voltage (Dry)	95KV RMS	
8.4	1 minute Power frequency withstand voltage (Wet)	75KV RMS	
8.5	Visible discharge voltage		
8.6	Dry flash over voltage	95 KV	
8.7	Power frequency puncture withstand voltage	1.3 times of actual dry flash over voltage	
8.8	Impulse withstand voltage (Switch in position)	170KV (Peak)	
8.9	Creepage distance	430mm (minimum). Actual creepage distance for which type test has been conducted is to be supplied	
9	**Impulse withstand voltage for positive & negative polarity**		
9.1	Across the isolating distance	195KV(Peak)	
9.2	To earth & between poles	170KV (Peak)	
10	**Rated one minute power frequency withstand voltage**		
10.1	Across the isolating distance	100KV(RMS)	
10.2	To earth & between poles	75KV RMS	
10.3	Rated normal current and rated frequency	400 Amps and 50HZ	
11	Rated short time current	16 kA(RMS)	
10	Rated peak withstand current	40 kA(RMS)	
11	Minimum clearance between adjacent phase		
11.1	Switch closed(center to center)	1200mm	
11.2	Switch opened (Center of post insulator to the edge of the blade)	640 mm	
12	Vertical clearance from top of insulator cap to mounting channel	508mm Min	
13	Galvanization		
13.1	a) Iron parts shall be hot dip Galvanized as per IS.2629		
13.2	b) The pipe shall be galvanized as per IS-4736		
14	Details of Phase:		
14.1	Coupling Rod	25mm nominal bore G.I. Pipe medium gauge.	
14.2	Operating Rod	32mm nominal bore G.I.Pipe medium gauge single length 6meters.	
14.3	Arching Horn	8 mm dia G.I.Rod with spring assisted operation	
14.4	Bearing System	One bearing shall be provided near the base channel to assist in operation.	
14.5	Force of fixed contact spring	50-75 lb	
14.6	Copper braided flexible tapes	320mm long flexible electrolytic copper tape or bradided chord with tin coated having minimum weight 450 gm/mtr and both ends shall be cripped with copper sockets through brass bolts and nuts with brass flat washers. Two no.s of suitable copper sockets shall be used at both ends.	

SN	Particular	NEA Requirement	To be filled by Bidder/Manufacturer
		The minimum no. of flexible wires should be 1536 of 36 SWG for each flexible chord	
14.7	Quick break device	Lever Mechanism	
14.8	Bearings	4 nos self-lubricating bearing is to be provided with grease nipple including 4th bearing being a thrust bearing arrangement.	
14.9	Locking Arrangement	Pad Lock and key arrangement at both "ON & OFF" position..	
14.9	Earth terminal	To be Provided at base channel .	
14.10	'T' connector	The 'T' connector provided on the channel having 'Moving Contact' shall be of G.I Nut & Bolt at the bottom end to facilitate replacement of this unit only during requirement and avoid entire change of the arm.	
14.11	I-Bolt	The 'I-Bolt" shall be longer with 75 mm thread	
15	Supporting Channel	75mmx40mm M.S.Channel. (Hot dip galvanized)	
16	Weight of each pole complete 50 Kg (Approximately)		
17	Delivery of equipment following award of contract and approval of drawing	months	
18.1	ISO 9001 holder (including design)	yes/no	
18.2	ISO 9001 certificate submitted	yes/no	
19.1	Type test certificate submitted	yes/no	
19.2	Submitted for the required ratings	yes/no	
19.3	Type test certified by		
20	User's certificate submitted	yes/no	
21	Has exported to third country	yes/no	
22	Copies of relevant standards attached	yes/no	
23	Outline Drawings and associated GA attached	yes/no	

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer ……

Power Fuse

1. General

This specification covers the design, manufacture, assembly, shop test, supply, delivery, installation works and field test of power fuse to be used with 33 kV underground line.

Manufacturer of fuse shall be holder of valid ISO 9001 Certificate (including design).

2. Design Requirements

Power fuse shall be in accordance with IEC standards. The fuse set shall be of drop out type and fuse shall be contained inside fiberglass suitable for outdoor use in a tropical climate. Complete fuse mountings and holders shall be furnished as specified in Technical Particulars enclosed. Refill units are to be furnished separately.

All terminals shall be of high conductivity copper alloy and all terminals for aluminum shall be plated with hot-flowed electro-tin or cadmium.

The insulated stick furnished for replacing the fuses shall be 6m (20 feet) and a combination type suitable for operating hook stick disconnectors. The stick shall be of fiberglass or plastic over a wood or plastic foam cane and have voltage withstand rating of 246 kV per meter.

3. Tests

In addition to the manufacturer's routine production tests, power fuse of each type and rating shall be subject to the tests in accordance with IEC standards.

4. Data

The contractor shall furnish complete data for applying and coordinating the fuses supplied. This data shall include log-log time-current curves of minimum and maximum clearing for each fuse size furnished.

5. TECHNICAL PARTICULARS OF POWER FUSE

1.	Type	Single pole, single throw, drop out, hook stick operated, outdoor type
2.	Application	Protection of 33kV Underground cable
3.	Quantity required	As per Price Schedule
4.	Voltage ratings	
	(a) Nominal voltage class	33kV
	(b) Rated maximum voltage	36kV
5.	Basic impulse level (BIL)	170kV
6.	Power frequency withstand voltage	70kV
7.	Current rating	100A
8.	Interrupting rating (Max. rms)	8kA (Symmetrical)
9.	Mounting position	Vertical (Pole Mounted)

GUARANTEED TECHNICAL PARTICULARS
(To be completed by Bidder/Manufacturer)

Item: 33kV Power Fuse

S. N.	Description	Unit	NEA requirement	To be filled by Bidder/Manufacturer
1	Manufacturer			
2	Country of Origin			
3	Year of manufacturing experience			
4	Model No.			
5	Applicable Standards		IEC 60282-2	
6	Type		Single pole, single throw, drop out, hook stick operated, outdoor	

S. N.	Description	Unit	NEA requirement	To be filled by Bidder/Manufacturer
			type	
7	frequency	Hz	50	
8	Rated voltage			
8.1	Nominal	kV	33	
8.2	Maximum	kV	36	
9	Current Rating			
9.1	Continuous at 45 deg C ambient	A	400	
9.2	Short time for 3 sec at max kV	kA	25	
9.3	Peak short time current	kA		
10	Interrupting rating (Max. rms)	kA	8 (Symmetrical)	
11	Insulation level			
11.1	Impulse withstand voltage(peak)	kV	170	
11.2	Power frequency withstand voltage (1min, rms)	kV	75	
12	Fuse			
12.1	Fuse Rating	A		
12.2	Fuse Type			
13	Mounting Position		Vertical	
14	Number of Pole		3	
15.1	Type of Contact			
15.2	Materials of Contact Service			
16	Creepage Distance	mm		
17	Air Gap between pole of phase			
18	Clamp Type Terminals for Copper/Aluminum Cable (25-150 mm2 size)	yes/no	yes	
19	Steel mounting bracket provided	yes/no	yes	
20	Dimensions (LxWxH)	mm		
21	Total Weight of Unit	kg		
22	Weight of Isolator	kg		
23	ISO 9001 holder (including design)	yes/no	yes	
23.1	ISO 9001 certificate submitted	yes/no	yes	
24	Type test certificate submitted	yes/no	yes	
24.1	Submitted for the required ratings	yes/no		
24.2	Type test certified by			
25	User's certificate submitted	yes/no	yes	
26	Has exported to third country	yes/no	yes	
27	Copies of relevant standards attached	yes/no	yes	
28	Outline Drawings and associated GA attached	yes/no	yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date……
Seal of Bidder/Manufacturer ……

Surge Arrester

1. General

This specification covers the design, manufacture, factory test, delivery, field test and installation of surge/lightning arresters, complete with all accessories intended to be used with 33 kV Underground line.

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

2. Design Requirements

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.

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

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

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

3. Test

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

Type test certificates on similar equipment and routine test certificate carried out shall be furnished for approval of the Employer/Employer's Representative.

4. Drawings and Data

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

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

5. 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

6. TECHNICAL PARTICULARS OF 30kV LIGHTNING ARRESTER

1.	Type	Outdoor, Pole Mounted type
2.	Quantity required	As per Price Schedule
3.	Mounting	Pedestal/Cross-Arm Channel
4.	Rated frequency	50Hz
5.	System voltage	33kV
6.	Rated voltage	30kV
7.	Impulse withstand voltage (BIL)	170kV
8.	Power frequency withstand voltage	70kV
9.	Nominal discharge current	10kA

GUARANTEED TECHNICAL PARTICULARS
(To be completed by Bidder/Manufacturer)

Item: 30kV Lightning Arrester

S. N.	Description	Unit	NEA requirement	To be filled by Bidder/Manufacturer
1	Manufacturer			
2	Country of Origin			
3	Year of manufacturing experience			
4	Model No.			
5	Applicable Standard		IEC	
6	Type		Outdoor, Gapless, Zinc-oxide, porcelain housed	
7	Voltage rating of LA	kV	30	
8	Nominal Discharge Current	kA	10	
9	Surge counter with insulating base furnished	yes/no	yes	
10	Minimum power frequency spark over voltage	kV		
11	Maximum 1/50 impulse spark over voltage	kV		
12	Maximum front wave spark over voltage	kV		
13	Maximum switch surge spark over voltage	kV		
14	Number of section per pole			
15	Insulation level			
15.1	Impulse withstand voltage (peak)	kV	170	
15.2	Power frequency withstand voltage (1min rms)	kV	75	
16	Creepage distance	mm	265	
17	Earth terminal and accessories provided	yes/no	yes	
18	Surge counter	yes/no	yes	
19	ISO 9001 holder	yes/no	yes	
20.1	ISO 9001 certificate submitted	yes/no	yes	
21	Type test certificate submitted	yes/no	yes	
21.1	Submitted for the required ratings	yes/no		
21.2	Type test certified by			
22	User's certificate submitted	yes/no	yes	
23	Has exported to third country	yes/no	yes	
24	Copies of relevant standards attached	yes/no	yes	
25	Outline Drawings and associated GA attached	yes/no	yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer …….

Underground Cable

1.1 Scope

This specification covers the design, manufacture, factory test, supply, delivery, type test, construction, of single core, aluminum conductor, single core cross-linked polyethylene (XLPE) insulated Power Cables to be used for underground line at 33 kV and 11 kV Voltage level including all its accessories required.

The equipment and installation works specified in this Section shall conform to the latest edition of the appropriate IEC specifications and/or other recognized international standards

The XLPE power cable shall be manufactured and tested in accordance with IEC 60502-2 or the latest version thereof or other equivalent international standards that ensures at least a substantially equal quality to the standard mentioned above.

2. General Requirements

2.1 The cable shall be cross-linked polyethylene insulated, PVC separation sheathed, steel armored and PVC outer sheathed.

2.2 The conductor shall consist of compact round stranded aluminum wires. They shall comply with the latest IEC standard or any other national or international standards that ensure at least a substantially equal quality to the standard mentioned above will also be acceptable. The maximum conductor temperature shall be 90 deg. C.

2.3 Each conductor shall be wrapped with a layer of semi-conducting tape or free stripping extrusion as a conductor (strand) screen. The conductor shall be insulated by cross-linked polyethylene material (XLPE). The XLPE layer shall be surrounded by insulation screen of semiconducting tape or free stripping extrusion. Above the insulation screen a metallic screen of plain copper tape shall be provided. All three conductors shall be assembled together with fillers and bound with a tape, which shall be again warped in PVC inner covering.

2.4 The armor shall be of hard drawn round aluminum wires for mechanical protection of the cable. The size of armor shall be as specified in the relevant Standards.

2.5 The outer covering of the cable shall be black PVC suitable for the operating temperature of cable and shall meet the requirements of the IEC Standard or any other national or international standards.

2.6 The minimum thickness of insulation at any point shall not fall below the as guaranteed value. Negative tolerances are not allowed for the thickness of insulation.

2.7 The minimum thickness of separation sheath or outer sheath at any point shall not fall below the nominal value.

2.8 The supplied cable shall be longitudinal water tight. For this purpose, a layer of suitable water swellable absorbent tape shall be provided over insulation screen.

2.9 Rating and features of the cables to be furnished shall be as per the requirements.

2.10 The outer covering of the cable shall be embossed with the name/brand of the manufacturer, type designation, Voltage grade, cable size, year of manufacture, name of the Purchaser, type of insulation at the spacing of each 2 meters. Every meters of outer covering of the cable shall also be embossed with length of the cable.

3. Specific Requirements

3.1 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.

TABLE 1: Rating and Features

SN	Description	Requirements	
		33 kV Line	**11 kV Line**
1	Rated voltage, phase to phase (Uo)	33 kV	11 kV
2	Highest voltage of three-phase system (Um)	36 kV	12 kV
3	Rated lightning impulse withstand voltage	170 kVp	75 kVp
4	Rated power-frequency short duration withstand voltage for one minute	70 kV	28 kV
5	Insulation		
5.1	Material of Insulation	XLPE	XLPE
5.2	Thickness of Insulation (minimum)	8 mm	3.4 mm
6	Conductor		
6.1	Type of Conductor	EC grade aluminum	EC grade aluminum
6.2	Stranded Conductor	yes	yes
7	Number of Cores	Single	
8	Maximum Initial conductor Temperature during operation	< 90 deg. C	< 90 deg. C
9	Maximum Final Conductor Temperature during short circuit	< 250 deg. C	< 250 deg. C

4. TESTS

(a) Type Tests

The Type Test from the recognized laboratory shall be conducted.

(b) Routine Tests (Factory Acceptance Tests)

The following tests shall be carried out at the manufacturer's plant before shipment as far as applicable for each type of conductors and cables:

i) Appearance check
ii) Conductor resistance measurement
iii) Capacitance measurement
iv) Insulation resistance measurement
v) A.C. withstand voltage
vi) A.C. long duration withstand voltage
vii) Impulse withstand voltage
viii) A.C. long duration breakdown voltage
ix) Impulse break-down voltage
x) Dielectric loss tangent
xi) Temperature-voltage characteristic
xii) Dimension
- Conductor outermost diameter
- Insulation thickness
- Sheath thickness
- Over-sheath thickness
- Thickness of each tape
- Interval of tape lapping
- Total diameter

xiii) Bending withstand characteristic

xiv) Over-sheath, tensile strength

xv) - do. - , thermal aging

xvi) - do. - , oil-proof

xvii) - do. - , non-inflammability

xviii) - do. - , thermal deformation

xix) - do. - , hardness

5. **Packaging**

The conductor shall be supplied in non-returnable drums/reels. The drum/reel shall be made of steel suitably protected against corrosion. Protective external lagging of sufficient thickness shall be provided and fitted closely on the reels. Binder consisting of steel straps shall be provided over the external laggings. The drum shall be new and sufficiently rugged in construction to withstand ocean shipping, road transport, several loading and unloading, storage in tropics, hauling and field erection of cables without distortion or disintegration.
Each reel of conductor furnished shall contain only one (1) length of cable.

All reel shall be legibly marked in paint with the following information:

a) Voltage grade of Cable
b) Size of cable
c) Type of Conductor
d) Type of insulation
e) Length in meters
f) Net weight of cable

6. 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 power cables. The Bidder shall clearly describe the type and routine tests to be performed on cables.

(e) Drum length for each of cable.

Cable Termination and Joint Kits

1. **Scope:**

This specification covers the design, manufacture, factory test, supply and delivery of cable termination and joint kits for single core, aluminum conductor, XLPE insulated armored power cable used in underground 33 kV and 11 kV distribution system.

2. Description:

2.1 All high voltage terminations and jointing kits shall be standard quality type. They shall be factory engineered kits containing all the necessary components to reinstate the cable insulation, metallic shielding of each core, together with the reinstatement of the sheath, of the cable being terminated.

2.2 The heat shrinkable termination and joint kit shall be manufactured and tested in accordance latest version of IEC, or any other national or international standard that ensures at least a substantially equal quality to the standard mentioned above will also be acceptable.

2.3 The manufacturer of the termination and joint kit (Indoor, outdoor and straight- through) must have been accredited with ISO 9001 quality certification.

2.4 The entire termination and joint kit shall be environmentally sealed and capable of preventing the ingress of external moisture and contamination.

2.5 Kits shall contain sufficient cleaning solvents and cleaning clothes for the proper making of the joint or termination.

2.6 Voltage stress relief shall be provided and this may be inherent in the heat recoverable polymeric material.

2.7 The terminating or jointing materials shall not be subjected to storage limitations such as controlled temperature or humidity restrictions, nor have self-life limitations.

3. Other Requirements

3.1 The outdoor termination kits shall be suitable for terminating the cable at steel cross arm complete with brackets, terminals, saddles and all necessary materials for fixing the termination. The heat shrinkable termination kit to be supplied and installed under this scope of work shall be capable enough to cope with all the weather change. Terminations that do not require manually built stress relief cones or field pouring compound are preferred.

3.2. The straight through joint kit shall be suitable for jointing single core of cables. The termination kits shall include all necessary components to join two alike cables sections together directly buried. Kits that do not require manually built stress relief cones or field pouring of compound are preferred.

3.3 Each of the above terminations and joint kits shall be complete in every respect and include clear, detailed instructions in English illustrating steps by step procedure in preparing the cable and applying the termination compounds.

3.4 Cross bond or suitable design of earthing shall be employed so that shielding of both sides of each joint shall be connected to the shielding of the other phase, so as to suppress the induced voltage. Necessary materials for such appropriate earthing shall be provided by the Contractor.

3.5 The minimum creepage distance of outdoor terminal/sealing-ends shall be as required for heavily polluted atmospheres in line with the appropriate IEC Standard.

3.6 Terminating and jointing kit shall be in a separate package, a list of materials indicating quantities and weights and an instruction sheet shall be included in the package.

3.6 Accessories shall match the cable test ratings in all respects. The supplied termination and joint kits shall be of suitable for the cables mentioned in Price Schedule

4. Testing

The routine tests of the kits shall be done at manufacturer's plant in accordance with IEC or other equivalent national or international standards including following tests.

- Appearance Test
- Construction Test
- High Voltage Test

5. Bid Documentation

1. The Bidder shall provide with the Bid two (2) clear copies of the manufacturer governing Standard of the termination and joints and kits two (2) clear copies of all other relevant standards referenced herein.
2. The Bidder shall provide certified type test results of the termination and joint kits as required by governing standards.
3. The Bidder shall provide complete description, catalogue and drawings of the termination and joint kits.
4. A clause-by-clause commentary on specification, specifying compliance and deviation, if any.
5. All data, drawing, catalogue and other technical documents supplied shall be bound separately from the Bid Document.

GUARANTEED TECHNICAL PARTICULARS

(To be completed by the Bidder/Manufacturer)

Item: Power Cable (XLPE)

S.N.	Description	Unit	33 kV Line		11 kV Line	
			NEA Req.	To be Filled by Bidder/Manufacturer	NEA Req.	To be Filled by Bidder/Manufacturer
1	Manufacturer					
	Country of Origin					
	Years of Manufacturing Experience					
2	Applicable standard		IEC			
3	Cable Type Designation					
4	Rated Voltage	kV				
4.1	Maximum System Voltage	kV	36		12	
4,2	Rated Voltage between conductor and screen	kV				
4.3	Rated Voltage between two conductors	kV				
4.4	Power Frequency Withstand Voltage	kV	70		28	
4.5	Impulse Withstand Voltage (BIL)	kV	170		75	
5	Conductor					
5.1	Conductor Material		EC grade AL		EC grade AL	
5.2	Cross section of the Conductor	sq. mm.				
5.3	Is Conductor Stranded?	(Yes/No)	yes		yes	
5.4	Stranded Conductor					

	i) Number of strands in each core					
	ii) Size of strand	Sq. mm.				
	iii) Maximum DC Resistance at 20 deg. C	Ohm/km				
	iv) Class of Stranding					
6	Number of Cores					
7	Insulation					
7.1	Insulation material and Type Designation		XLPE		XLPE	
7.2	Minimum thickness of insulation	mm	8		3.4	
7.3	Minimum volume resistivity at 27 deg. C, 70 deg. C and 90 deg. C	Ohm-cm				
8	Sheath					
8.1	Material for inner sheath, type of sheathing and Type Designation					
8.2	Minimum thickness of inner sheath	mm				
8.3	Material for outer sheath, type of sheathing and Type Designation					
8.4	Minimum thickness of outer sheath	mm				
9	Armor					
9.1	Material					
9.2	Shape					
9.3	Dimension	mm				
10	Conductor Screen					
10.1	Material					
10.2	Thickness	mm				
11	Insulation Screen					
11.1	Material					
11.2	Thickness	mm				
12	Metallic Layer/Screen					
12.1	Type					
12.2	Material					
12.3	Thickness	mm				
13.1	Overall Diameter of the Cable	mm				
13.2	Geometric Mean Radius (GMR) of the Cable/Conductor	mm				
14	Minimum Bending Radius	mm				
15	Insulation Resistance at 27 deg. C	Ohm/km				
16	Capacitive Reactance	Ohm/km				
17	Inductive Reactance	Ohm/km				
18	Conductor Temperature rise during					
18.1	Normal Operation	deg. C	90		90	
18.2	Short Circuit	deg. C	250		250	
19	Continuous Current Carrying Capacity					
19.1	Continuous Current Carrying Capacity in air and Corresponding assumptions/Conditions of installation	A				
19.2	Continuous Current Carrying Capacity under ambient	A				

	temperature					
19.3	Continuous Current Carrying Capacity under Cable laid in Covered cable trenches	A				
19.4	Continuous Current Carrying Capacity under 3-6 Cables per tray touching each other in Covered cable trenches	A				
19.5	Continuous Current Carrying Capacity under ambient temperature for Cable laid in ground	A				
20	Short circuit current					
20.1	Short circuit current for 0.1 sec	kA				
20.2	Short circuit current for 1.0 sec (minimum kA)	kA				
20.3	Short circuit current for armor 1.0 sec (minimum kA)	kA				
21.1	Minimum tensile strength of insulation	kg/sq. cm				
21.2	Minimum elongation at break	%				
22.1	Minimum tensile strength of sheath	kg/sq. cm				
22.2	Minimum elongation at break	%				
23.1	Minimum tensile strength of armor	kg/sq. cm				
23.2	Minimum elongation at break	%				
24.1	Weight of Cable per km	kg/km				
24.2	Standard length of Cable per drum	m	min. 500m		min. 500m	
24.3	Net weight of cable in drum	kg				
25	Method of Core identification					
25.1	For Cables up to Five Cores					
25.2	For Cable with more than Five Cores					
26	Details of Anti Termite Covering					
27	Fire Retardant	yes/no	yes		yes	
28	Moisture Resistant	yes/no	yes		yes	
29	Longitudinal water tight	yes/no	yes		yes	
30	Details of Marking on Outer Sheath					
31	Please indicate in YES or NO whether the following tests have been carried out					
31.1	Ageing Test	yes/no	yes		yes	
31.2	Loss of Mass Test	yes/no	yes		yes	
31.3	Cold Impact Test	yes/no	yes		yes	
31.4	Heat Shock Test	yes/no	yes		yes	
31.5	Fire Retardant Test	yes/no	yes		yes	
32	ISO 9001 holder (including design)	yes/no	yes		yes	
32.1	ISO 9001 certificate submitted	yes/no	yes		yes	
33	Type test certificate submitted	yes/no	yes		yes	
33.1	Submitted for the required ratings	yes/no				

33.2	Type test certified by					
34	User's certificate submitted	yes/no	yes		yes	
35	Has exported to third country	yes/no	yes		yes	
36	Copies of relevant standards attached	yes/no	yes		yes	
37	Outline Drawings and associated GA attached	yes/no	yes		yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer ……

GUARANTEED TECHNICAL PARTICULARS

(To be completed by the Bidder/Manufacturer)

Item: Outdoor Termination Kit and Straight Through Joints (XLPE)

S.N.	Description	Unit	For 33 kV Line		11 kV Line	
			NEA Req.	To be Filled by Bidder/Manufacturer	NEA Req.	To be Filled by Bidder/Manufacturer
1	Manufacturer					
2	Country of Origin					
3	Years of Manufacturing Experience					
4	Applicable standard		IEC			
5	Type					
6	Insulation level					
7	Maximum design voltage					
8	Impulse withstand voltage(BIL)					
9	Fire resistance treated	yes/no	yes		yes	
10	Smoke resistance treated	yes/no	yes		yes	
11	Stress relief performed	yes/no	yes		yes	
12	Installation Instruction attached	yes/no	yes		yes	
13	List of Installation Accessories Supplied					
14	ISO 9001 holder (including design)	yes/no	yes		yes	
14.1	ISO 9001 certificate submitted	yes/no	yes		yes	
15	Type test certificate submitted	yes/no	yes		yes	
15.1	Submitted for the required ratings	yes/no				
15.2	Type test certified by					
16	User's certificate submitted	yes/no	yes		yes	
17	Has exported to third country	yes/no	yes		yes	
18	Copies of relevant standards attached	yes/no	yes		yes	

19	Outline Drawings and associated GA attached	yes/no	yes		yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date……
Seal of Bidder/Manufacturer ……

Installation of Underground Cable

a) General Scope

The contractor shall lay cables in accordance with IS 1255 or equivalent national or international Standards by using flexible pipes. The cable laying methodology based upon the applicable standards shall be duly approved by the Employer before the commencement of works.

b) Installation of cables

The underground cable lines consist of 3 numbers of power cables.

Joint and/or terminal works for the cables shall be made with utmost care by the skilled workers. Extra loop of approximately 2 to 5 m length at cable termination and joint shall be made as far as the space is available.

The contractor shall install the steel and/or concrete cable mark as approved by the Employer at 50 m intervals along the cable route.

The cables shall be terminated with sealing ends and bushings. Each terminal shall be provided with phase identification marks of R-Y-B.

Arrangement of flexible pipes for cable installation shall be approved by the Employer. Joints and terminations of those pipes shall be properly made so that penetration of water inside the flexible pipes after completion of the works is not allowed.

Prior to pull-through of the cable into the flexible pipes, the Contractor shall calculate the pull-through length of the cable and confirm that the pull-through tension is not more than permissible tension.

The shields of the power cables shall be grounded in the approved manner at each joint.

c) Installation of Terminal/ Sealing Ends

The cable end at both sides of the Park at river banks shall be made as per IEC standard. Necessary additional steel structure with concrete foundation shall be constructed for the installation of bushings as well as LA.

d) Inspection and Tests

Through the work execution, various inspections and tests on the progressing works will be ordered to the Contractor by the Employer.

Following inspections and tests will be carried out after completion of the works section by section. The Contractor shall perform all the inspections and tests in accordance with IEC Standard.

a) Visual inspection of the underground cable lines

- Back filling and grade
- Cable and joint marks
- Cable termination and connection

b) Measurement insulation resistance of the lines

c) H. V. test

Outdoor Cable Joint Cabinet

a) General

This specification covers the design, manufacture, assembly, shop test, supply, delivery, installation works and field test of the equipment 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:

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

b) Equipment to be furnished

36 kV, 630 A Cable Joint Cabinet, outdoor type including XLPE Cable Termination Kits at input & output terminals and essential spare parts & tools. The Cabinet will be erected above ground Level. The location in site shall be in safe place as agreed by employer

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

The equipment shall be from following manufacturers or equivalent.

a) ALSTHOM (Areva)	b) Fuji
c) CGELEC	d) Reyrolle
e) ABB	f) Siemens
g) Toshiba	h) Mitsubishi

c) Design Requirements

The equipment shall be used for the 33kV, 50Hz, 3 phase system. The enclosure is made of hot dip galvanized steel plate with additional corrosion protection on components that will be installed underground. The cable connectors shall be enclosed safely and connected in the Cabinet. The cable cabinet shall be supplied with a lock and padlock hasp.

The equipment shall be installed outdoor, erected above surface in a hot, humid climate. All equipment, accessories shall be provided with tropical finish to prevent fungus growth and to prevent moisture inside. Connections are made above ground, as necessary selected cables can be disconnected for maintenance.

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 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."

The equipment 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.

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

d) Tests

Type and routine tests on the equipment and components shall be in accordance with latest revision of IEC Standards or equivalent standards approved by the Employer/Employer's Representative.

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

(i) Routine tests

- Power frequency voltage dry test
- Measurement of resistance of main circuit
- Mechanical operation test

(ii) 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 equipment, 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 equipment of the offered model along with the bid.

The type and routine test certificate shall be furnished in the required number of copies to the Employer/Employer's Representative for approval before dispatch of the equipment from the works.

(iii) Field tests

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

(i) Construction inspection

(ii) Measurement of insulation resistance

(iii) Mechanical operation test

e) Drawings, Data and Manuals

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

(i) General arrangement drawing with different sections showing constructional features.

(ii) Technical leaflets on disconnecting switches offered explaining the function of various parts, principle of operation and special features (if any).

(iii) Typical type test results on identical equipment offered in the Tender.

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:

(i) Outline dimensional drawings of the equipment showing general arrangement and location of fittings.

(ii) Transport/shipping dimensions with weights.

(iii) Foundation and anchor bolt details including loading condition.

(iv) Assembly drawing for erection at site with part numbers and schedule of materials.

(v) Electrical schematic and wiring diagram.

(vi) Any other relevant drawings and data necessary for erection, operation and maintenance.

(vii) Instruction manual and data sheets.

(viii) Any other relevant data, drawing and information necessary for review of the items stated above.

f) Spare parts

(i) One (1) lot of necessary materials for repair for four times.

(ii) One (1) set of spares as recommended by the manufacturer, excluding those mentioned above.

TECHNICAL PARTICULARS OF 36 kV Cable Joint Cabinet

1.	phase, outdoor		3
1.	Quantity required		As per Price Schedule
3.	Voltage ratings		
	(a) Nominal system voltage	33kV	
	(b) Rated maximum voltage	36kV	
4.	Frequency		50Hz
5.	Insulation levels		
	(a) Basic impulse level (BIL)		170kV
	(b) Power frequency withstand voltage (1 min.)	75kV	
6.	Current ratings		
	(a) Continuous current		630A
	(b) Short time current (1 seconds)		
	(c) Peak short time current		
7.	Operating mechanism		Manual

TECHNICAL DATA SHEET

(To Be Completed By the Bidder)

36 kV, cable Joint cabinet with accessories

	DESCRIPTION	UNIT	NEA REQ	DATA to be Filled
1	Manufacturer and Country of Origin			
2	Year of manufacturing experience	Years	5	
3	Catalogue Number			
4	Copies of Governing Standards Attached		Yes	
5	Applicable standard		IEC	

6	Copies of type test attached	Yes/no	Yes
7	Type		Outdoor
8	Rated Voltage	kV	36
9	Rated current	A	630
10	Power frequency withstand voltage	kV	
11	Impulse withstand voltage(BIL)	KV	
12	Installation Instruction attached	Yes/No	yes
13	Is ISO 9001 certificate submitted?	Yes/No	Yes
14	Size of the enclosure		yes
15	Protection of the enclosure		yes
16	type of cable Connectors		Yes
17	provision of Cable earthing/discharging with special earthing devices and tools	yes/no	yes
18	Enclosure of hot-dip galvanized steel plate with additional corrosion protection on underground components	yes/no	yes
19	description of accessories submitted		yes
20	Technical literature/drawings submitted?	Yes/No	Yes

Deviations from technical requirements:

Signed……..

As Representative for……

Address:……

Date:……..

Flexible Pipe

1. General

Hard corrugated flexible conduit pipe of minimum outer diameter of 105 mm shall be used for installation of 33 kV and 11 kV XLPE power cable. The flexible pipe shall be buried before the cable installation and, then the cables shall be pulled in.

2. Requirement

The flexible conduit pipe shall be of polyethylene and shall be strong enough to withstand the compression force from heavy trucks or lorries when it is buried more than 80 cm below the ground level. The pipe's projected cross section shall be practically round and it shall be corrugated to get flexibility. The pipe should be suitable for 4 kgf/cm^2 pressures. However, contractor shall submit separate GTP and GA for pipes to be used along road crossings.

3. Accessories

The flexible conduit pipe shall be provided with necessary accessories, such as joints and sealing material etc.

The straight joint sleeve shall be made of high density polyethylene coloured black and to be so designed as to be screwed on to flexible pipe.

Bell mouth shall be fixed to the end of corrugated pipe to facilitate cable pulling in.

The bell mouth shall be so designed as to screwed into the pipe. It shall be made of hard density polyethylene and colored black.

Water proof materials for pipes in manhole shall be mounted to an outlet of duct to keep the water tightness.

The waterproof materials shall be comprised the components such as sand-proof seal, sealing tape, neo seal compound, VUL-CO tape, PVC tape and other necessary materials to complete the specified scope of works.

GUARANTEED TECHNICAL PARTICULARS
(To be completed by the Bidder/Manufacturer)

Item: Flexible Pipe

S.N	Description	Unit	NEA Requirement	To be filled by Bidder/Manufacturer
1	Manufacturer			
2	Country of Origin			
3	Years of Manufacturing Experience			
4	Applicable standard			
5	Manufacturer Type Designation			
6	Type		Corrugated hard polyethylene	
7	Thickness of pipe	mm		
8	Outer diameter of the pipe	mm		
9	Tensile Strength	N/mm^2		
10	Compressive Strength	N/mm^2		
11	Bending Strength	N/mm^2		
12	Delivery of equipment following award of contract and approval of drawing	months		
13	ISO 9001 holder (including design)	yes/no		
13.1	ISO 9001 certificate submitted	yes/no		
14	Type test certificate submitted	yes/no		
14.1	Submitted for the required ratings	yes/no		
147.2	Type test certified by			
15	User's certificate submitted	yes/no		

16	Has exported to third country	yes/no		
17	Copies of relevant standards attached	yes/no		
18	Outline Drawings and associated GA attached	yes/no		

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer ……

Covered Conductor

1. **Scope**

This Specification covers the general requirements of design, manufacture and testing of XLPE covered aluminum alloy conductor for 11kV overhead distribution system.

2. **Description**

2.1 The conductor shall be of multi-strand round compacted hard drawn aluminum alloy conforming to AS 3675 with latest revision thereof or any recognized international standards that ensures at least a substantially equal quality to the standard mentioned above. The Conductor wires shall not have any joints except for those made on the base wire.

2.2 The covering insulating material shall be of track resistant UV stabilized (weather resistant). The average thickness of the covering insulation shall not be less than that stipulated in the Technical Requirements. The hardness of the covering XLPE shall be such that it should not get damaged by the kite string and shall be suitable for fixing insulation piercing Arc Protectors. The covering shall be fully pressure extruded and dry cured so as to provide a uniform thickness throughout the length of the conductor.

2.3 Suitable water blocking material shall be incorporated between the conductor and the covering during the extrusion process to prevent the ingress of water along the conductor. The water blocking material shall be of contrasting colour to that of the conductor. The water blocking material shall not affect the inter-strand conduction and also not affect the adhesion between the conductor and the XLPE cover. Water blocking material shall be stable at maximum operating temperature of 80^{o}C and full technical particulars with regard to the above shall be furnished with the offer.

2.4 The following types of covered conductors shall be supplied:

A) Nominal conductor area mm2 – 120 & 80
i) Number of strands Nos. - 7
ii) Diameter of the wire mm - 4.75
iii) Nominal conductor diameter mm - 14.5
iv) Max. linear resistance at 200C Ohms/km - 0.239

B) Covering Insulation
i) Minimum average thickness of XLPE covering mm - 2.0
ii) Minimum thickness of XLPE covering at any point - 1.7
iii) Maximum thickness of XLPE covering at any point - 2.5

C) Covered Conductor
i) Minimum breaking strength of conductor (kN) – 27.1
ii) Short time current rating/1sec. (kA) – 11.0
iii) Conductor Operating Temperatures (Max.)
1) Continuous operation ^{0}C - 80
2) Emergency operation ^{0}C - 100
3) Short circuit operation (5 sec) ^{0}C - 210

iv) Covered conductor overall diameter range mm - 19.3 to 21.9

3. **Packaging**

3.1 The finished covered conductors shall be delivered in continuous lengths of 500 ± 5 meters and the ends of the covered conductors shall be effectively sealed with heat shrinkable cap to prevent ingress of moisture. The conductor shall be wound to the drum with the lowest number at the inner end of the drum. They shall be supplied in wooden drums made of well-seasoned wood that is treated to prevent deterioration by termites or fungus attack and suitable for outdoor storage of twelve (12) months or steel drums. The chemical used for treating the wood shall not be harmful to the conductor and the drum shall be lined with an impervious material to prevent direct contact of the covered conductor with the drum.
The external flange diameter shall be such that the distance between the outer edge of the flange and the packed conductor shall not be less than 75mm so that the drum could be rolled

on the flanges without causing damage to the conductor. Direction of rolling shall be clearly marked.

The drum shall have spindle hole of adequate diameter and reinforced with steel plates for mounting the drum on horizontal axle for laying out the conductor.

3.2 Each reel of the conductors furnished shall contain only one (1) length of conductor.

3.3 All reels shall be legibly marked in paint with the following information:

a) Size of conductor
b) Type of conductor
c) Length in meters
d) Net weight of conductor
e) Direction of rolling

3.4 The standard length of the completed covered conductor in each reel shall be as per the table below:

Conductor Size (sq. mm):	120 and 80
Normal Length of the Conductor (m):	500

4. Tests

4.1 Routine Tests

The manufactured conductor shall be tested in full compliance with the governing standard including following routine tests:

Test on wire before stranding

i) Wire diameter
ii) Ultimate tensile strength
iii) Wrapping test
iv) Resistivity test

Test on finished covered conductor

i) Inter-strand conductivity test
ii) Thickness of covering
iii) Static water blocking test
iv) Stripping test
v) Spark test

4.2 Type Tests

The Bidder shall submit the type test reports along with the Bid. The Covered Conductors shall be type tested conforming to AS 3675 of 1993 or revisions thereof, or IEC Standard or UK ESI or NFC and certified copies of the type test certificates shall be furnished with the bid. The test shall have been carried out in internationally recognized independent testing authority. The employer also reserves the right to have tests carried out at his own cost by an independent agency, whenever there is a dispute regarding the quality of supply. The cable shall be subjected to the following type tests:

a) Tests on wire before stranding
b) Tests on covering material
c) Tests on finished covered conductor

The Type Test Certificates furnished shall be from a recognized independent testing authority acceptable to the purchaser.

5. Bid Documentation

5.1 The Bidder shall provide with the Bid two (2) clear copies of the governing standards for fabrication and testing of the covered conductor and two (2) clear copies of all other relevant standards referenced therein.

5.2 The Bidder shall provide certified type test results of the types of covered conductor as required by governing standards.

5.3 The Bidder shall also furnish the Certificate of Compliance at the time of the shipment of each lot of conductor, or as required by the appropriate section of the equivalent international standard.

5.4 A clause-by-clause commentary on specification, specifying compliance and deviations, if any.

5.5 All data, drawings, catalogues and other technical documents shall be bound separately from the Bid documents.

GUARANTEED TECHNICAL PARTICULARS

(To be completed by Bidder/Manufacturer)

Item: Covered Conductor

S.N.	DESCRIPTION	UNIT	NEA REQ.	To be Filled by Bidder/Manufacturer
1	Manufacturer			
	Country of Origin			
	Years of Manufacturing Experience			
2	Applicable standard		AS/NZ or Equivalent	
3	Cable Type Designation			
4	Rated Voltage	kV		
4.1	Maximum System Voltage	kV		
4.2	Power Frequency Withstand Voltage	kV		
4.3	Impulse Withstand Voltage (BIL)	kV		
5	Conductor			
5.1	Conductor Material		AL	
5.2	Alloy Type/Grade			
5.3	Cross section of the Conductor	sq. mm.	120 sq.mm.	
5.4	Is Conductor Stranded?	(Yes/No)		
5.5	Stranded Conductor			
	v) Number of strands in each core			
	vi) Size of strand	Sq. mm.		
	vii) Maximum DC Resistance at 20 deg. C	Ohm/km		
	viii) Class of Stranding			
6	Number of Cores		One	
7	Covering Insulation			
7.1	Insulation material and Type Designation		XLPE	
7.2	Minimum average thickness of XLPE covering	mm	As per IEC	
7.3	Minimum thickness of XLPE covering at any point	mm		
7.4	Maximum thickness of XLPE covering at any point	mm		
7.5	Tolerance on the measured value of thickness	%		
7.6	Minimum volume resistivity at 27 deg. C, 70 deg. C and 90 deg. C	Ohm-cm		
	Water Blocking Material			
8	Sheath			
8.1	Material for sheath, type of sheathing and Type Designation		As per IEC	
8.2	Thickness of sheath and tolerance on measured value	mm, %	As per IEC	
13.1	Overall Diameter of the Cable	mm		
13.2	Tolerance on diameter	%		
13.3	Geometric Mean Radius (GMR) of the Cable/Conductor	mm		
14	Minimum Bending Radius	mm		
15	Insulation Resistance at 27 deg. C	Ohm/km		
16	Capacitive Reactance	Ohm/km		
17	Inductive Reactance	Ohm/km		
18	Conductor Temperature rise during			
18.1	Normal Operation	deg. C		

18.2	Short Circuit	deg. C		
19	Continuous Current Carrying Capacity	A		
20	Short circuit current			
20.1	Short circuit current for 0.1 sec	kA		
20.2	Short circuit current for 1.0 sec (minimum kA)	kA		
21.1	Minimum tensile strength of insulation	kg/sq. cm		
21.2	Minimum elongation at break	%		
22.1	Minimum breaking strength of conductor	kg/sq. cm		
22.2	Minimum elongation at break	%		
23.1	Minimum tensile strength of armor	kg/sq. cm		
23.2	Minimum elongation at break	%		
24.1	Weight of Cable per km	kg/km		
24.2	Standard length of Cable per drum	m		
24.3	Tolerance on length of cable per drum	%		
24.4	Net weight of cable in drum	kg		
25	Please indicate in YES or NO whether the following tests have been carried out			
25.1	Ageing Test	Yes/No	Yes	
25.2	Loss of Mass Test	Yes/No	Yes	
25.3	Cold Impact Test	Yes/No	Yes	
25.4	Heat Shock Test	Yes/No	Yes	
25.5	LV and Tertiary Winding	Yes/No	Yes	
25.6	Oxygen index test and temperature index test	Yes/No	Yes	
25.7	Fire Retardant Test	Yes/No	Yes	
26	Delivery of equipment following award of contract and approval of drawing	months		
27	ISO 9001 holder (including design)	yes/no	yes	
27.1	ISO 9001 certificate submitted	yes/no	yes	
28	Type test certificate submitted	yes/no	yes	
29.1	Submitted for the required ratings	yes/no		
29.2	Type test certified by			
30	User's certificate submitted	yes/no	yes	
31	Has exported to third country	yes/no	yes	
32	Copies of relevant standards attached	yes/no	yes	
33	Outline Drawings and associated GA attached	yes/no	yes	

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer ……

Fitting for Covered Conductors

1. Scope

This Specification covers the fabrication and supply of fittings and associated apparatus for with HV AAC XLPE covered conductors.

2. Description

2.1 The fittings, hardware and equipment shall be fabricated in accordance with International recognized standards such as BS/EN, NFC for Fittings and Associated Apparatus that ensures at least a substantially equal quality to the standard mentioned above, will also be acceptable. The fitting and accessories shall be suitable for 11 kV nominal voltage applications.

2.2 The Covered Conductor hardware manufacturing company shall have been accredited with ISO 9001 quality certification (including design for covered conductor accessories).

2.3 The fittings shall be for use in conjunction with XLPE covered conductor of 120 sq. mm and 80 sq.mm. nominal cross-sectional areas.

2.4 Contractor shall get approval of all drawings and hardware sample from Purchaser before starting the fabrication of all hardware.

3. Power Arc Devices

Power arc devices are used as an arcing protection device for covered conductors.

4. Pin insulator for covered conductor

The Pin insulators should be porcelain type and specially designed to be used with covered conductors. There shall be a plastic sleeve in the top-groove of the insulator to enable pulling of conductor without using pulleys. The conductor can be tied to the top-groove or to the neck.

4. Tension insulator for covered conductor

The tension insulators should be porcelain type and specially designed to be used with covered conductors.

5. Horizontal and Terminal Cross-Arm for covered conductor

The horizontal and terminal cross-arms including braces and accessories should be hot dipped galvanized steel specially designed for use with covered conductors for 11 kV distribution lines. The strength and loading of lines and material grade of steel shall be similar to the other overhead 11 kV distribution lines but of suitable for covered conductors.

7. Dead End Clamps/ Anchor Clamps

The covered conductors shall be suitable to be tensioned using the tension insulator string with bolted/wedge type tension clamp. The bolted type covered conductor tension clamps are made of aluminum alloy and suitable for fixing to pin of the ball and socket type disc insulators. The purpose of terminating covered conductors over the covering fitting shall include, but are not limited to the cone, bolted or wedge type clamp and preformed helical fittings. The fittings shall be able to withstand the specific minimum failure load (SMFL) and shall not damage the covering and shall be designed to prevent the ingress of moisture during service.

8. Preformed Ties/ Composite Ties

Preformed ties/ Composite ties shall be used for attaching 120 sq mm and 80 sq.mm. AAC XLPE covered conductors to pin insulators either for straight line position or angle position. The ties for MV covered conductor shall be composite prefabricated type with a white rigid PVC rod covered by a black resistive conductive layer, no metal parts are allowed. Ties shall be used without removing the sheath of covered conductors. They shall combine the necessary mechanical holding function with protection of the conductor sheath from long term deterioration caused by electrical stress. The electrical integrity of covered conductor/ insulator system shall be maintained. The bidder shall furnish the climate ageing test report for 1000 hrs, failing which the bid shall be liable for rejection.

9. Mid Span Full Tension Joints

Mid span full tension joints are intended to ensure mechanical and electrical connection between two lengths of same cross section of bare conductors.

Each mid-span full tension joint comprises one aluminum alloy sleeve and a galvanized steel sleeve allowing the hexagonal compression on conductor core and one water tightened system heat shrinkable cover to prevent the penetration of water into the covered conductor.

Mid-span full tension joints shall be used for 120 sq. mm. and 80 sq.mm. XLPE AAC covered conductor. The Mid-span full tension joints shall be hexagonal compression type. These joints guarantee mechanical and electrical features at least equivalent to those of the conductor on which they are installed.

When in use, no conductor failure shall appear next to the mid-span full tension joints and no conductor slip shall appear at tensile load below the nominal breaking load value of the conductor.

10. Heat Shrinkable Cable End Cap

The insulated end cable cap shall be suitable for effectively sealing the end terminal of the covered conductors and shall have wet flashover voltage not less than 11 kV. The cap shall be heat shrinkable type and the inner diameter of the cap shall be such that it shall tightly fit to the covered conductors to prevent entry of moisture.

11. Insulation piercing connectors

These insulation-piercing connectors are intended to connect two covered conductors with the same or different cross section between them. The main conductor should be stretched or not. The tap connector shall be a bridge constituted by a not stretched linking covered conductor. The insulation piercing connector shall not have losable components that are liable to be lost during installation. The housing shall be made entirely of mechanical and resistant plastic insulation material and no metallic part outside the housing is acceptable except for the tightening system. The housing shall be an integral part of the connector.

The number and the length of the teeth shall be adequate enough to penetrate the relevant covered conductor insulation to establish proper contact without any contract resistance and without the need to strip the covered conductor insulation. To achieve the required water tightness a special rubber seal be provide around the teeth of the present connector. The bolts and washers shall be of corrosion resistant type. The piercing of insulation shall be simultaneous on main and tap conductor when tightening the bolts. Two different types of piercing connectors are used in covered conductor which shall be supplied with two bolts.

Main covered conductor to tap covered conductor with capacity from 50 to 120 sq mm both side

Main bare aluminum conductor to tap covered conductor with capacity main capacity 50 to 120 sq mm bare aluminum and tap covered conductor 50 to 120 sq mm.

12. Tests

12.1 Type test

The bidder shall submit the type test report along with the Bid. The report shall be issued by a recognized independent testing authority. The tests shall comply with relevant IEC/NF C Standard or the governing standard. The Employer also reserves the right to have tests carried out at his own cost by and independent agency, whenever there is a dispute regarding the quality of supply. In respect of the following fittings, the test shall include, but not limited to the following:

Dead End clamps:

- Mechanical test
  - Tensile (high tension) test on bracket
  - Tensile on anchoring clamps
- Climate ageing test

  - voltage test
  - mechanical strength test
- Voltage test
- Corrosion test
- Dynamic test at low temperature
- Endurance test under mechanical and thermal stresses
  - slippage checking test
  - voltage test

Insulation piercing connectors:

- Current carrying capacity test of the connector
- Temperature rise and over current test
  - Initial temperature test
  - Over current test
  - Final temperature test
- Electrical ageing test
- Climate ageing test
- Corrosion test
- Installation test at low temperature
- Mechanical test
  - Electrical continuity test
  - Mechanical tightening test
  - Mechanical strength of tap
- Electrical heat cycle test
- Voltage and water tightness test

Mid Span Full Tension Joint:

- Mechanical test
  - Crimping ability test
  - Tensile test
- Voltage and water tightness test
- Climate ageing test
- Corrosion test
- Electrical ageing test
- Endurance test under mechanical and thermal stresses

Tests for fittings and hardware shall be conducted in accordance with the NF C and IEC Standard or equivalent international standards including voltage and water tightness test wherever applicable.

12.2 Routine tests

Each batch of fittings shall be subjected to routine tests while manufacturing to confirm to the specified standard.

13. Quality Assurance Program

Along with the Bid the Bidder shall furnish quality assurance program of the manufacturer which includes the Quality System and the Quality Plans, which shall include, among others, information to meet the following requirement, failing which the Bid shall be liable for rejection.

i. The structure of the organization;
ii. The duties and responsibilities assigned to staff ensuring quality of works;
iii. The system for purchasing, taking delivery and verification of materials;
iv. The system for ensuring quality of workmanship;
v. The quality assurance arrangement shall conform to relevant requirements of ISO9001; 2008

vi. Statement giving list of important raw materials, names of manufacturer for the raw materials, list of standards according to which the raw materials are tested, list of test normally carried out on raw materials;
vii. List of manufacturing facilities available;
viii. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections;
ix. List of testing equipment available with the manufacturer for final testing of equipment specified and the test plant limitation, if any, vis-à-vis the type, special, acceptance and routine tests specified in the relevant standards.

14. Bid Documentation

14.1 The Bidder shall furnish with the Bid two (2) clear copies of the Standard governing fabrication and testing of the fittings and accessories for LV ABC and two (2) clear copies of all other relevant standards referenced therein.

14.2 The Bidder shall furnish two (2) sets of complete description, catalogue, dimensional drawings showing general construction and size of all fittings and accessories.

14.3 The Bidder shall furnish two (2) clear certified copies of type test report for Dead end clamp/Anchor clamp, mid span full tension joints and IPCs, failing which the bid shall be liable for rejection.

14.4 A clause-by-clause commentary on specification, specifying compliance and deviations, if any.

14.5 All technical data, drawings, catalogues and other technical documents shall be bound separately from the bid documents. Drawings for Dead end clamp/Anchor clamp, mid span full tension joints and IPCs must be submitted failing which the bid shall be liable for rejection.

14.6 The NEA may ask to furnish the type test report for other accessories from the substantially responsive bidders.

14.7 The Bidder shall furnish the sample of accessories such as Composite Ties and IPCs along with the bid, failing which the bid shall be liable for rejection.

Aerial Bundled Conductor (ABC)

1. **Scope**

This Specification covers the design, manufacture, factory test and supply of 0.6/1 kV cross-linked polyethylene (XLPE) insulated with insulated neutral messenger conductor supporting aerial bundled conductors (ABC) for use in the construction of 400/230V, 3-phase, 4-wire distribution network of Nepal Electricity Authority.

2. System Parameters

a)	Nominal Voltage	400/230V
b)	System Highest Voltage	1kV
c)	System frequency	50Hz
d)	No. of Phases	3
e)	Neutral Earthing	Effective
f)	System fault current	20kA rms

3. Service Condition

a)	Ambient temperature	-5 to 55 deg. C
b)	Annual average ambient temperature	30 deg. C
c)	Maximum relative humidity	99%
d)	Environmental condition	Humid Tropical climate
e)	Operational altitude	Up to 3000m above msl
f)	Isokeraunic (Thunder day) level	90 days
g)	Solar Radiation	1.6kW/m2
h)	Wind Zone	Zone 4

4. Applicable Standards

The equipment and components supplied shall be in accordance with the latest editions of the standards specified below and amendments thereof or any international equivalent standards and the NEA Specifications specified hereafter.

a)	NF C 33-209	Bundled assembled flexible cords for overhead systems of rated voltage 0.6/1kV
b)	BS 7870-5	Polymeric Insulated aerial bundled conductors (ABC) of rated voltage 0.6/1kV for overhead distribution
c)	IS 14225	Aerial Bundled Cables – for working voltages up to and including 1100V

The Bidder may propose alternative standards, provided it is demonstrated that they give a degree of quality and performance equivalent to or better than the referenced standards. The purchaser shall adjudge whether to accept or reject any standards.

The Bidder shall furnish a copy of the alternative standard proposed along with his bid. If the alternative standard is in a language other than English, an English translation shall be submitted with the standard. In case of conflict the order of the precedence shall be (1) IEC standards, (2) ISO standards, (3) European or British Standards, (4) Indian Standards, (5) Other alternative standards.

This list is not to be considered exhaustive and reference to a particular standard or recommendation in this specification does not relieve the Contractor or the necessity of providing the goods complying with other relevant standards or recommendation.

5. Technical Parameters

5.1 Minimum Technical Requirements

S.N.	Description	Unit	3x95+70mm2
1	Rated Voltage	kV	
2	Maximum System Voltage	kV	
3	Rated Voltage between two conductors	kV	
4	Power Frequency withstand voltage	kV	
5	Number of Cores		4

S.N.	Description	Unit	3x95+70mm2
6	Phase Conductor		3
6.1	Material Type		EC Grade Al.
6.2	No. and Diameter of Strand	No/mm.	7/
7	Messenger Conductor		
7.1	Material Type		AAAC
7.2	No. and Diameter of Strand	No/mm.	7/
8	Insulation Material		XLPE
9	Conductor Temperature Rise during Normal Operation	deg. C	90
10	Conductor Temperature Rise during Short Circuit	deg. C	250
11	Direction of Lay		Right Hand
12	Standard Length of Cable Per drum	m	Min. 500

5.2 Requirements of size

The required size of cable shall be:
3x95+70 mm2
4x70mm2
4x50mm2
4x25mm2

6. Basic Features

6.1 Design

The Aerial Bundled Conductor shall conform in all respects to highest standards of engineering, design, workmanship, this specification and the latest revisions of relevant standards at the time of offer and the Purchaser shall have the power to reject any work or material, which, in his judgment is not in full accordance therewith.

The ABC shall be insulated aluminum neutral messenger conductor supported type.

6.2 Conductors

The phase conductor shall be of multi-strand round aluminum of compacted circular cross-section conforming to IEC. The messenger takes all the mechanical stress and also serves as a neutral conductor. The neutral messenger conductor shall be of multi-strand round compact aluminum alloy conforming to IEC. The conductors shall be insulated by extruded black & UV stabilized cross-linked polyethylene (XLPE) material.

The complete cable shall consist of four insulated conductors stranded together, and the direction of lay shall be right-hand. The type of construction shall cause the tensile load to be shared equally between conductors. The properties of the aluminum wires (Tensile strength & Resistivity) before stranding shall be as per relevant standards. No joints are allowed in the conductor except those made on the base rod or wire before first drawing within the standard length.

6.3 Insulation

The Aerial Bunched Cables shall be insulated with extruded cross-linked polyethylene (XLPE) material. The voltage class and the insulation wall thickness shall be determined in accordance with applicable standards.

The insulating material shall be black and suitable to resist ultra violet radiation, salt laden sprays, chemical pollution, ageing effects, abrasion and mechanical shocks and mechanical and electrical stress at temperature up to 90 deg. C in normal operation and 250 deg. C under short circuit conditions. The carbon black content in the XLPE insulation shall be as per the applicable standards.

6.4 Phase Identification & Marking

The identification of the conductors shall be provided by means of ribbing on the external surface of the insulation. R, Y and B phase conductors shall have one, two, and three ribs respectively. Space between the ribs in R, Y and B phases shall be 5 mm. Ribs shall be in rounded form. The neutral messenger conductor shall be plain without any ribs.

Each individual conductor comprising the bundle shall be embossed with the following at the spacing of five meters. The embossing should be very clear and easily visible to naked eye. The height of the printed lettering shall be not less than 20% of the overall diameter of the conductor. Every meter of outer covering of the cable shall also be embossed with length of the cable.

- Applicable Standards
- Name/Identification of the manufacturer,
- Name of the Purchaser 'Nepal Electricity Authority'
- Year of Manufacture '20XX'
- Designation of Conductor Type/Cross Section
- Rated Voltage Class
- Type of Insulation 'XLPE'
- Back up conductor identification: conductors with one, two and three projections shall be marked 'R', 'Y' and 'B' respectively. The conductor with no projection shall be marked 'N'.

7. Additional Requirements

7.1 Packaging

All conductors shall be furnished on non-returnable steel drums capable of withstanding all normal transportation and handling. Protective external lagging of sufficient thickness shall be provided and fitted closely on the drums. Binder consisting of steel straps shall be provided over the external laggings. The drums shall be new and sufficiently sturdy in construction to withstand ocean shipping, road transport, several loading and unloading, storage in tropics, hauling and field erection of conductor without distortion or disintegration.

Before dispatch, the ends of the bundled conductors shall be sealed to prevent moisture ingress during transportation and storage. Both ends of every length of the assembled bundle shall be temporarily bound in such a manner as to prevent cores from separating.
Each reel of the conductors furnished shall contain only one (1) length of conductor. The minimum length of each drum shall be minimum of 500m. All drums shall be legibly marked in paint with the following information:

(i) Manufacturer's Name and Trademark (if any)
(ii) Drum Number or identification number
(iii) Type of conductor
(iv) Size of conductor
(v) Voltage Grade
(vi) Length in meters
(vii) Gross Weight
(viii) Net weight of conductor
(ix) Direction of rolling

8. INSPECTION AND TESTING

8.1 Acceptance Test

The successful Bidder shall make necessary arrangements for pre-shipment inspection and tests by the nominated NEA Inspectors to carry out in his presence the necessary Sample/Acceptance tests conforming to the relevant governing standards on the completed cables offered.

8.2 Routine Test

The Routine Tests shall be carried out on the completed cables at the manufacturer's plant in accordance with the governing standards. The test reports shall be made available for the observation of the NEA Inspector at the time of inspection.

9. BID DOCUMENTATION

9.1 The following shall be furnished with the offer.

(a) Complete description, catalogue, drawings showing general construction and size of the cables including dimensional drawing of cable drum for each type of ABC.
(b) Completed Schedule of Guaranteed Technical Particulars
(c) A copy of the Manufacturer's ISO 9001 Certificate conforming to design and manufacture
(d) Type Test Certificates: The Type Test Certificates shall be from an Accredited Independent Testing Authority acceptable to the Purchaser.
(e) Copy of the Governing Standards
(f) Technical Literature in English Language on installation, operation and maintenance with necessary diagrams and drawings.

9.2 Type Test Certificates

The material offered shall be fully type tested by an independent accredited testing laboratory acceptable to the Employer. The bidder shall submit the type test reports along with the offer. The tests shall comply with relevant Standards. The Employer also reserves the right to have tests carried out by an independent agency, whenever there is a dispute regarding the quality of supply. The Aerial bundled Cable shall be subjected to the following type tests:

(a) Tensile test
(b) Wrapping test
(c) Conductor resistance test
(d) Test for thickness of insulation
(e) Tensile strength and elongation at break of insulation
(f) Physical tests for XLPE insulation
(g) Ageing in air oven
(h) Shrinkage test
(i) Hot deformation
(j) Loss of mass in air oven
(k) Heat shock test
(l) Thermal stability
(m) Test for bleeding and blooming of pigment
(n) Insulation resistance test
(o) High voltage test including water immersion test
(p) High voltage test at room temperature
(q) Flammability test
(r) Resistance test at each phase/neutral of the conductor at 20 deg. C
(s) Breaking load test (to be made on the finished conductors) (for messenger only)
(t) Elongation test (for messenger only)

GUARANTEED TECHNICAL PARTICULARS

(To be filled by the Bidder/Manufacturer)

Item: Aerial Bundled Conductor

S.N.	Description	Unit	3x95+70mm2	4x70mm2	4x50mm2	4x25mm2
1	Manufacturer					
	Country of Origin					
2	Years of Manufacturing Experience					
3	Applicable standard		NFC	NFC	NFC	NFC
4	Cable Type Designation					
5	Rated Voltage	kV				
6	Maximum System Voltage	kV				
7	Rated Voltage between two conductors	kV				
8	Power Frequency withstand voltage	kV				
9	Number of Cores					

S.N.	Description	Unit	3x95+70mm2	4x70mm2	4x50mm2	4x25mm2
10	Phase Conductor					
10.1	Material Type					
10.2	Min. Cross Section Area	sq.mm.				
10.3	No. and Diameter of Strand	No/mm.				
10.4	Overall Diameter					
10.5	Max. DC resistance at 20 deg. C	Ohm/km				
11	Messenger					
11.1	Material Type		AAAC	AAAC	AAAC	AAAC
11.2	Min. Cross Section Area	sq.mm.	70	70	50	25
11.3	No. and Diameter of Strand	No/mm.				
11.4	Overall Diameter	mm				
11.5	Max. DC resistance at 20 deg. C	Ohm/km				
11.6	Minimum Breaking Load	kN				
12	Overall Diameter of Bundled Conductor	mm				
12	Insulation Material					
12.1	Min. Thickness of Insulation	mm				
12.2	Max. Volume resistivity of Insulation at 27 deg. C					
13	Conductor Temperature Rise during Normal Operation	deg. C				
14	Conductor Temperature Rise during Short Circuit	deg. C				
15	Continuous Current Carrying Capacity in air & corresponding assumptions/conditions of installation	A				
16	Short Circuit Current for 0.1 sec	A				
17	Short Circuit Current for 1.0 sec	A				
18	Tensile Strength of Insulation	kN				
19	Min. elongation at break (insulation)	%				
20	Direction of Lay					
21	Weight of Cable	kg/km				
22	Standard Length of Cable Per drum	m				
23	Net Weight of Cable per Drum	kg				
24	Core Identification and marking					
25	Delivery of equipment following award of contract and approval of drawing	months				
26	ISO 9001 holder (including design)	yes/no				
26.1	ISO 9001 certificate submitted	yes/no				
27	Type test certificate submitted	yes/no				
27.1	Submitted for the required ratings	yes/no				
27.2	Type test certified by					
28	User's certificate submitted	yes/no				
29	Has exported to third country	yes/no				
30	Copies of relevant standards attached	yes/no				
31	Outline Drawings and associated GA attached	yes/no				

Signed by……..
Designation……..

As Representative for……..
Place……
Date…….
Seal of Bidder/Manufacturer ……

Fitting for Aerial Bundled Conductor (ABC Fittings)

1. Scope

This Specification covers the fabrication and supply of fittings and associated apparatus for with LV aerial bundled conductors (ABC).

2. Description

2.1 The fittings, hardware and equipment shall be fabricated in accordance with International recognized standards such as IEC, NFC for Fittings and Associated Apparatus for use with LV ABC of latest revision, and all referenced standards therein, or latest revision thereof or other recognized international standards that ensures at least a substantially equal quality to the standard mentioned above, will also be acceptable.

2.2 The ABC Cable hardware manufacturing company shall have been accredited with ISO 9001 quality certification (including design for LV ABC accessories).

2.3 The fittings shall be for use in conjunction with insulated neutral messenger 3-core phase, and 1-core neutral messenger ABC of 95 sq. mm, 70 sq.mm., 50 sq. mm. and 25 sq.mm. nominal cross-sectional areas.

2.4 Contractor shall get approval of all drawings and hardware sample from Purchaser before starting the fabrication of all hardware.

2.5 The fittings and accessories are as follows:

3.1 Anchor clamp with bracket:

The clamps should be designed to anchor insulated messenger of ABC. The clamp should consist of an aluminum alloy corrosion resistant body, bail of stainless steel and self-adjusting plastic wedges which shall anchor/hold the neutral messenger without damaging the insulation.

The clamp should be installed properly with no losable part. It shall conform to the standard NFC33-041 or equivalent other international standards. The clamp body should be made of corrosion resistant aluminum alloy, bail should be of stainless steel to prevent from corrosion & climatic variations, a plastic saddle should be installed on the flexible bail to limit abrasion with hook/bracket and wedges should be of weather and UV resistant polymer. It should be fixed with pole by eye hook/bracket. Bracket should be made of corrosion resistant aluminum alloy. Ultimate Tensile Strength of the clamp should not be less than 12 KN for 50/70 sq.mm insulated messenger wire / 8 KN for 25/35 sq.mm insulated messenger wire. Slip load of the clamp should not be less than 5KN for 50/70 sq.mm insulated messenger & 3KN for 25/35 sq.mm insulated messenger wire. Design as per furnished drawing.

3.2 Suspension clamps with bracket:

The clamp should be designed to hang LV-ABC with insulated neutral messengers. The neutral messengers should be fixed by an adjustable grip device. A movable link should allow longitudinal and transversal movement of the clamp body.

The suspension clamp range to accommodate messenger shall be 25-95mm2. The clamp should be installed properly with no losable parts. The clamp shall conform to the standard NFC33-040 or other equivalent international standards. The clamp and movable link made of weather and UV resistant thermoplastic polymer should provide additional insulation between the cable and the pole. The clamps and the movable links should be made of weather and UV resistant thermoplastic polymer. Clamps should be fixed with pole by eye hook/bracket. Bracket should be made of corrosion resistant aluminum alloy. The Suspension Clamp & the bracket will be preferably delivered together in order to minimize abrasion between two materials. Ultimate Tensile Strength of the clamp should not be less than 12 KN for 25-95 sq.mm insulated messenger wire. Maximum Allowable load of the clamp should not be less than 12 KN for 25-95 sq.mm insulated messenger wire. Slip load of the clamp should not be less than 300N for 25-95 sq.mm insulated messenger wire. The clamp should sustain to maximum angle of deviation of 60 degrees of the conductors. Design as per furnished drawing.

3.3. Insulated cable end caps

The insulated cable end caps shall be made of weather and age resistant insulating material and shall have wet flashover voltage not less than 6 kV. The cap shall be heat shrinkable type or without heat shrinkable and shall be coated internally with a suitable sealant. The caps shall be suitable for supplied sizes of ABC.

3.4. Insulated insulation piercing connectors (IPC)

The insulated insulation piercing connector (or the connector for short) shall be suitable for using with aluminum ABC and concentric cables. It shall be made of high quality, weather, heat and age resistant insulating material having wet flashover voltage not less than 6 kV. It shall be watertight and suitable for making connections to the live lines. The piercing of main line and the tapping shall be done simultaneously. The design of the connectors shall be such that its removal is possible even after breaking of the shear head. The connector shall be provided with end cap for tapping end. The IPCs for the network application (Type A) shall be preferably of two bolt type and service application (Type B) shall be preferably of single bolt type. The IPCs for the network application shall withstand at least 5 kA fault current for 1s without damage. The connector shall be suitable for following cables.

Type	Main	Tapping
Type A	50-120 sq. mm, ABC	50-120 sq. mm, ABC
Type B	50-120 sq. mm, ABC	6-25 sq. mm, ABC/ concentric cable

3.5. Core separators (pairs)

The core separators shall essentially comprise two wedges to facilitate the installation of connectors on tensioned ABC cable. The two separators shall be joined together with a nylon cord. The two separators, which shall be made from wither hardwood or rigid plastic, shall be so shaped as to be capable of being positively locked in position.

3.6. Jointing sleeves

The joint should be Pre-Insulated for Phases, neutral messengers and Street Lighting conductors. Sleeve should be made of Aluminum, insulated with an anti UV black thermoplastic tube hermetically sealed two ends with 2 flexible rings to prevent water penetration. The sleeves shall be water tight with wet flashover voltage not less than 6kV upon installation.

3.7. Stainless Steel Strap and Buckle

The stainless steel strap shall be of 20x0.7mm size and be supplied in a roll of 50m. The breaking strength of the strap shall be at least 0.95 kN/mm2

3.8. Stainless Steel Strap Binding Tool

The strap binding tool shall be of ratchet type to be operated by the lines men by hand while working on the poles.

4. Tests

4.1 Type tests

The bidder shall submit the type test report along with the Bid. The report shall be issued by a recognized independent testing authority. The tests shall comply with relevant IEC Standard or the governing standard. The Employer also reserves the right to have tests carried out at his own cost by and independent agency, whenever there is a dispute regarding the quality of supply. In respect of the following fittings, the test shall include, but not limited to the following:

Anchor clamps:

- Mechanical test
  - Tensile (high tension) test on bracket
  - Tensile on anchoring clamps
- Climate ageing test
  - voltage test
  - mechanical strength test
- Voltage test
- Corrosion test
- Dynamic test at low temperature
- Endurance test under mechanical and thermal stresses
  - slippage checking test
  - voltage test

Suspension clamps:

- Mechanical test
  - Tensile test on bracket
  - Tensile test on sub-assembly
- Slip test on the clamp
- Voltage test
  - on the supports
  - on sub-assembly
- Mechanical strength test
- Climate ageing test
- Corrosion test
- Endurance test under mechanical and thermal stresses
  - slippage checking test
  - voltage test

Insulation piercing connectors:

- Current carrying capacity test of the connector
- Temperature rise and over current test
  - Initial temperature test
  - Over current test
  - Final temperature test
- Electrical ageing test
- Climate ageing test
- Corrosion test
- Installation test at low temperature
- Mechanical test
  - Electrical continuity test
  - Mechanical tightening test
  - Mechanical strength of tap
- Electrical heat cycle test
- Voltage and watertightness test

Tests for fittings and hardware shall be conducted in accordance with the NF C and IEC Standard or equivalent international standards including voltage and water tightness test wherever applicable.

4.2 Routine tests

Each batch of fittings shall be subjected to routine tests while manufacturing to confirm to the specified standard.

5. Quality Assurance Program

Along with the Bid the Bidder shall furnish quality assurance program of the manufacturer which includes the Quality System and the Quality Plans, which shall include, among others, information to meet the following requirement, failing which the Bid shall be liable for rejection.

i. The structure of the organization;
ii. The duties and responsibilities assigned to staff ensuring quality of works;
iii. The system for purchasing, taking delivery and verification of materials;
iv. The system for ensuring quality of workmanship;
v. The quality assurance arrangement shall conform to relevant requirements of ISO9001; 2008
vi. Statement giving list of important raw materials, names of manufacturer for the raw materials, list of standards according to which the raw materials are tested, list of test normally carried out on raw materials;
vii. List of manufacturing facilities available;
viii. List of areas in manufacturing process, where stage inspections are normally carried out for quality control and details of such tests and inspections;
ix. List of testing equipment available with the manufacturer for final testing of equipment specified and the test plant limitation, if any, vis-à-vis the type, special, acceptance and routine tests specified in the relevant standards.

6. Bid Documentation

6.1 The Bidder shall furnish with the Bid two (2) clear copies of the Standard governing fabrication and testing of the fittings and accessories for LV ABC and two (2) clear copies of all other relevant standards referenced therein.

6.2 The Bidder shall furnish two (2) sets of complete description, catalogue, dimensional drawings showing general construction and size of all fittings and accessories.

6.3 The Bidder shall furnish two (2) clear certified copies of type test report for Anchor clamp, Suspension clamp and IPCs failing which the bid shall be liable for rejection.

6.4 A clause-by-clause commentary on specification, specifying compliance and deviations, if any.

6.5 All technical data, drawings, catalogues and other technical documents shall be bound separately from the bid documents. Drawings for Suspension clamp with bracket, Anchor clamp with bracket, Jointing sleeves and IPCs must be submitted failing which the bid shall be liable for rejection.

6.6 The NEA may ask to furnish the type test report for other accessories from the substantially responsive bidders.

6.7 The Bidder shall furnish the sample of accessories such as Type A IPCs along with the bid, failing which the bid shall be liable for rejection.

VOLUME – IIB OF III

SECTION – 3

INSPECTION, TESTING AND COMMISSIONING

FOR

LINE AND DISTRIBUTION TRANSFORMER CONSTRUCTION WORKS

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 line 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 line sections.

2. Objectives

The objectives of commissioning work, prior to the successful energization of lines 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.

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 provisions of the clauses on Test and Inspection of the General Conditions of Contract and Special Conditions of Contract shall be applicable to the supply and erection portions of the Works. 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.

4. Tests at Manufacturers Works

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 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 manufacturer's factory to witness the fabrication, assembly and testing of any or all parts of major equipment. The costs of such visits shall be

borne by the Employer. If any additional Tests are required or the listed below visit is insufficient, the manufacturer/contractor shall bear the cost required for visit by the Employer/Employer's representative. The number of the Employer's personnel and equipment to be witnessed will be as listed below. The duration of such visits shall be minimum of three days to maximum of seven days as per inspection/testing requirements.

33 & 11 kV Line and Distribution Transformer		
S.N	**Equipment**	**No. of visit and person**
1	Distribution Transformer	2 persons, 1 visit
2	XLPE Power Cable (36 kV and 12 kV) and Accessories	1 person, 1 visit
3	ACSR Conductor (DOG and RABBIT) and Accessories (PG Clamp & Compression Joints)	2 persons, 1 visit
4	AB Cable and & Accessories	2 persons, 1 visit
5	Covered Conductor & Accessories	2 persons, 1 visit
6	Steel Telescopic Pole	2 persons, 1 visit
7	Steel Tubular Pole	2 persons, 1 visit
8	Insulators and Insulator Fittings	1 person, 1 visit
9	DO, LA, Air Break Switch	1 person, 1 visit
10	MCCB with Box	1 person, 1 visit
	Transformer Platform	1 person, 1 visit
11	Pole Accessories (Channel, Angle, Braces) and Stay Wire and Stay Set	1 person, 1 visit

During the visit of Manufacturer's premises by the Employer/Employer's representative, all tests shall be duly completed by the manufacturer with the witness of Employer/Employer's representative. "Factory Acceptance Test" reports shall be duly signed and if the results are satisfactory, the dispatch clearance instructions shall be provided by the Employer/Employer's representative.

4.2 Test Certificates

Within 30 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 two copies to the Employer.

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 relevant Standards, the Employer shall have the right to accept such certificates in line 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.

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.

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.

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.

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.

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.

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.

10.1 Test Procedures

The following basic tests, in addition to others, shall be carried out:

- Measurement of insulation resistance.
- AC withstand voltage test

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 megger.

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.

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.

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.

10.5 Test Methods

Carry out all necessary tests for commissioning the sub-transmission and distribution line. The contractor must strictly adhere to the methods of testing approved by the Employer.

(a) Particular Constraints and Special Tests

The Contractor shall be prepared to cooperate with any special tests requested by the Employer.

VOLUME – IIB OF III

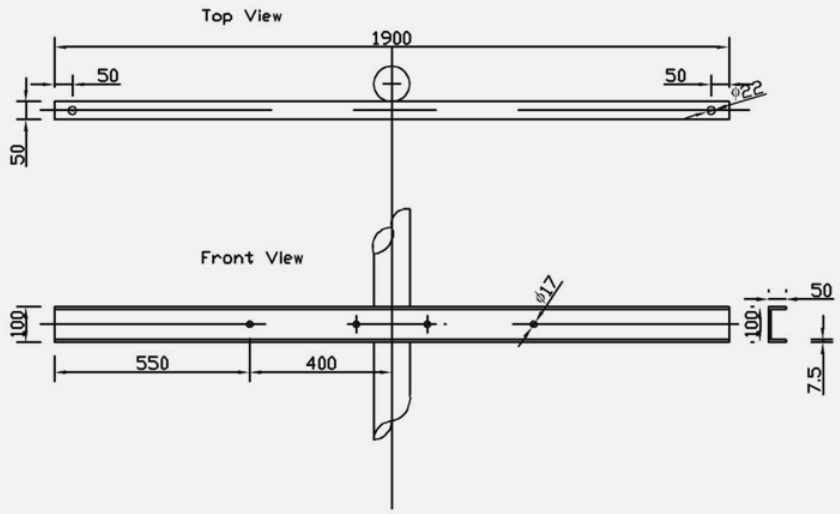
SECTION – 4

DRAWINGS

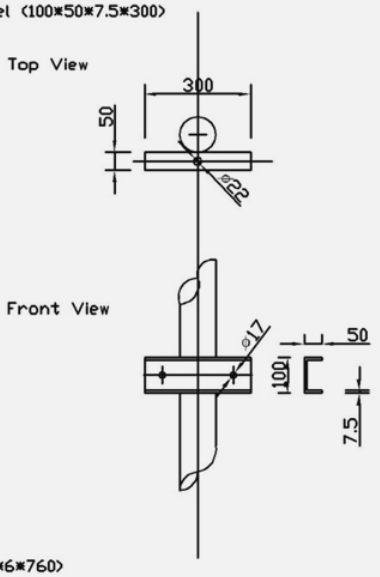
FOR

LINE AND DISTRIBUTION TRANSFORMER CONSTRUCTION WORKS

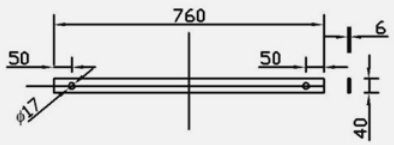
Standard Crossarm Channel (100*50*7.5*1900)



Pole Top Crossarm Channel (100*50*7.5*300)



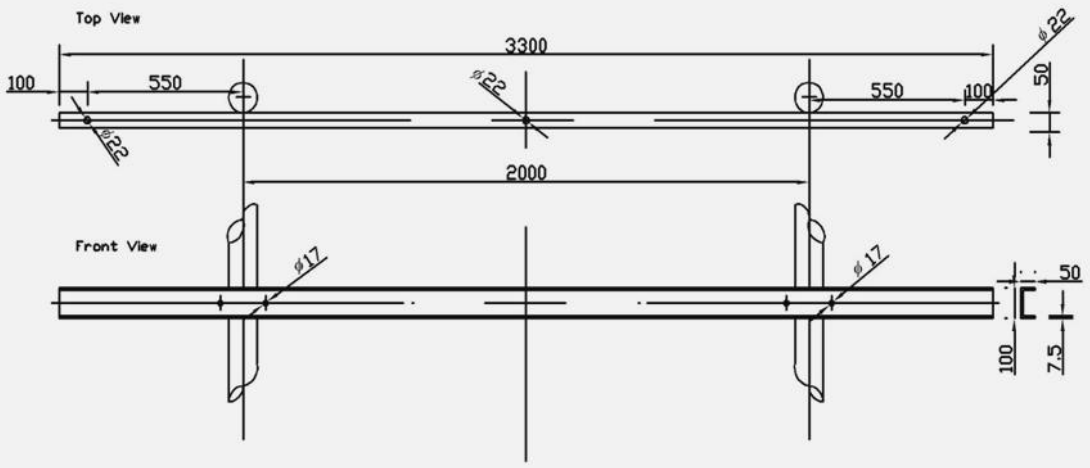
Flat Crossarm Brace (40*6*760)



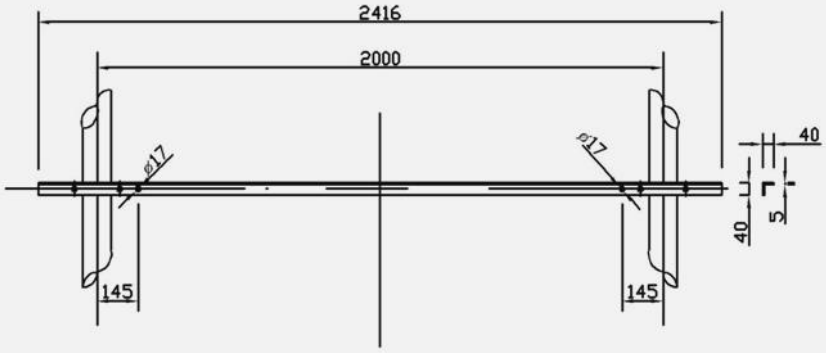
Location of holes should be confirmed prior to manufacture

Drawing	CrossArm & Bracing for	NEPAL ELECTRICITY AUTHORITY
CS33-LM-01	**33 kV Single Pole Structure**	

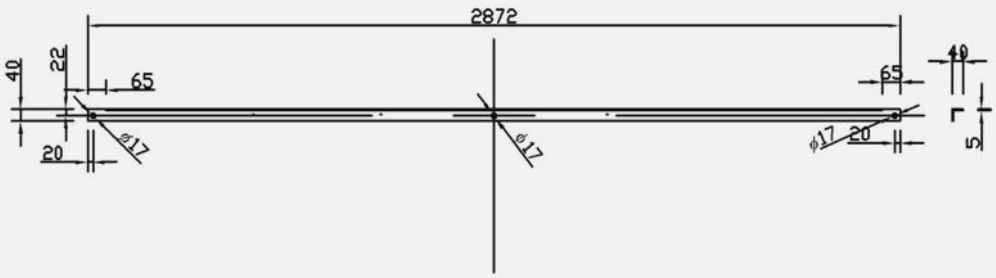
Standard Crossarm Channel (100×50×7.5×3300)



Bracing Angle (40×40×5×2416)



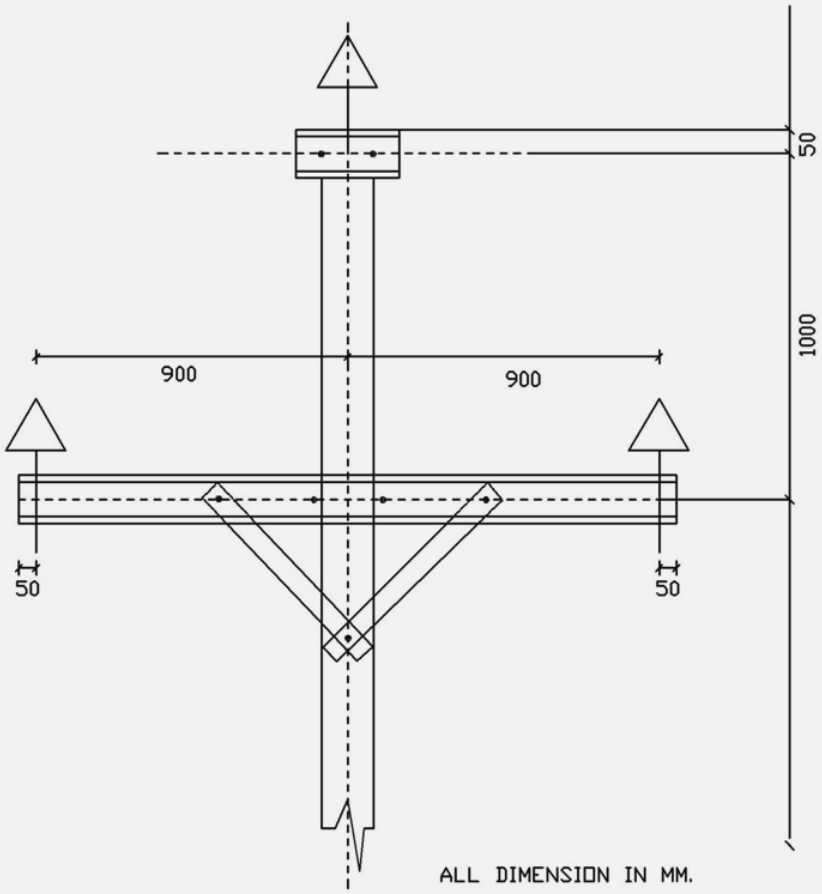
Cross Bracing Angle (40×40×5×2872)



Location of holes should be confirmed prior to manufacture

Drawing **CS33-LM-02**	**CrossArm & Bracing for 33 kV Double Pole Structure (H - Structure)**	NEPAL ELECTRICITY AUTHORITY

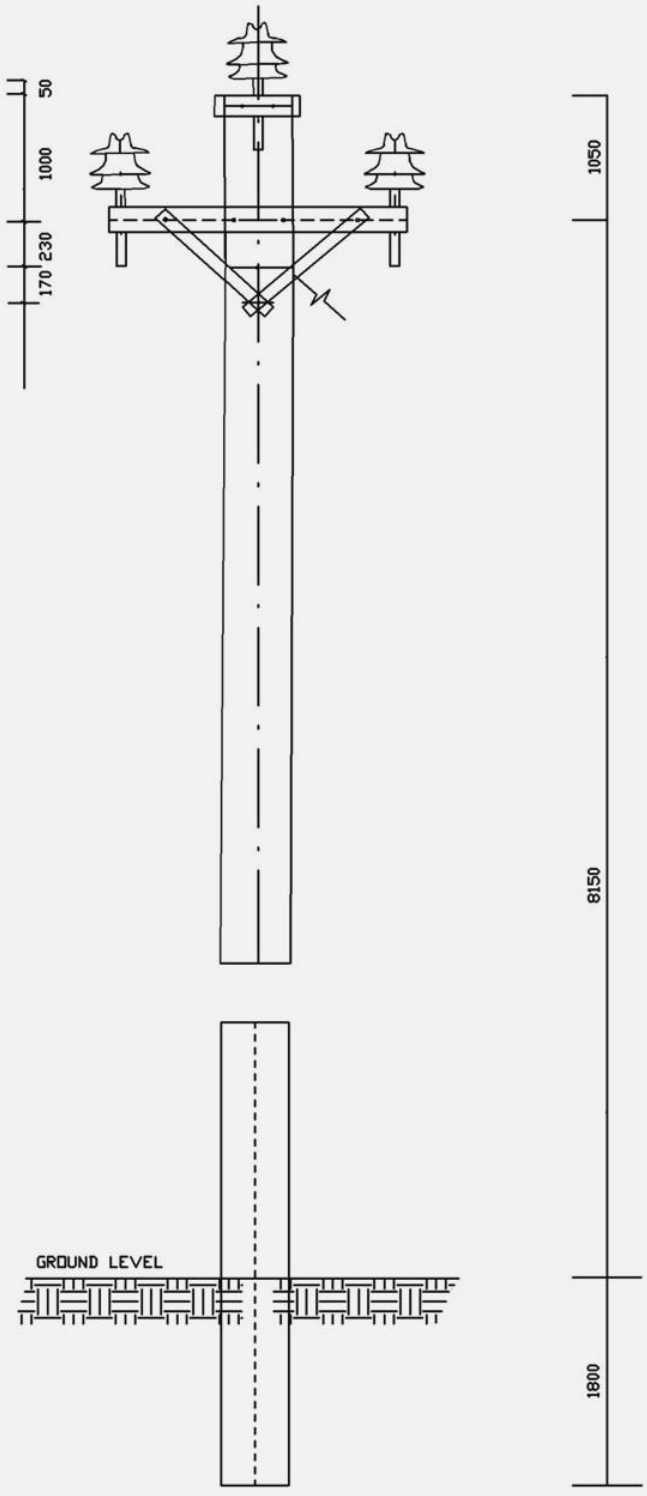
33 kV CONDUCTOR POSITIONS



ALL DIMENSION IN MM.

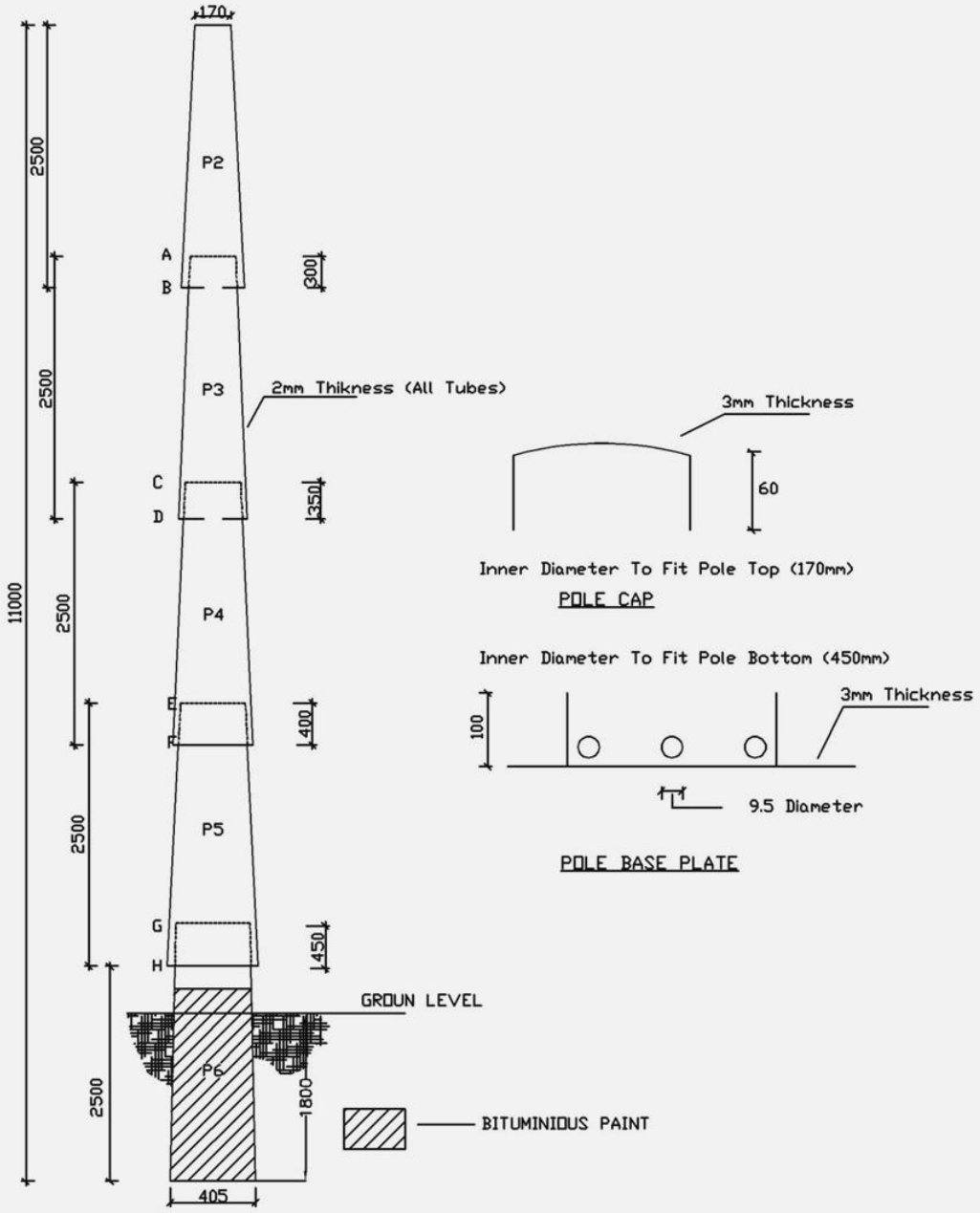
Drawing **CS33-LM-06**	**33 kV Conductor Positions**	NEPAL ELECTRICITY AUTHORITY

STEEL TELESCOPIC TUBULAR (STT) POLE



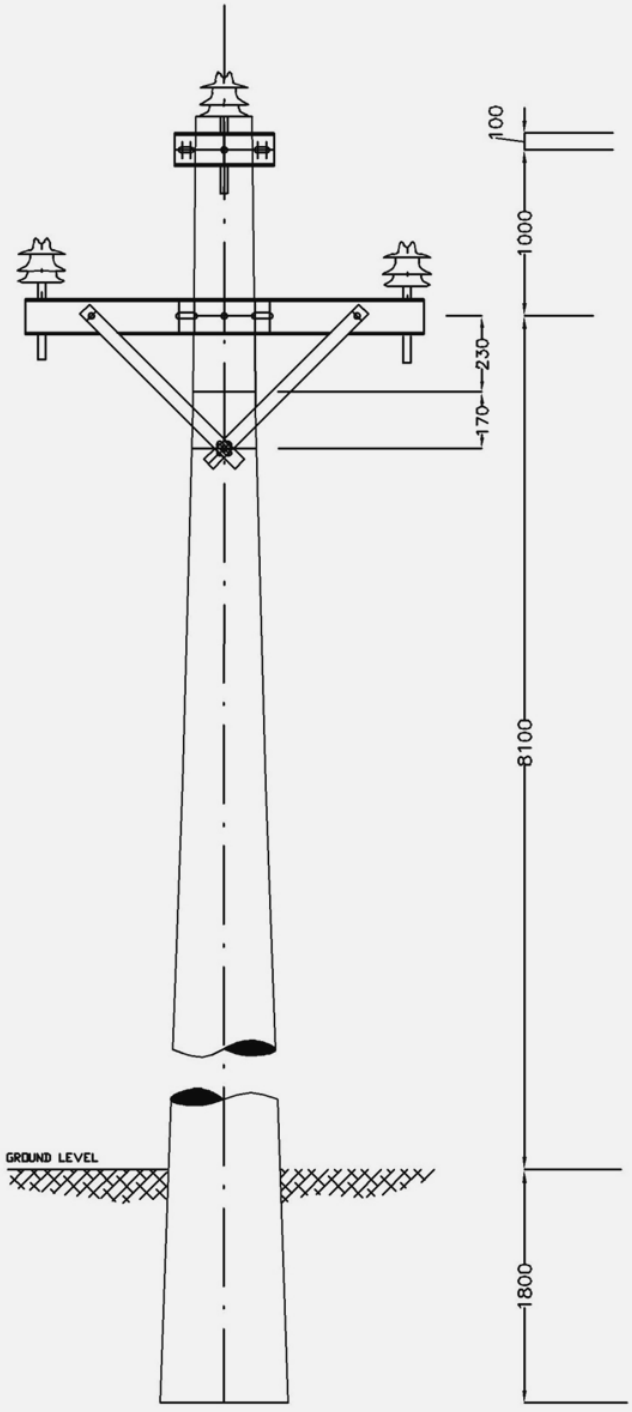
ALL DIMENSION ARE IN MM.

Drawing	33 kV, 11m STT Pole	NEPAL ELECTRICITY AUTHORITY
CS33-STTP-01	**Hole Pattern**	

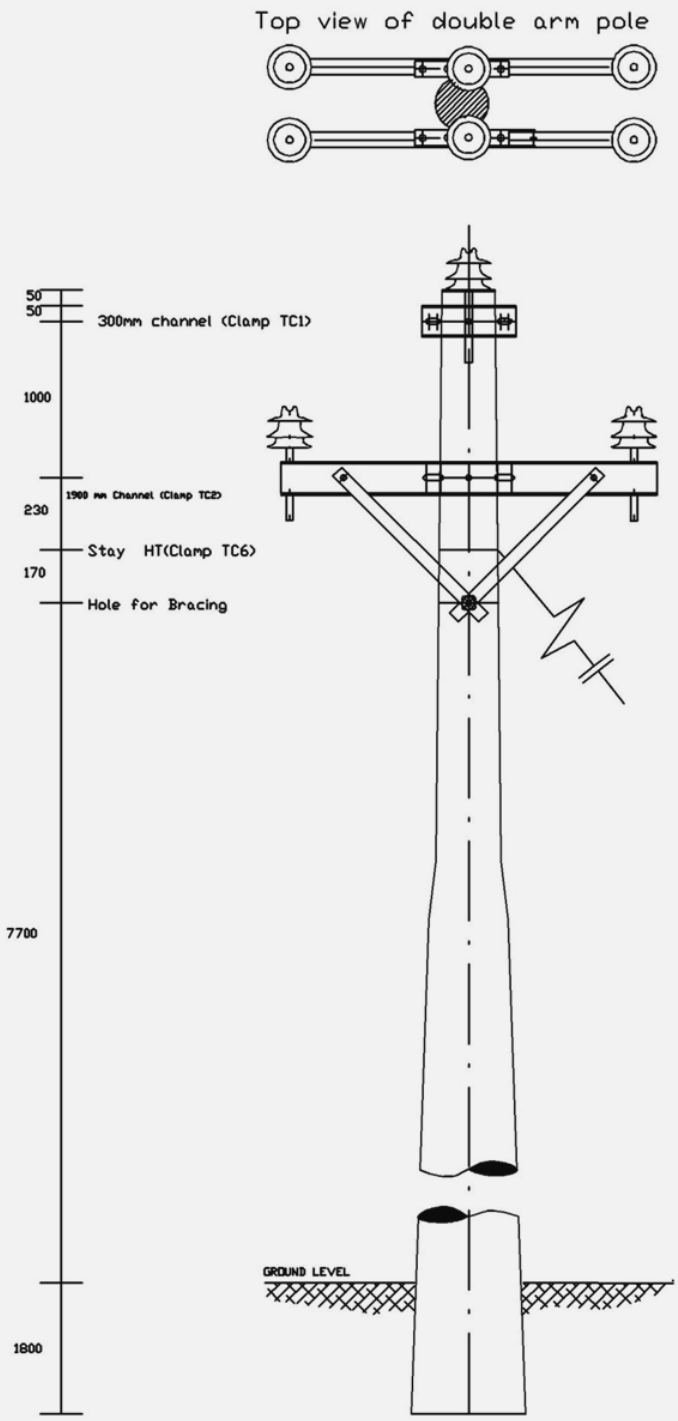


ALL DIMENSIONS ARE IN MM.

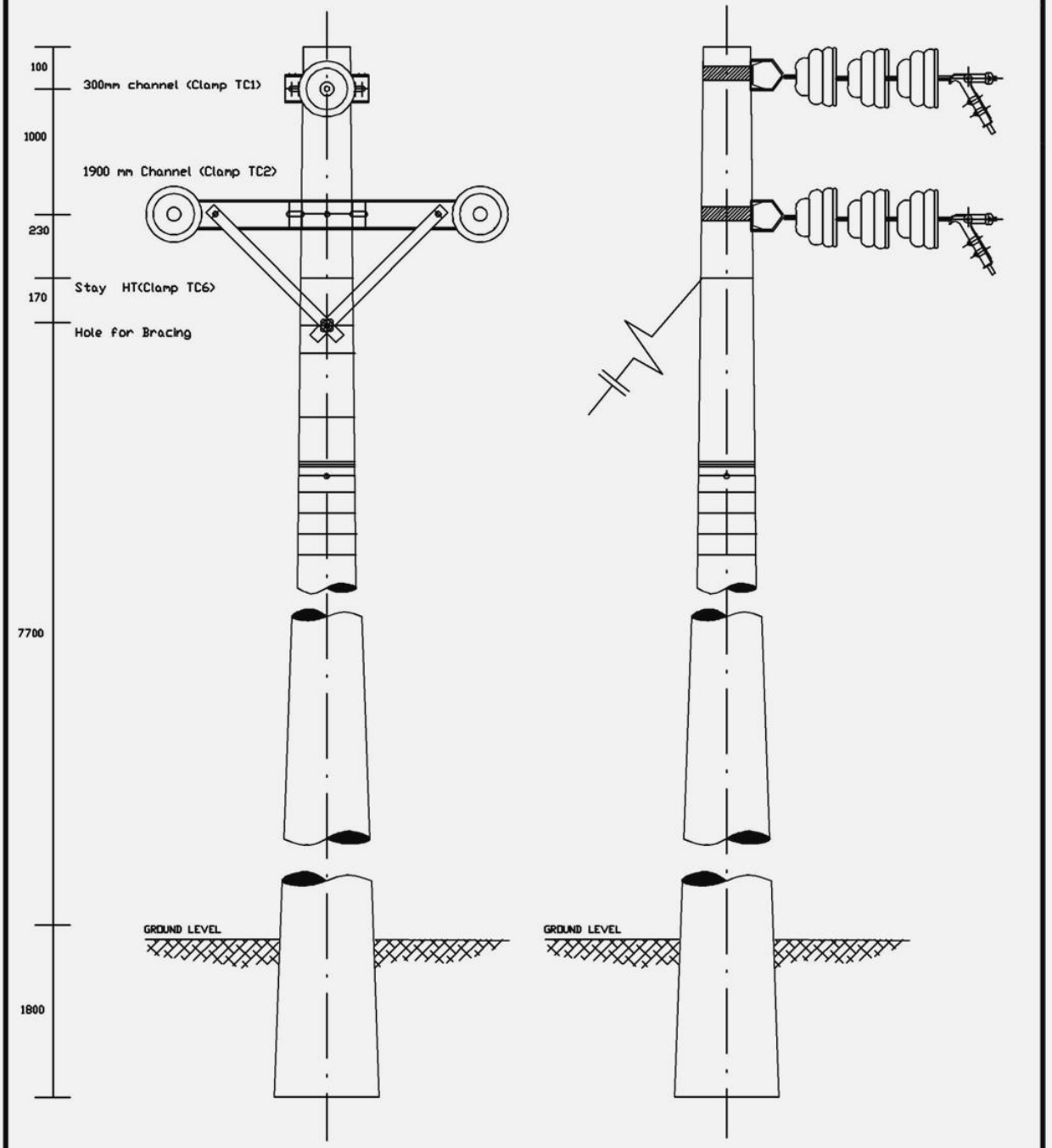
Drawing **CS33-STTP-02**	**33 kV, 11m STT Pole** **Pole Details**	NEPAL ELECTRICITY AUTHORITY



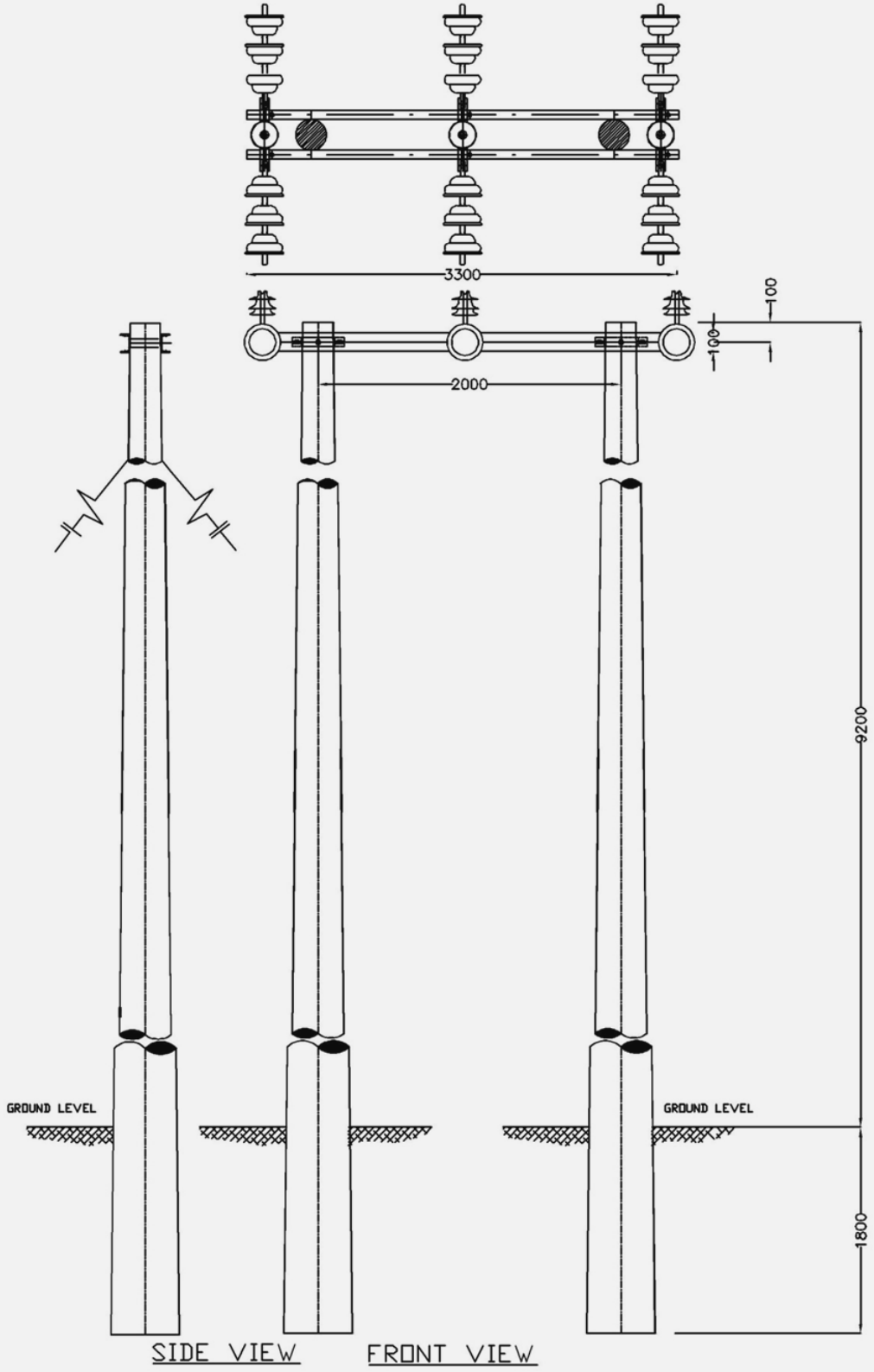
Drawing **CS33-STTP-03**	**33 kV, 11m STT Pole** **Single Arm Structure**	NEPAL ELECTRICITY AUTHORITY



Drawing **CS33-STTP-04**	**33 kV, 11m STT Pole** **Double Arm Structure**	NEPAL ELECTRICITY AUTHORITY

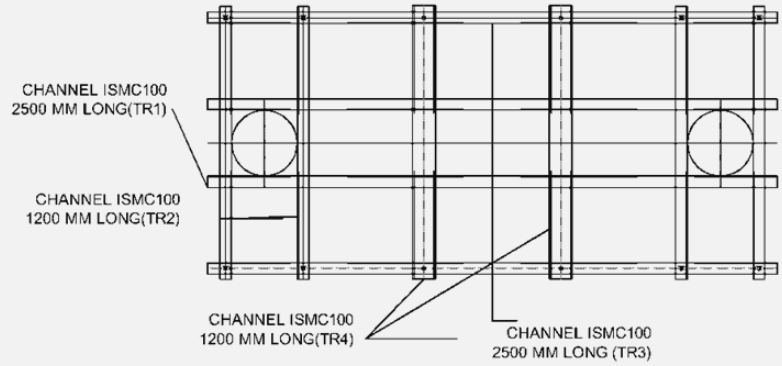


Drawing **CS33-STTP-05**	**33 kV, 11m STT Pole** **Dead End Structure**	NEPAL ELECTRICITY AUTHORITY

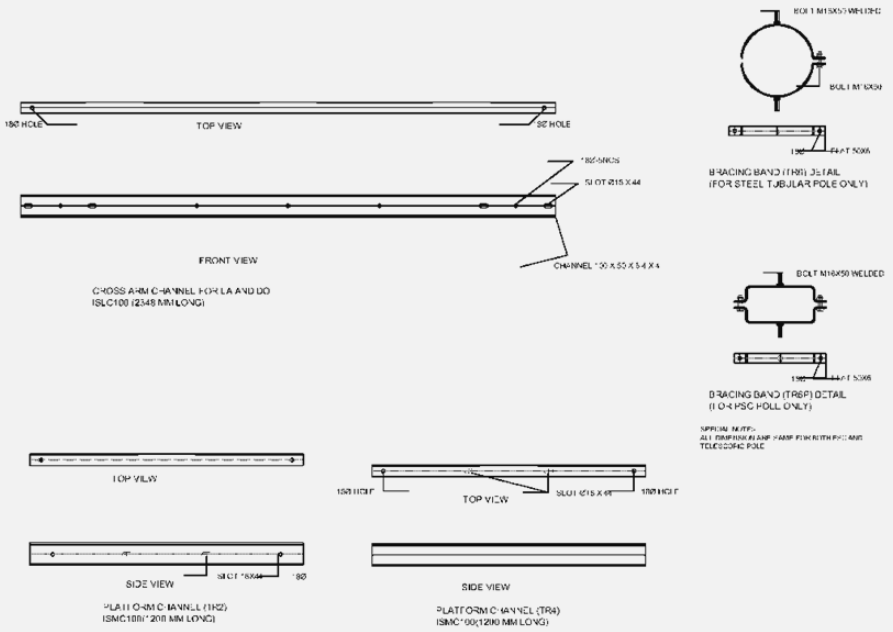


Drawing **CS33-STTP-07**	**33 kV, 11m STT Pole** **Double Pole Double Arm** **Dead End Structure**	NEPAL ELECTRICITY AUTHORITY

				Refer Drawing No: CS11 - TRN -	**01 - 04**
	S.No.	**QTY.**	**UNIT**	**MATERIAL**	
	1	6	NOS	PIN INSULATOR WITH PIN AND NUTS/WASHER	
	2	2	NOS	STEEL CROSSARM CHANNEL(50x100x6.4 x300) mm.	
	3	2	NOS	POLE CLAMP WITH NUTS, BOLTS AND WASHERS (PC1)	
	4	2	NOS	STEEL CROSSARM CHANNEL(500x100x 6.4 x 1200) mm.	
	5	2	NOS	POLE CLAMP WITH NUTS, BOLTS AND WASHERS (PC2)	
	6	4	NOS	FLAT CROSS ARM	
	7	3	NOS	9 kV SURGE ARRESTOR	
	8	3	NOS	DISTRIBUTION CUTOUT WITH FUSE HOLDERS	
	9	1	NOS	CHANNEL FOR LA & DO ISLC 1002348 MM	
	10	2	NOS	PLATFORM CHANNEL (TR1) ISMC 100 2500 MM	
	11	2	NOS	PLATFORM CHANNEL (TR3) ISMC 100 2500 MM	
	12	4	NOS	PLATFORM CHANNEL (TR2) ISMC 100 1200 MM	
	13	2	NOS	PLATFORM CHANNEL (TR4) ISMC 100 1200 MM	
	14	8	NOS	BRACING ANGLE (TR5) 50 X 50 X 5841 MM	
	15	2	SET	BRACING BAND (TR6 OR TR6P) WITH 2-M16 BOLT, 2-M16 X 50 BOLT, 8-M16 NUT, 8-M16 WASHER	
	16	16	NOS	M16 X 50 BOLT WITH 2-M16 NUT, 2-M16 WASHER	
	17	8	NOS	M16 X 250 BOLT WITH 2-M16 NUT, 2-M16 WASHER	
	18	8	NOS	M16 X 350 BOLT WITH 2-M16 NUT, 2-M16 WASHER	
	19	1	NOS	TRANSFORMER	
	20	3	NOS	TRANSFORMER EARTHING	
	21	AS REQ.	M	GROUNDING CONDUCTOR (COPPER)	
	22	6	NOS	PREFORM TIES	
	23	2	NOS	STEEL TUBULAR POLE/ PSC POLE	
CONSTRUCTION STANDARDS				**NEPAL ELECTRICITY AUTHORITY**	
11/0.4 kV TRANSFORMER STRUCTURE					
(INTERMEDIATE)					

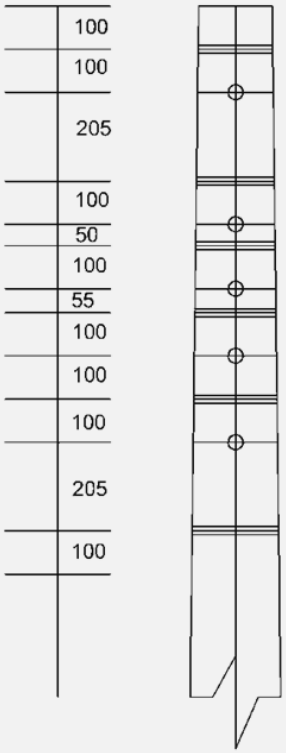


TRANSFORMER PLAT-FORM TOP VIEW

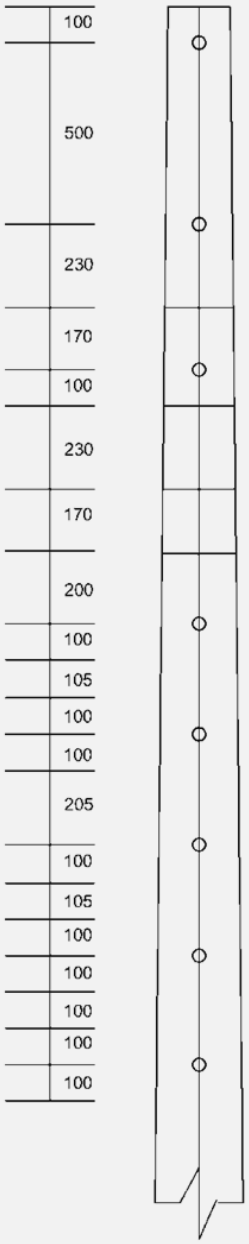


Drawing CS11-TRN-05	**Transformer Platform and Accessories**	NEPAL ELECTRICITY AUTHORITY

Steel Tubular Pole (STP)



9 Meter STP

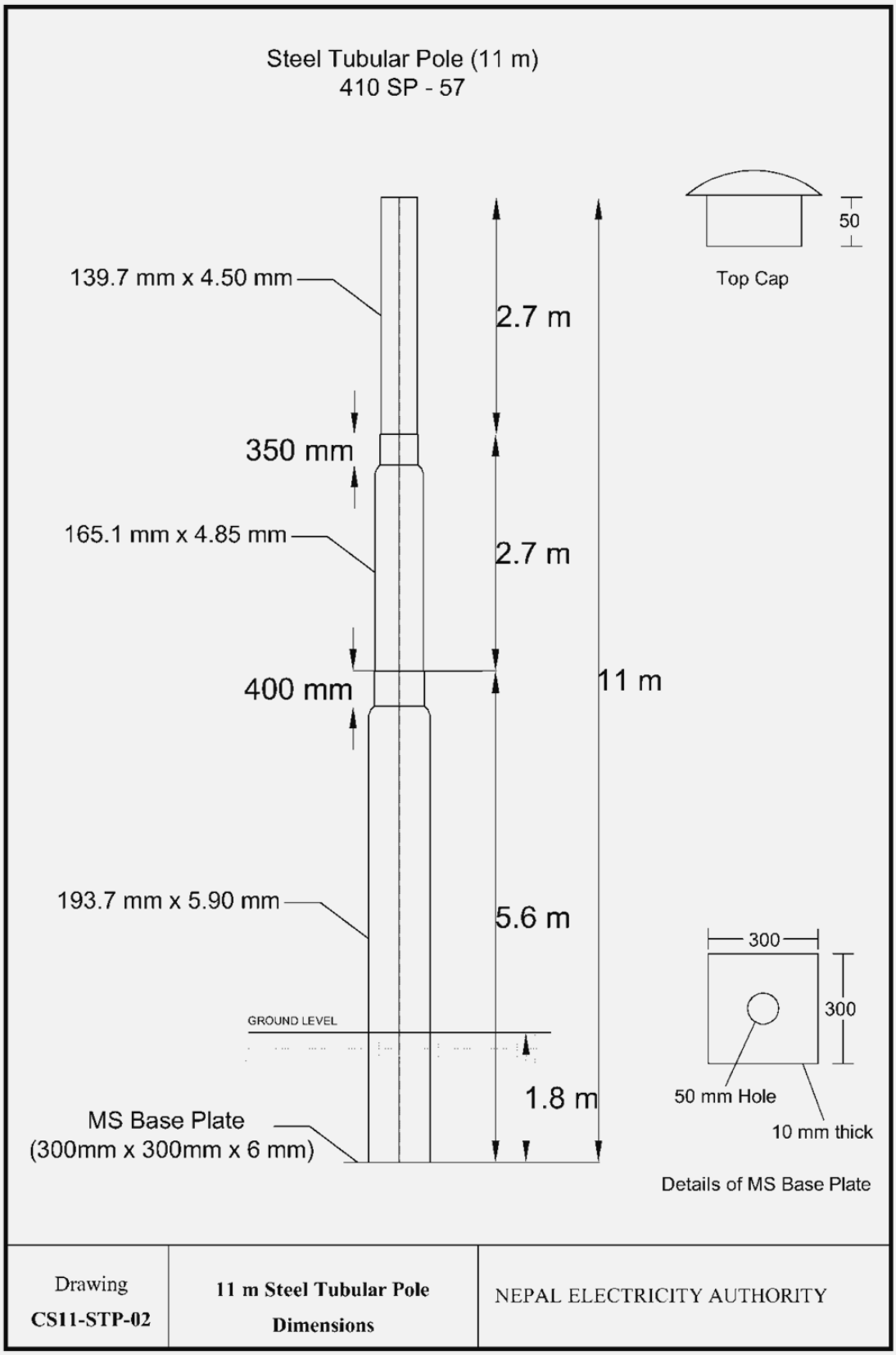


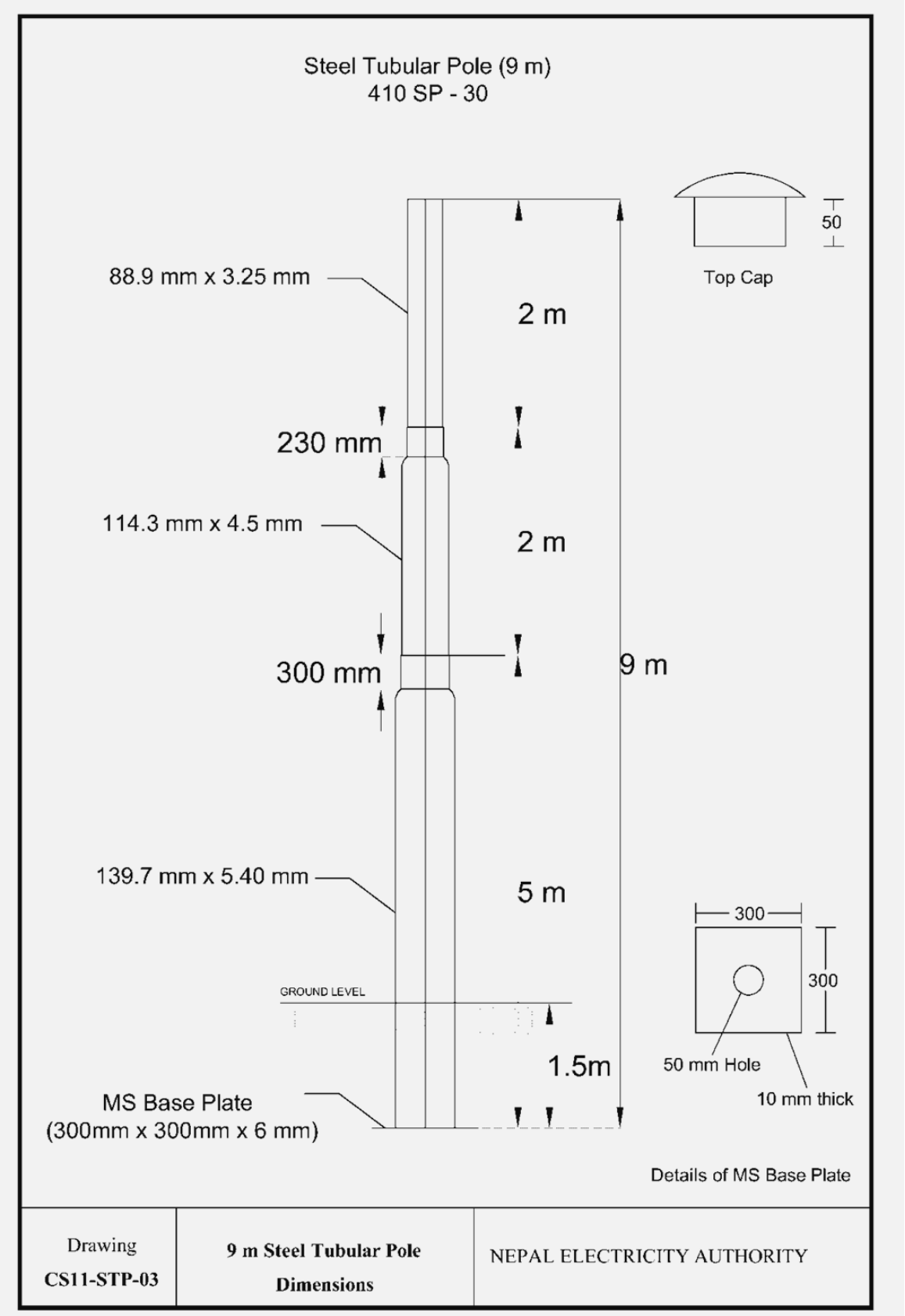
11 Meter STP

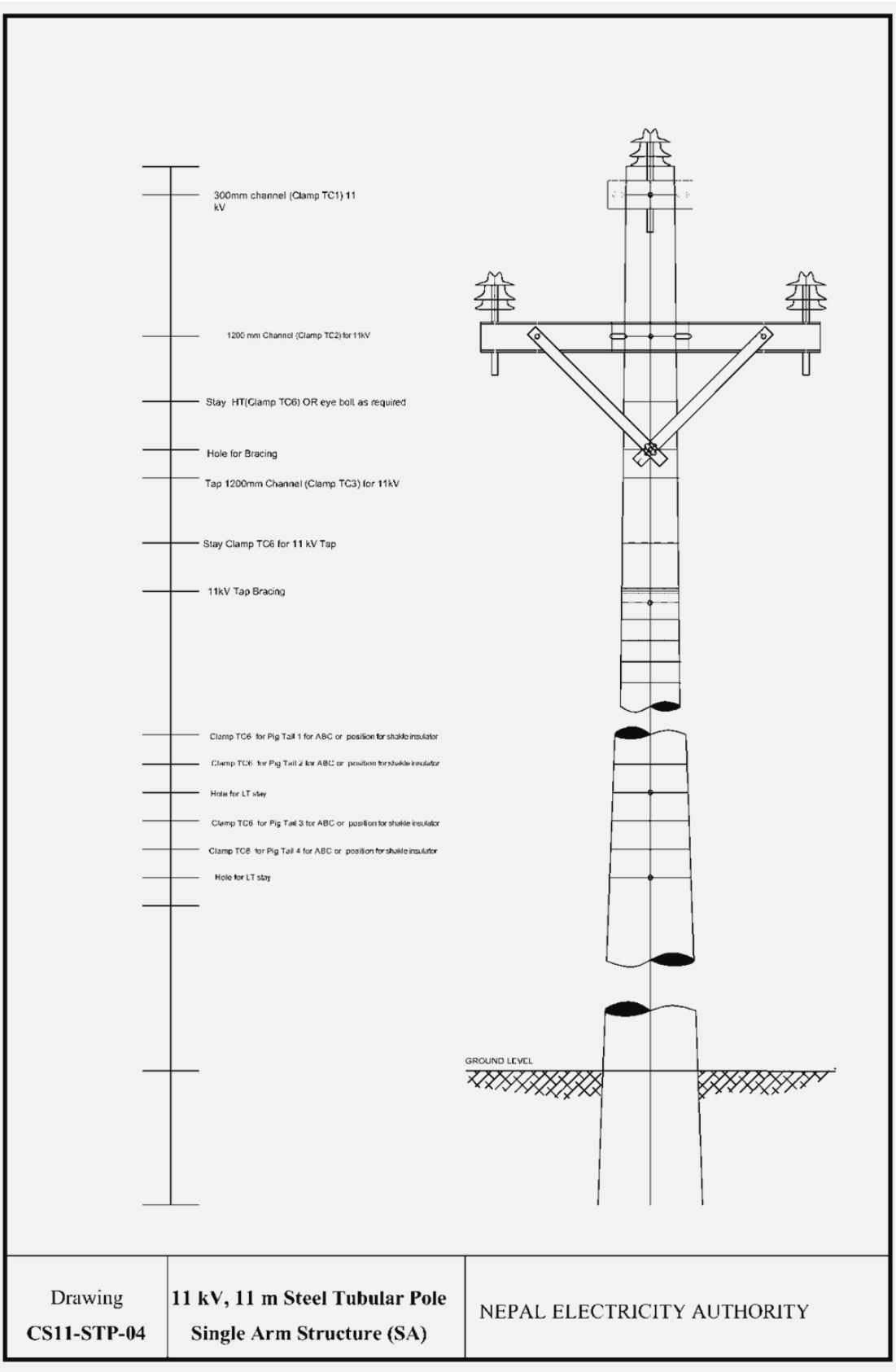
Hole diameter is 18 mm

Note: All dimensions are in mm

Drawing	9/11 m Steel Tubular Pole	NEPAL ELECTRICITY AUTHORITY
CS11-STP-01	**Hole Pattern**	


Steel Tubular Pole (11 m)
410 SP - 57
139.7 mm x 4.50 mm
165.1 mm x 4.85 mm
193.7 mm x 5.90 mm
MS Base Plate
(300mm x 300mm x 6 mm)
350 mm
400 mm
2.7 m
2.7 m
5.6 m
1.8 m
11 m
GROUND LEVEL
50
Top Cap
300
300
50 mm Hole
10 mm thick
Details of MS Base Plate
Drawing
CS11-STP-02
11 m Steel Tubular Pole
Dimensions
NEPAL ELECTRICITY AUTHORITY

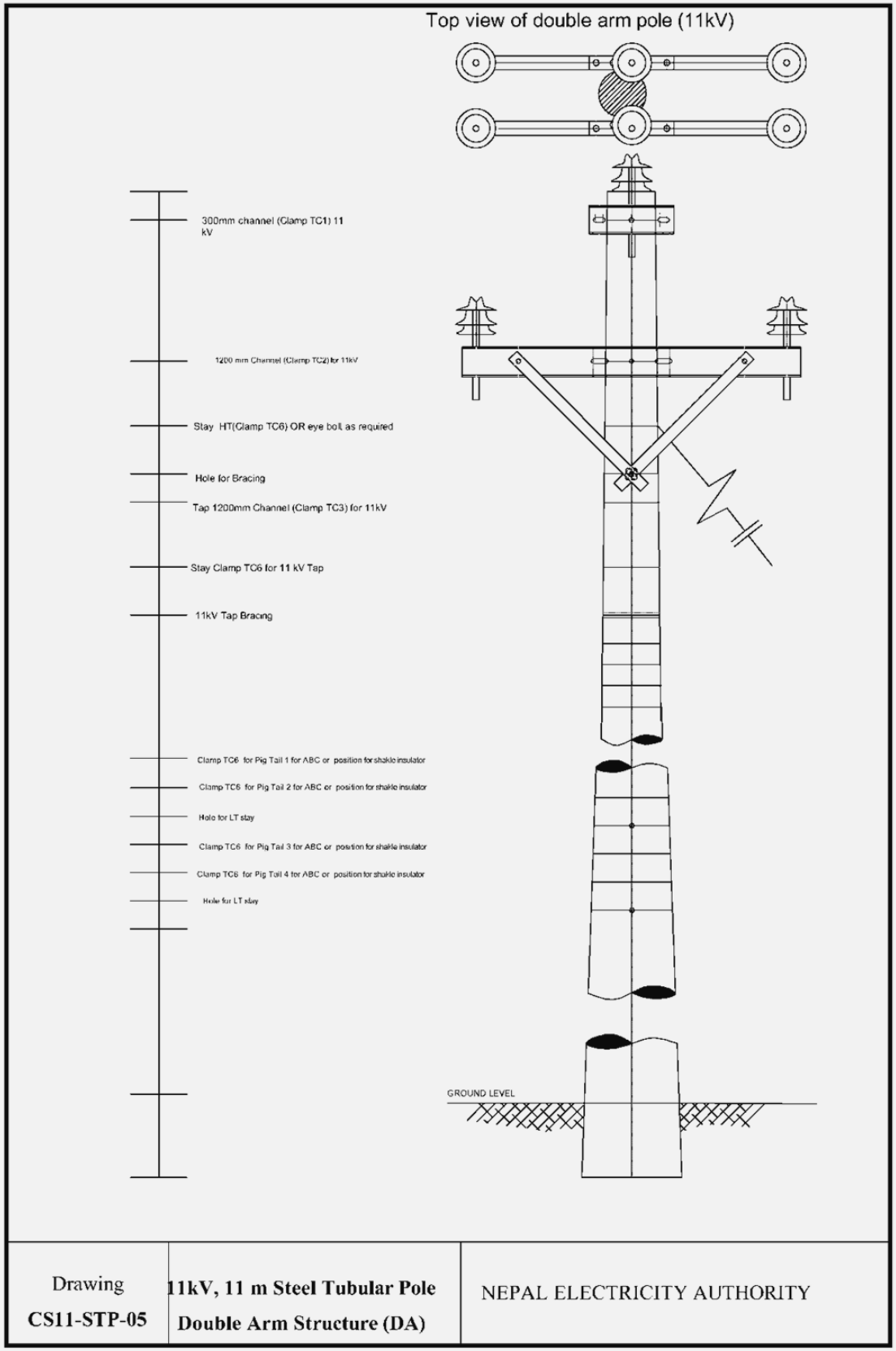

Steel Tubular Pole (9 m)
410 SP - 30
50
Top Cap
88.9 mm x 3.25 mm
2 m
230 mm
114.3 mm x 4.5 mm
2 m
300 mm
9 m
139.7 mm x 5.40 mm
5 m
GROUND LEVEL
1.5m
MS Base Plate
(300mm x 300mm x 6 mm)
300
300
50 mm Hole
10 mm thick
Details of MS Base Plate
Drawing
CS11-STP-03
9 m Steel Tubular Pole
Dimensions
NEPAL ELECTRICITY AUTHORITY



Drawing	11 kV, 11 m Steel Tubular Pole	NEPAL ELECTRICITY AUTHORITY
CS11-STP-04	**Single Arm Structure (SA)**	

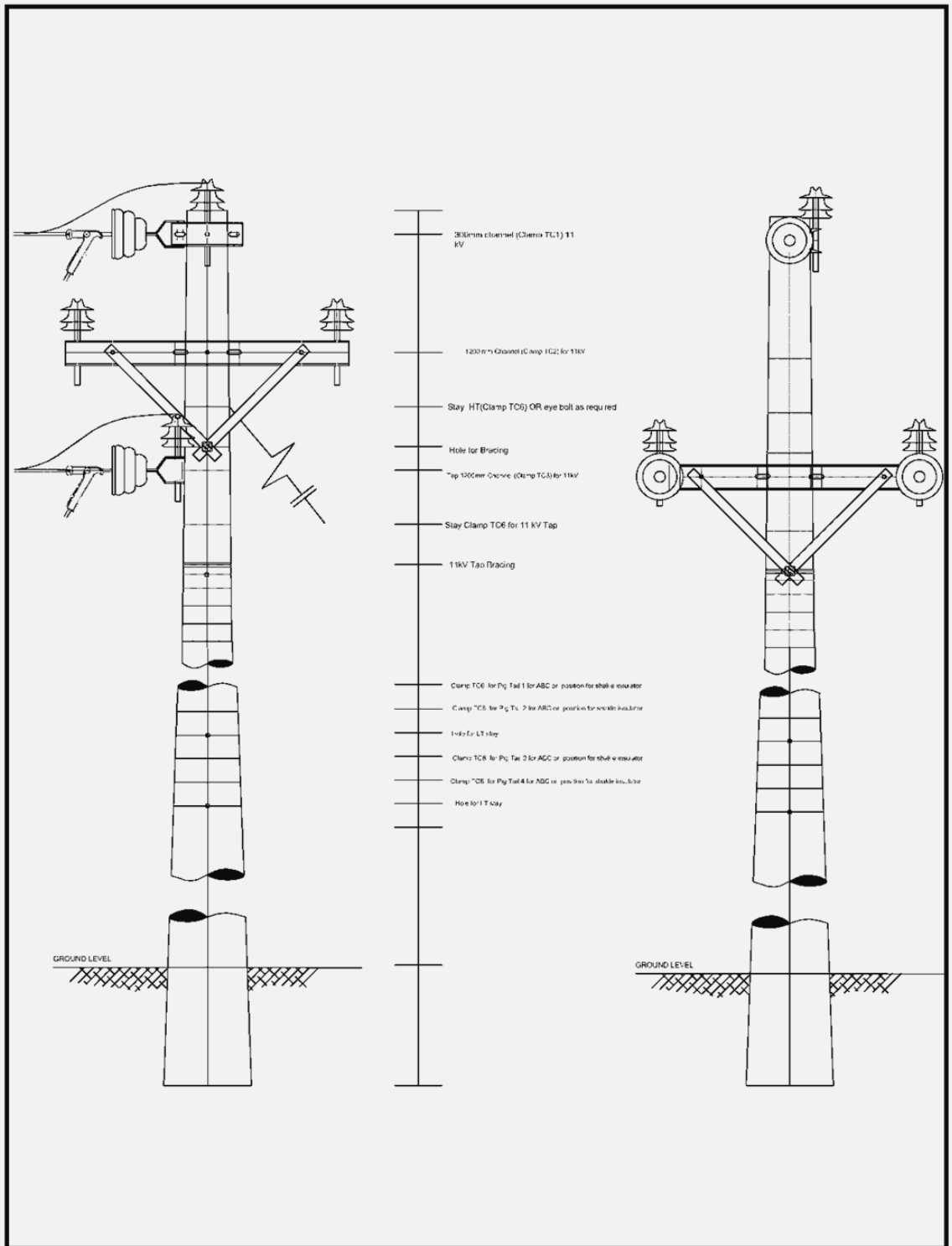
S.No.	QTY.	UNIT	MATERIAL
1	3	NOS	PIN INSULATOR WITH PIN AND NUTS/WASHER
2	1	NOS	STEEL CROSSARM CHANNEL (50x100x300) mm.
3	1	NOS	POLE CLAMP WITH NUTS, BOLTS AND WASHERS (TC1)
4	1	NOS	STEEL CROSSARM CHANNEL (50x100x1200) mm.
5	1	NOS	POLE CLAMP WITH NUTS, BOLTS AND WASHERS (TC2)
6	2	NOS	FLAT CROSSARM BRACE (40 X 6 X 660) mm
7	1	LOT	BOLTS WITH SUITABLE NUTS AND WASHERS
8	3	NOS	PREFORMED WIRE (TOP TIE)
9	1	NOS	STEEL TUBULAR POLE 11 M

CONSTRUCTION STANDARDS **11 kV SINGLE ARM STRUCTURE (SA)** **STEEL TUBULAR POLE**	**NEPAL ELECTRICITY AUTHORITY**


Top view of double arm pole (11kV)
300mm channel (Clamp TC1) 11 kV
1200 mm Channel (Clamp TC2) for 11kV
Stay HT(Clamp TC6) OR eye bolt as required
Hole for Bracing
Tap 1200mm Channel (Clamp TC3) for 11kV
Stay Clamp TC6 for 11 kV Tap
11kV Tap Bracing
Clamp TC6 for Pig Tail 1 for ABC or position for shakle insulator
Clamp TC6 for Pig Tail 2 for ABC or position for shakle insulator
Hole for LT stay
Clamp TC6 for Pig Tail 3 for ABC or position for shakle insulator
Clamp TC6 for Pig Tail 4 for ABC or position for shakle insulator
Hole for LT stay
GROUND LEVEL
Drawing
CS11-STP-05
11kV, 11 m Steel Tubular Pole
Double Arm Structure (DA)
NEPAL ELECTRICITY AUTHORITY

S.No.	QTY.	UNIT	MATERIAL
1	6	NOS	PIN INSULATOR WITH PIN AND NUTS/WASHER
2	2	NOS	STEEL CROSSARM CHANNEL (50x100x300) mm.
3	2	NOS	STEEL CROSSARM CHANNEL (50x100x1200) mm.
4	4	NOS	FLAT CROSSARM BRACE (40 X 6 X 660) mm
5	1	LOT	BOLTS WITH SUITABLE NUTS AND WASHERS
6	6	NOS	PREFORMED WIRE (DOUBLE SIDE TIES)
7	1	NOS	STEEL TUBULAR POLE - 11 M

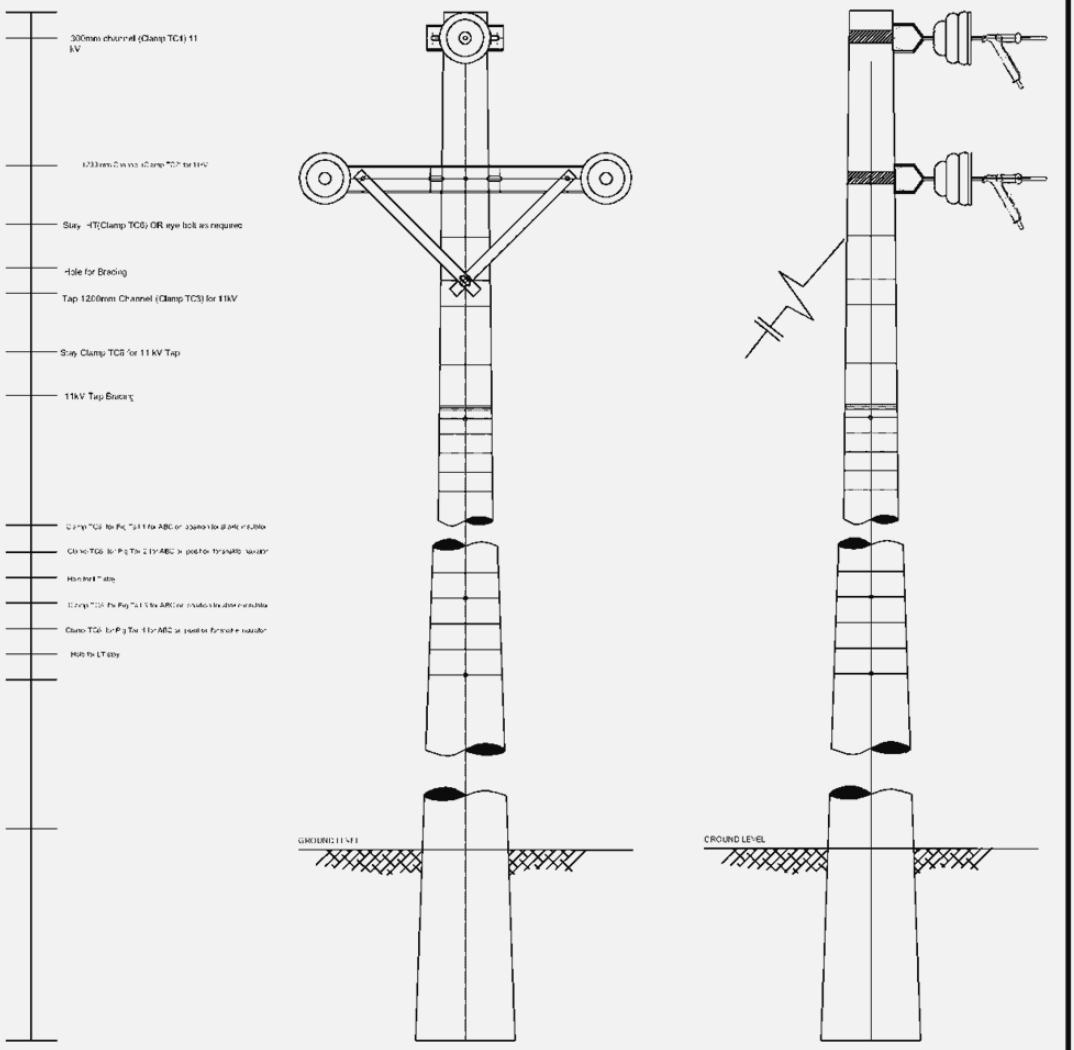
CONSTRUCTION STANDARDS **11 kV DOUBLE ARM STRUCTURE (DA)** **STEEL TUBULAR POLE**	**NEPAL ELECTRICITY AUTHORITY**



Drawing	11kV, 11 m Steel Tubular Pole	NEPAL ELECTRICITY AUTHORITY
CS11-STP-06	**Tap Off Structure (TO)**	

S.No.	QTY.	UNIT	MATERIAL
1	5	NOS	PIN INSULATOR WITH PIN AND NUTS/WASHER
2	3	SET	DISC INSULATOR WITH HARDWARE
3	3	NOS	DEAD END CLAMPS
4	1	NOS	STEEL CROSSARM CHANNEL (50x100x300) mm.
5	1	NOS	POLE CLAMP WITH NUTS, BOLTS AND WASHERS (TC1)
6	2	NOS	STEEL CROSSARM CHANNEL (50x100x1200) mm.
7	1	NOS	POLE CLAMP WITH NUTS, BOLTS AND WASHERS (TC3)
8	4	NOS	FLAT CROSSARM BRACE (40 X 6 X 660) mm
9	1	LOT	BOLTS WITH SUITABLE NUTS AND WASHERS
10	5	NOS	PREFORMED WIRE (TOP TIE)
11	3	NOS	INSULATED PIERCING CONNECTORS
12	1	SET	HT STAY (TYPE AS REQUIRED)
13	1	NOS	STEEL TUBULAR POLE - 11 M

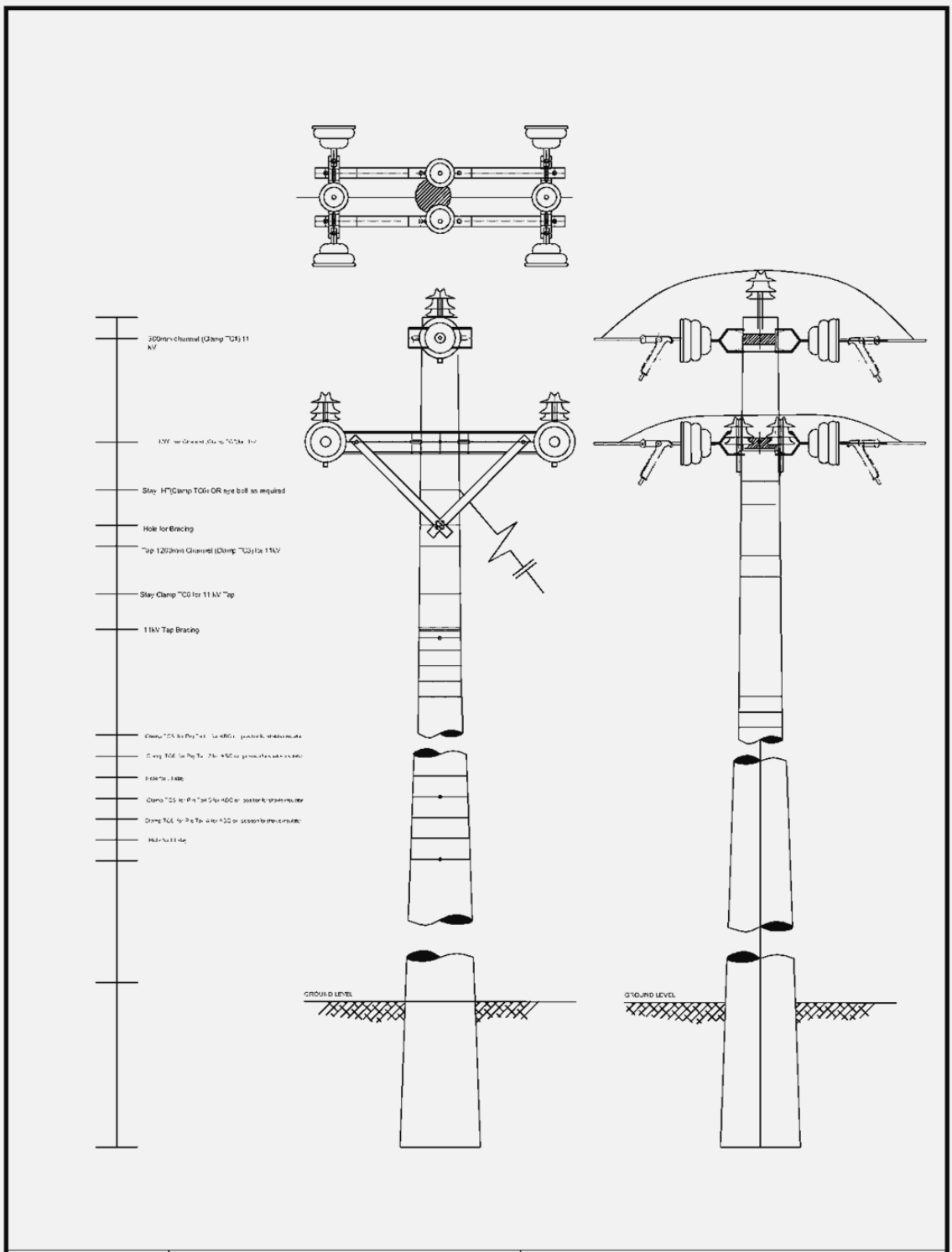
CONSTRUCTION STANDARDS **11 kV TAP OFF STRUCTURE (TO)** **STEEL TUBULARPOLE**	**NEPAL ELECTRICITY AUTHORITY**



Drawing	11kV, 11 m Steel Tubular Pole	NEPAL ELECTRICITY AUTHORITY
CS11-STP-07	**Dead End Structure (DE)**	

S.No.	QTY.	UNIT	MATERIAL
1	3	NOS	DISC INSULATOR WITH HARDWARE
2	3	NOS	DEAD END CLAMPS
3	1	NOS	STEEL CROSSARM CHANNEL (50x100x300) mm.
4	1	NOS	POLE CLAMP WITH NUTS, BOLTS AND WASHERS T)
5	1	NOS	STEEL CROSSARM CHANNEL (50x100x1200) mm.
6	1	NOS	POLE CLAMP WITH NUTS, BOLTS AND WASHERS (TC2)
7	2	NOS	FLAT CROSSARM BRACE (40 X 6 X 660) mm
8	1	LOT	BOLTS WITH SUITABLE NUTS AND WASHERS
9	1	SET	HT STAY (TYPE AS REQUIRED)
10	1	NOS	STEEL TUBULAR POLE – 11m

CONSTRUCTION STANDARDS **11 kV DEAD END STRUCTURE (DE)** **STEEL TUBULAR POLE**	**NEPAL ELECTRICITY AUTHORITY**

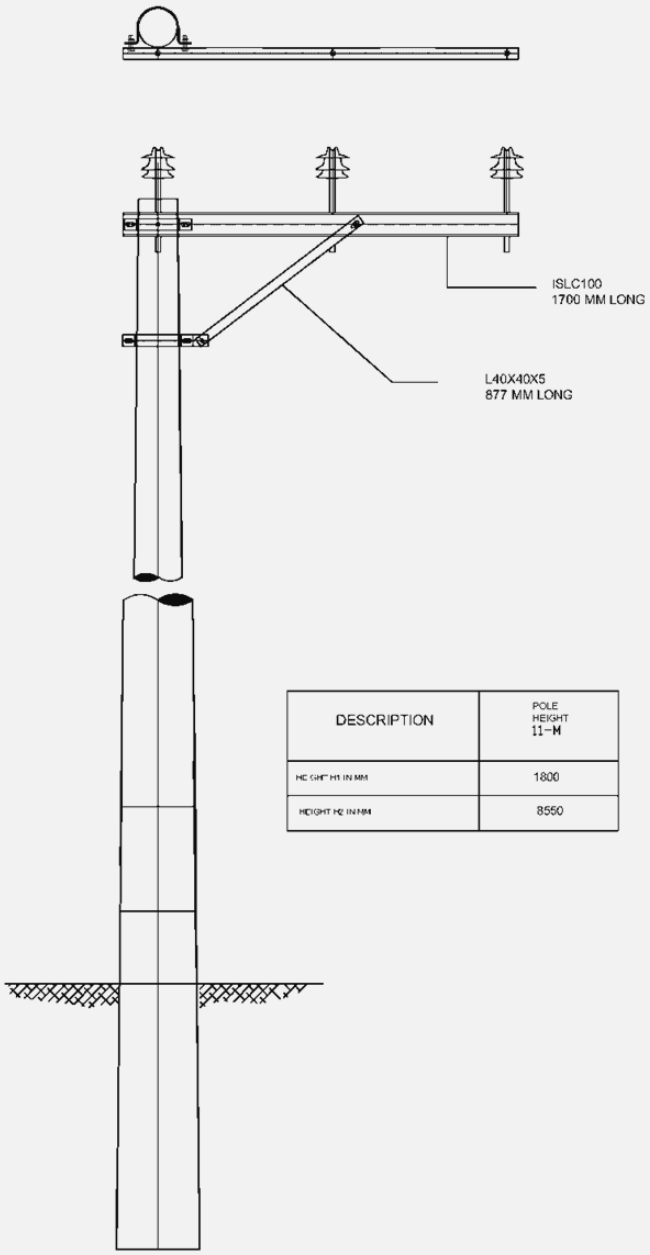


Drawing	11kV, 11 m Steel Tubular Pole	NEPAL ELECTRICITY AUTHORITY
CS11-STP-08	**Double Dead End Structure (DDE)**	

S.No.	QTY.	UNIT	MATERIAL
1	3	NOS	PIN INSULATOR WITH PIN AND NUTS/WASHER
2	6	SET	DISC INSULATOR WITH HARDWARE
3	6	NOS	DEAD END CLAMPS
4	2	NOS	STEEL CROSSARM CHANNEL (50x100x300) mm.
5	2	NOS	STEEL CROSSARM CHANNEL (50x100x1200) mm.
6	4	NOS	FLAT CROSSARM BRACE (40 X 6 X 660) mm
7	1	LOT	BOLTS WITH SUITABLE NUTS AND WASHERS
8	3	NOS	PREFORMED WIRE (TOP TIE)
9	3	NOS	INSULATED PIERCING CONNECTOR
10	1	NOS	STEEL TUBULAR POLE - 11 M

CONSTRUCTION STANDARDS **11 kV DOUBLE DEAD END STRUCTURE (DDE)** **STEEL TUBULAR POLE**	**NEPAL ELECTRICITY AUTHORITY**

TOP VIEW



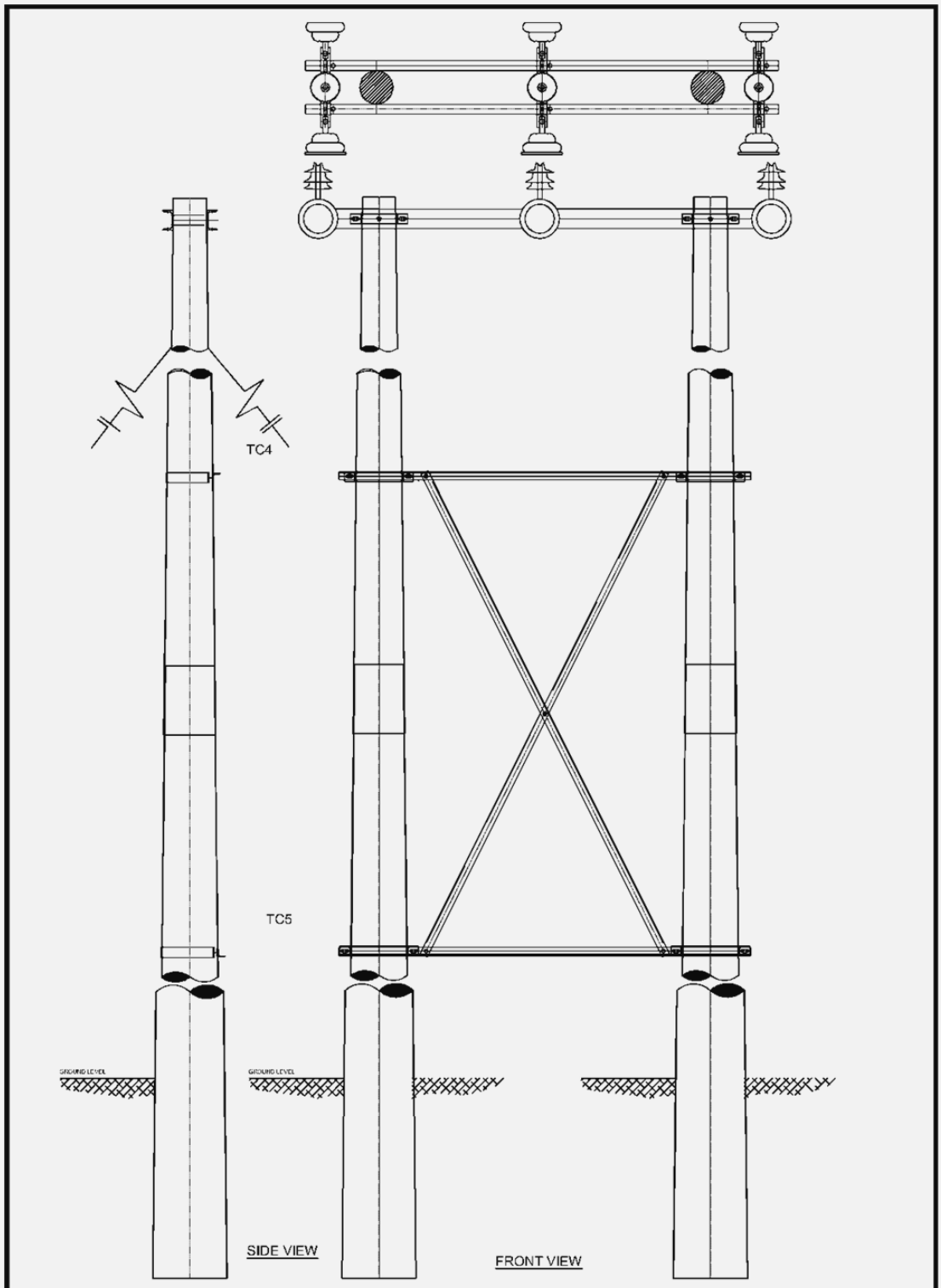
DESCRIPTION	POLE HEIGHT 11–M
HEIGHT H1 IN MM	1800
HEIGHT H2 IN MM	8550

ALL DIMENSIONS ARE IN MM

Drawing		
CS11-STP-09	**11kV, 11 m Steel Tubular Pole Offset Pole Structure (OS)**	NEPAL ELECTRICITY AUTHORITY

S.No.	QTY.	UNIT	MATERIAL
1	3	NOS	PIN INSULATOR WITH PIN AND NUTS/WASHER
2	1	NOS	STEEL CROSSARM CHANNEL (50x100x1700) mm.
3	1	NOS	POLE CLAMP WITH NUTS, BOLTS AND WASHERS (TC1)
4	1	NOS	BRACING ANGLE FOR OFFSET STRUCTURE (827 X 40 X 5) mm
5	1	NOS	POLE CLAMP WITH NUTS, BOLTS AND WASHERS (TC2)
6	4	NOS	FLAT BRACE FOR OFFSET STRUCTURE (40 X 6 X 374) mm
7	1	LOT	BOLTS WITH SUITABLE NUTS AND WASHERS
8	3	NOS	PREFORMED WIRE (TOP TIE)
9	1	NOS	STEEL TUBULAR POLE - 11 M

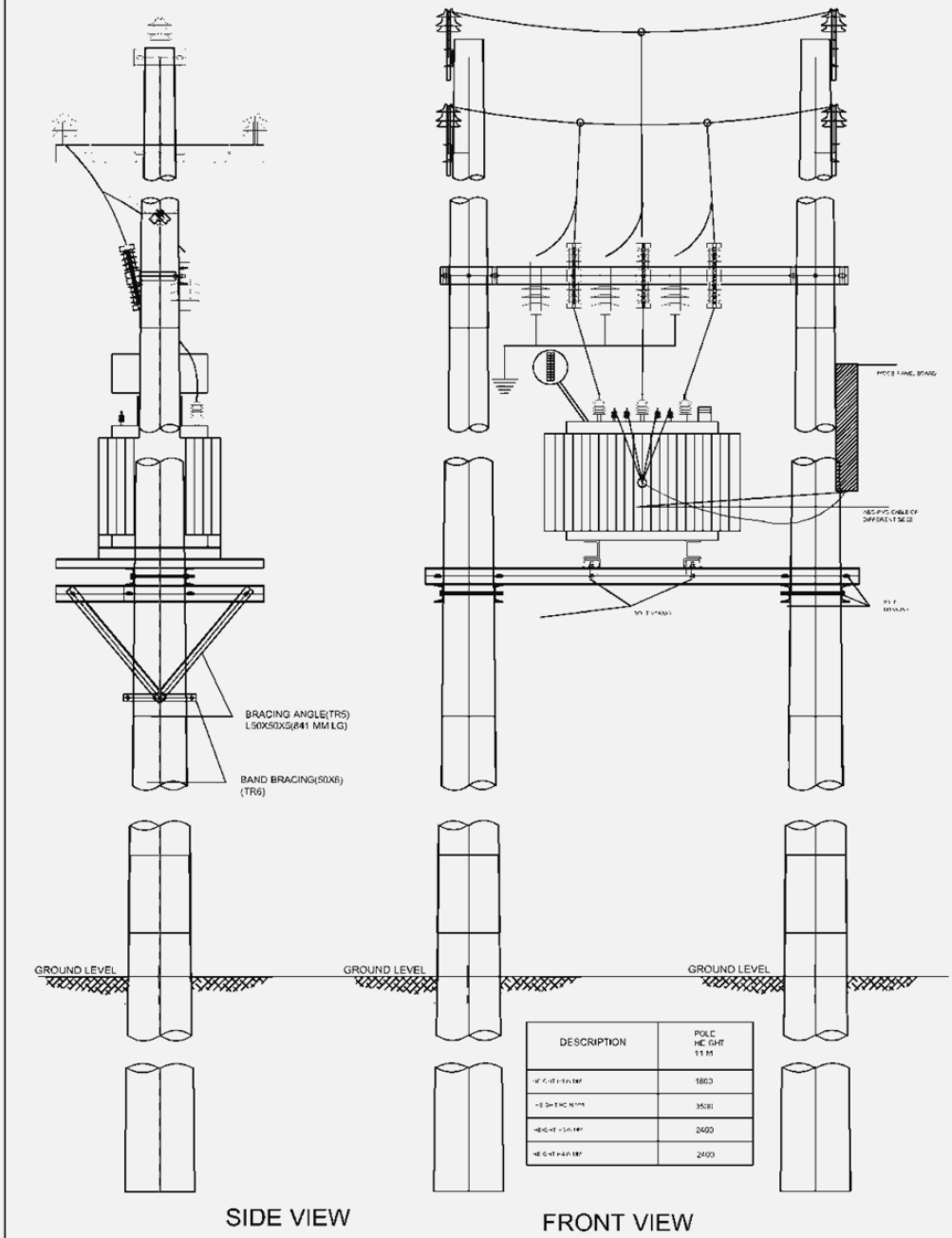
CONSTRUCTION STANDARDS **11 kV OFF SET STRUCTURE (OS)** **STEEL TUBULAR POLE**	**NEPAL ELECTRICITY AUTHORITY**



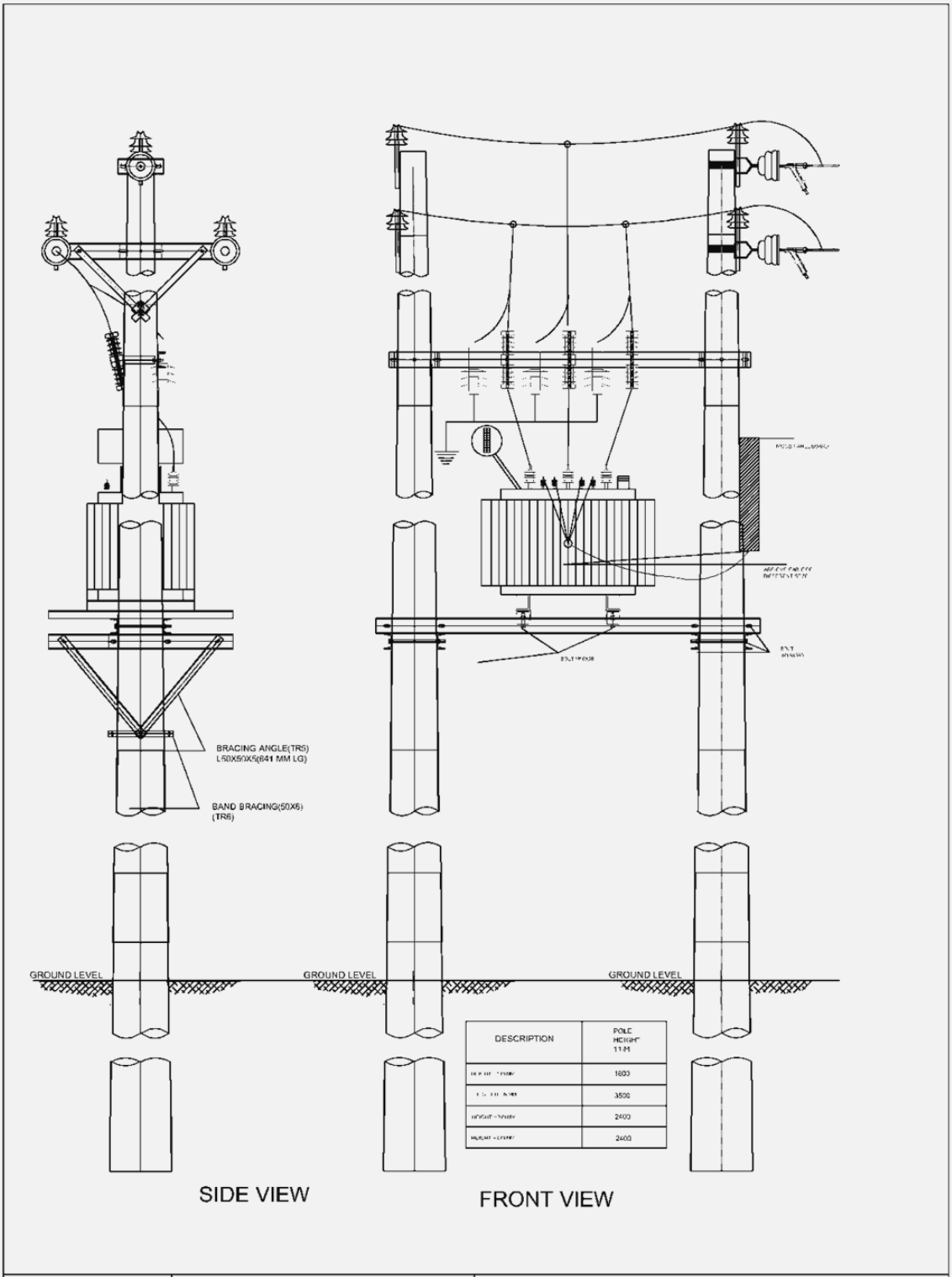
Drawing **CS11-STP-10**	**11kV, 11 m Steel Tubular Pole** **H - Structure (HS)**	NEPAL ELECTRICITY AUTHORITY

S.No.	QTY.	UNIT	MATERIAL
1	3	NOS	PIN INSULATOR WITH PIN AND NUTS/WASHER
2	6	SET	DISC INSULATOR WITH HARDWARE
3	6	NOS	DEAD END CLAMPS
4	1	NOS	STEEL CROSSARM CHANNEL (50x100x6.4 x2390) mm.
5	2	NOS	POLE CLAMP WITH NUTS, BOLTS AND WASHERS (TC1)
6	2	NOS	BRACING ANGLE (40 x 40 x 5 x 2071) mm.
7	2	NOS	POLE CLAMP WITH NUTS, BOLTS AND WASHERS (TC4)
8	2	NOS	POLE CLAMP WITH NUTS, BOLTS AND WASHERS (TC5)
9	2	NOS	BRACING ANGLE (40 x 40 x 5 x 2723) mm.
10	1	LOT	BOLTS WITH SUITABLE NUTS AND WASHERS
11	3	NOS	PREFORMED TIE (TOP TIE)
12	3	NOS	INSULATED PIERCING CONNECTORS
13	1	SET	HT STAY SET (TYPE AS REQUIRED)
14	2	NOS	STEEL TUBULAR POLE - 11 M

CONSTRUCTION STANDARDS **11 kV H - STRUCTURE (HS)** **STEEL TUBULAR POLE**	**NEPAL ELECTRICITY AUTHORITY**

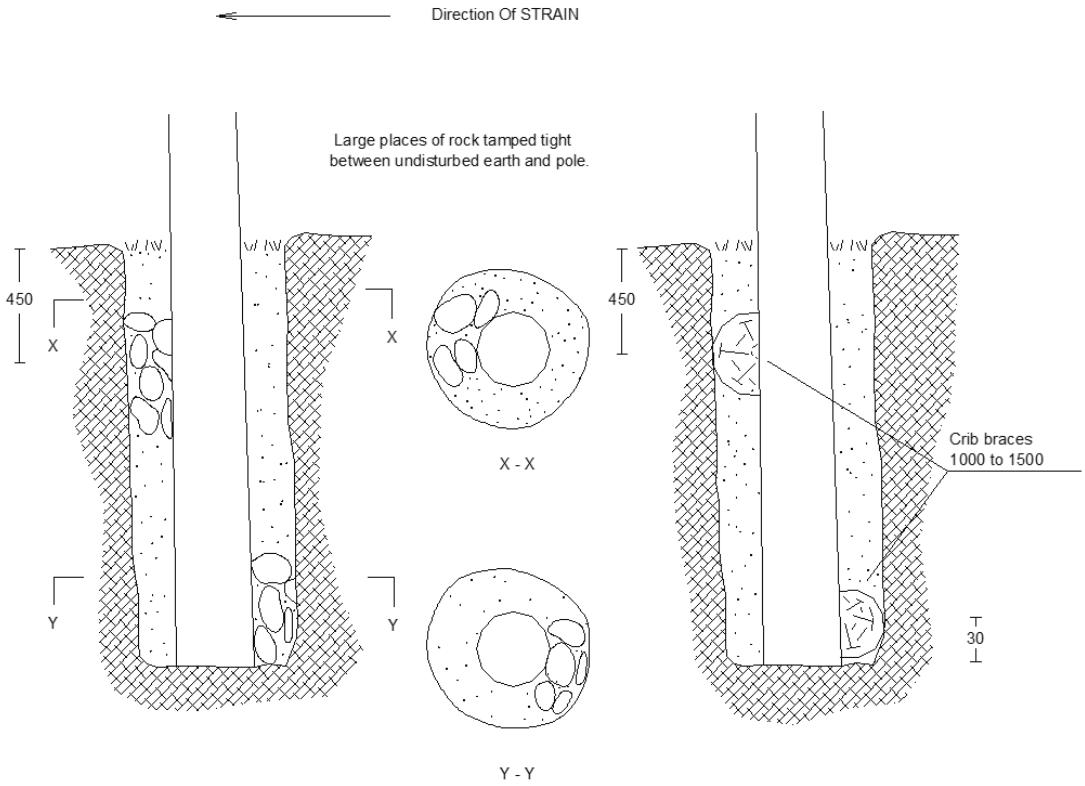


Drawing CS11-TRN-03	**11 m Steel Tubular Pole 11/0.4 Intermediate Transformer Structure (TR)**	NEPAL ELECTRICITY AUTHORITY



Drawing	11 m Steel Tubular Pole	NEPAL ELECTRICITY AUTHORITY
CS11-TRN-04	**11/0.4 Dead End Transformer Structure (TR)**	

PLOE LENGTH (m.)	DEPTH OF BURIAL (m.)
8	1.5
9	1.5
10	1.7
1·	1.8

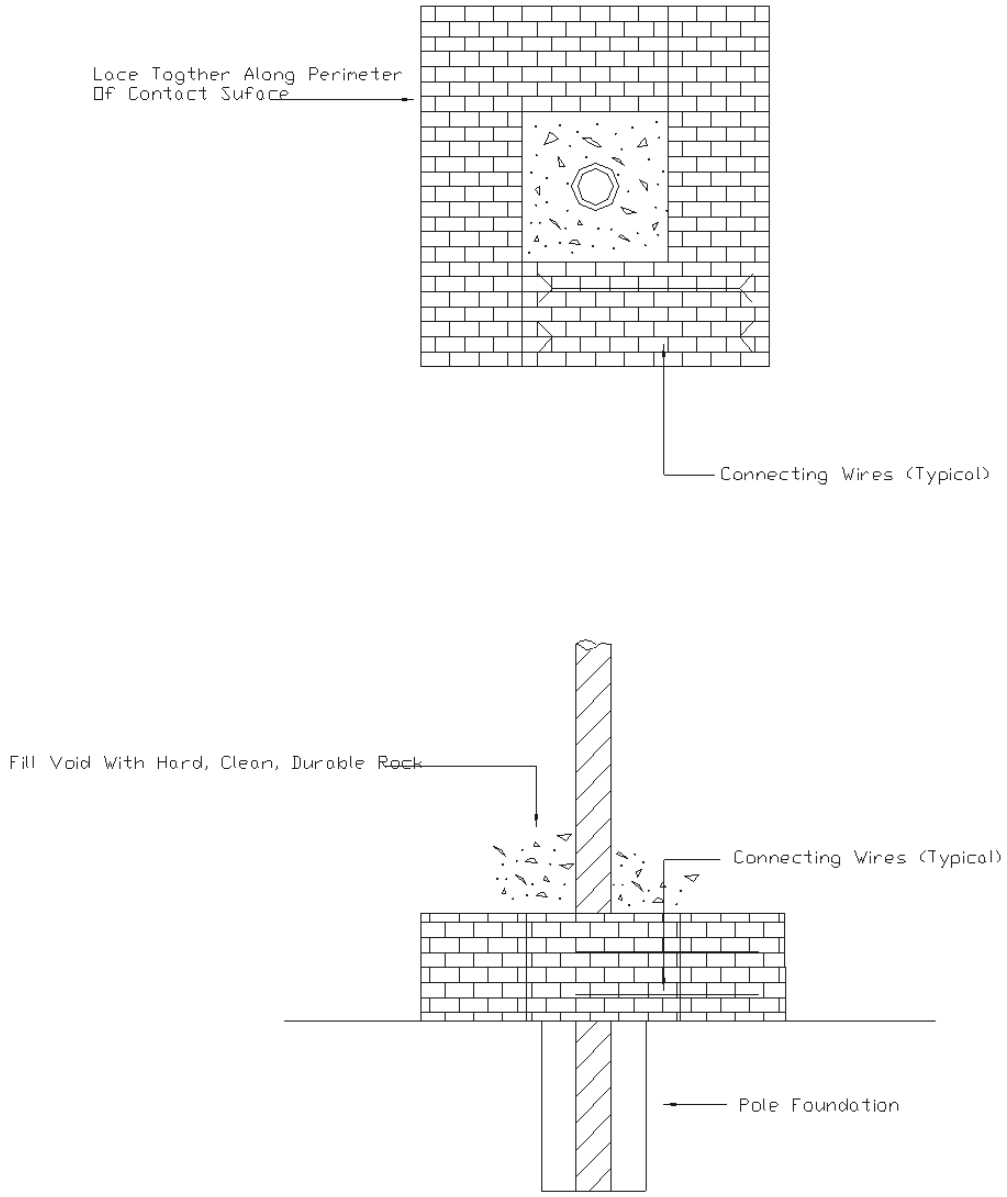


For use where ground is soild or compact.

For use where ground is soft

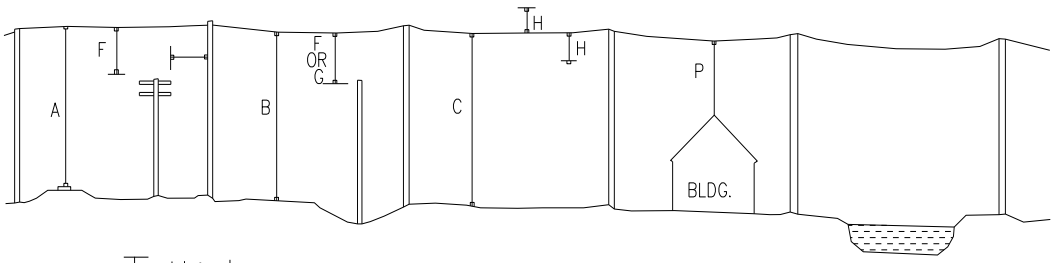
NOTE
CRIBBING FOR POLES WITHOUT CONCRETE FUNDATIONS.

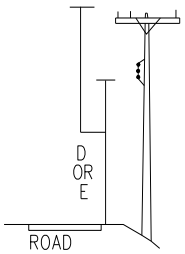
CSG-05	CONSTRUCTION STANDARDS POLE BURIAL	



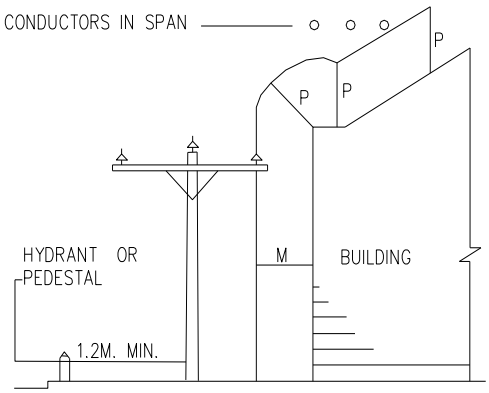
CSG-06	CONSTRUCTION STANDARDS POLE PROTECTION IN SHALLOW RIVER BEDS	NEPAL ELECTRICITY AUTHORITY

CONDUCTOR CLEARANCE





POLES ADJACENT TO ROADS



MINIMMUM CLEARANCE FROM BUILDINGS

	CROSSING OVER	VOLTAGE OF CIRCUIT CROSSING	METER
A	RAILROAD OR TURNPIKE	STAY & CABLE MESSENGER	7.10
		0 – 650 V.	7.10
		651 – 33,000 V.	7.60
B	ROAD, STREET, HIGHWAY OR LIMITED ACCESS HIGHWAY –	STAY & CABLE MESSENGER	5.80
		0 – 650 V.	5.80
		651 – 33,000 V.	6.10
C	AREAS ACCESSIBLE TO PEDESTRIANS ONLY	STAY & CABLE MESSENGER	4.60
		0 – 650 V.	4.60
		651 – 33,000	5.50
	LINE ALONG SIDE OF		
D	MAIN HIGHWAYS STREETS OR ALLEYS	STAY & CABLE MESSENGER	5.50
		0 – 650 V.	5.50
		6581 – 33,000 V.	6.10
E	RURAL ROADS NO VEHICLE CROSSING UNDER	STAY & CABLE MESSENGER	4.60
		0 – 650 V.	4.60
		651 – 33,000 V.	6.00

LOCATIONB	VOLTAGE	CLEARANCE (METER)
M	0 – 11.000 V.	1.20
	11.000 – 33.000 V.	1.83
P	0 – 11.000 V.	2.44
	11.000 – 33.000 V.	3.65

CLEARANCE M ALSO SPECIFIED HORIZONTAL CLEARANCE FROM BALCONIES.

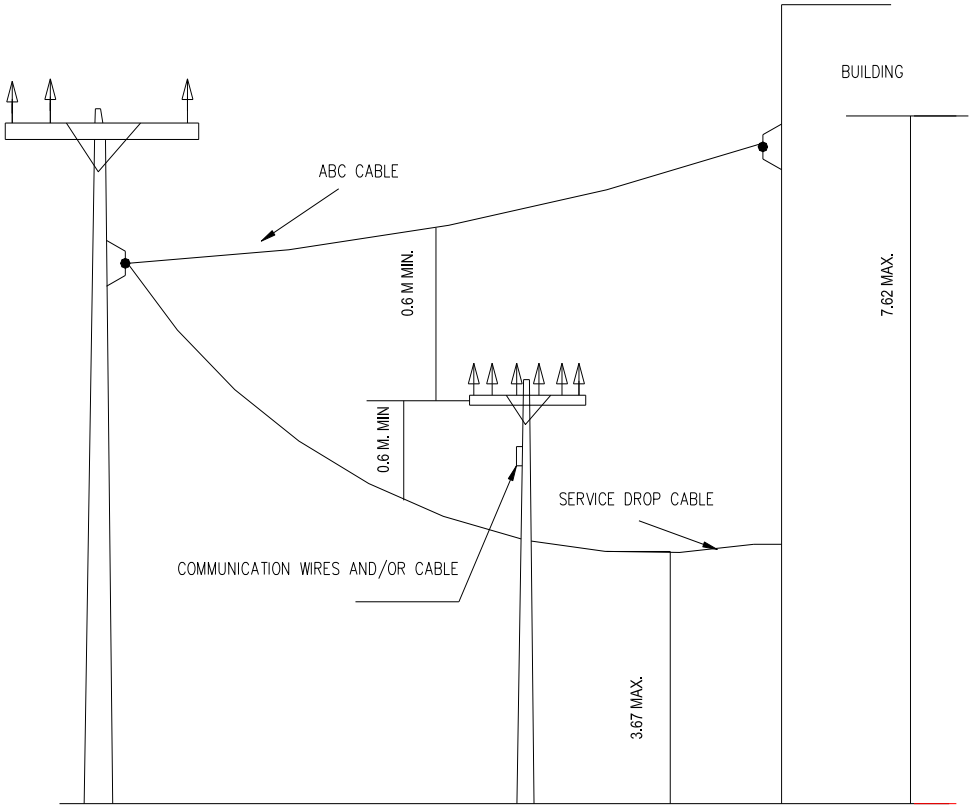
CSG–01	CONSTRUCTION STANDARDS CONDUCTOR CLEARANCE	NEPAL ELECTRICITY AUTHORITY

CONDUCTORS AT HIGHER LEVEL / CONDUCTORS AT LOWER LEVEL		SERVICE DROP 0 – 650 V	OPEN SUPPLY WIRES			STAYS AND SUPPLY CABLES ON GROUNDED MESSENGER
			0 – 650V	651 – 11000 V	33000 V	
F	COMMUNICATION WIRES	0.60 M.				
	COMMUNICATION CABLES AND MESSENGER	0.6 M. OVER 1.2 M. UNDER	1.38	2.15	—	0.60
G	SUPPLY CABLES ON EFFECTIVE GROUNDED MESSENGER	0.6 M. OVER 1.2 M. UNDER	0.60	0.60	—	0.60
H	OPEN SUPPLY 0 – 650 V.	—	1.30	1.80	2.70	0.60
	WIRES 651 – 11,000 V.	—	—	1.20	—	1.20
GUYS SERVICE DROPS 0 – 650 V.		0.60	0.60	1.20	—	—

— VOLTAGE SHOWN ARE PHASE TO GROUND VALUES.

CSG–02	CONSTRUCTION STANDARDS CONDUCTOR CLEARANCE	NEPAL ELECTRICITY AUTHORITY

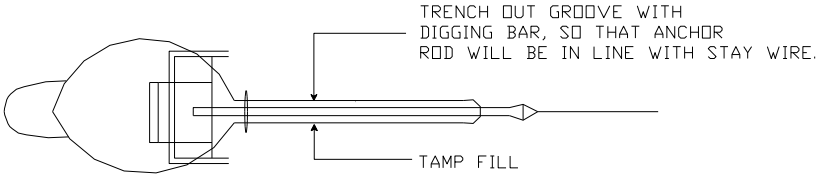
CONDUCTOR CLEARANCE

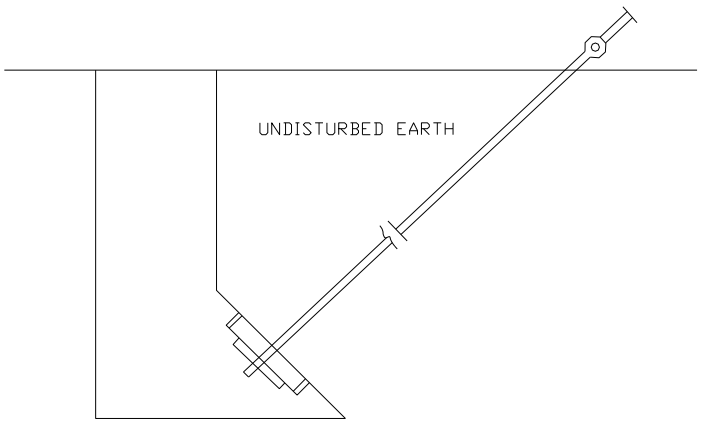


SERVICE DROP: Install Service over communication facilities where practical and attached to pole when available; otherwise cross under communication facilities; with proper clearance.

SERVICE DROP (0-600 V) Crossing Over	CLEARANCE
DRIVE WAY TO RESIDENCE, GARAGE, OR OVER PARKING LOT EXCLUDING TRACKS IN URBAN AREA	3.67 M
DRIVE WAY AND COMMERCIAL PARKING LOT OR AREA SUBJECT TO TRUCK TRAFFIC	4.57 M

CSG-03	CONSTRUCTION STANDARDS CONDUCTOR CLEARANCE	NEPAL ELECTRICITY AUTHORITY





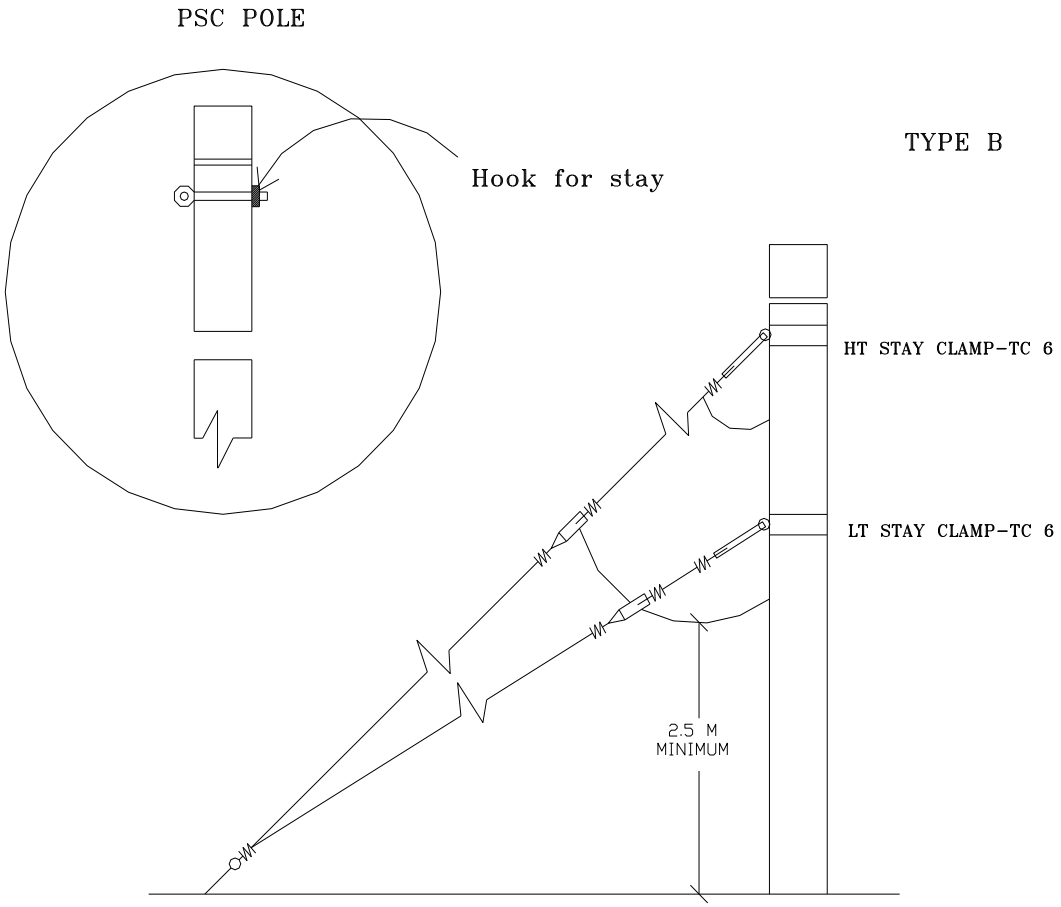
MAKE UNDERCUT AT BOTTOM OF ANCHOR HOLE,
PLATE TO BEAR AGAINST UNDISTURBED EARTH.

1. BACKFILL SHALL BE THOROUGHLY TAMPED.
2. BACKFILL FOR ANCHORS PLACED IN SOFT OR UNSTABLE SOIL SHALL BE 50MM GRAVEL PLACED TO DEPTH OF 1000 MM ABOVE ANCHOR PLATE.

CSG-07	CONSTRUCTION STANDARDS STAYS AND ANCHORS	NEPAL ELECTRICITY AUTHORITY

S.No.	MATERIAL (HT-STAY)	QTY.	UNIT	MATERIAL (LT-STAY)	QTY
1	HT STAY SET (600 x 600 MM PLATE AND ROD)	1	NOS	LT STAY SET (300 X 300 MM PLATE AND ROD)	1
2	HT TURN BUCKLE	1	NOS	LT TURN BUCKLE	1
3	HT THIMBLES	1	NOS	LT THIMBLES	1
4	POLE CLAMP(TC6)	1	NOS	POLE CLAMP(TC8)	0
5	HT STAY INSULATOR	1	NOS	STAY INSULATOR	1
6	PREFORM TIE FOR STAY WIRE 7/8 SWG	4	NOS	PREFORM TIE FOR STAY WIRE 7/12 SWG	4
7	7/8" SWG STAY WIRE	12	M	7/12" SWG STAY WIRE	10
8	HT EYE BOLT	0	NOS	LT EYE BOLT	0

CONSTRUCTION STANDARDS **HT AND LT - SINGLE STAY**	**NEPAL ELECTRICITY AUTHORITY**



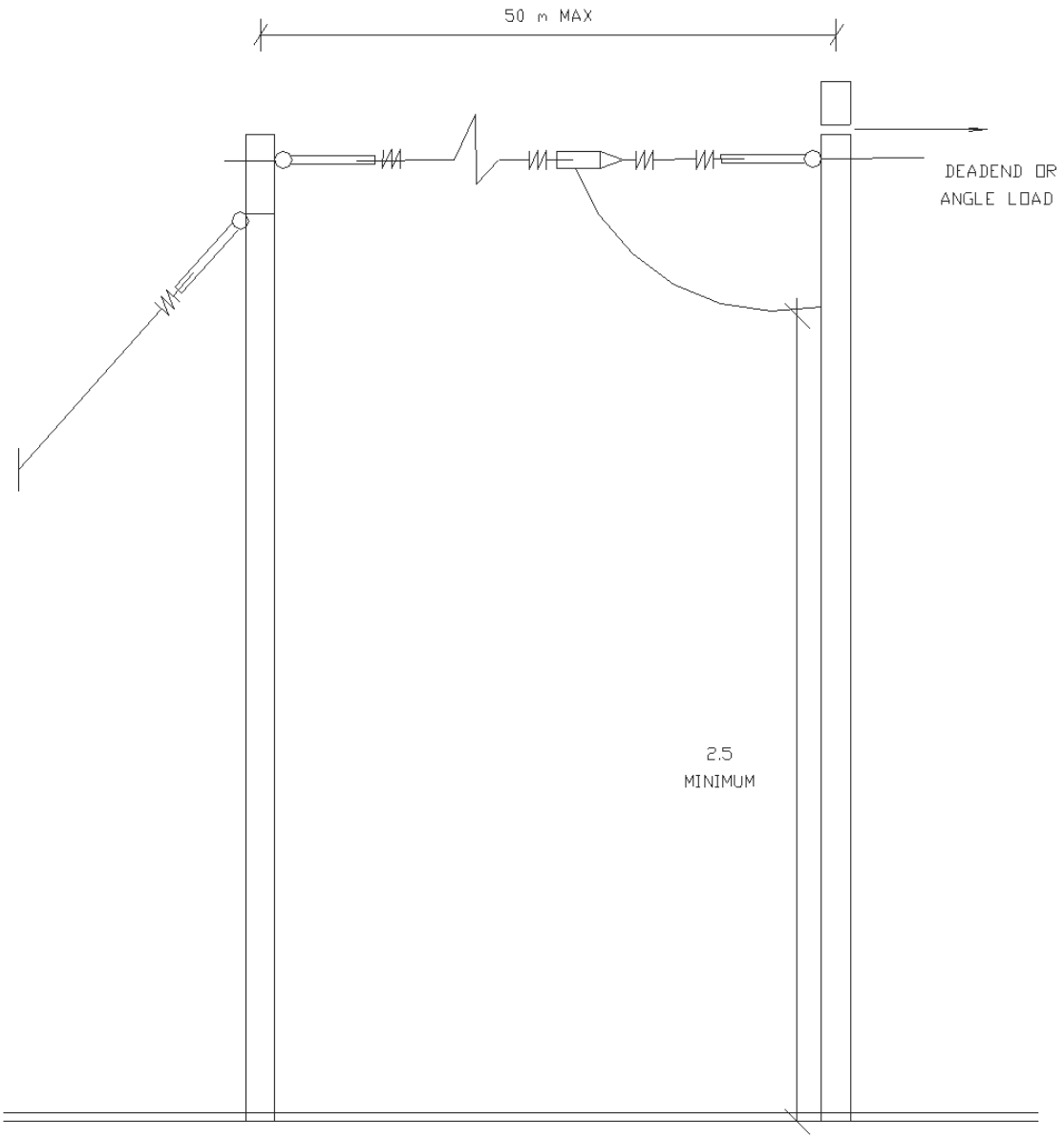
NOTE:
1. REFER CSG-M3 & CSG-M4 FOR PSC & TTSP POLE RESPECTIVELY FOR B/M.
2. STAY ROD EYE SHALL NOT EXTEND ABOVE SOIL MORE THAN 150mm.
3. REFER FOR CONSTRUCTION STANDARD, SECTION IX-2D.

CSG-09	CONSTRUCTION STANDARDS STAYS AND ANCHORS	NEPAL ELECTRICITY AUTHORITY

S.No.	MATERIAL (HT-STAY)	QTY.	UNIT	MATERIAL (LT-STAY)	QTY
1	HT STAY SET (600 x 600 MM PLATE AND ROD)	1	NOS	LT STAY SET (300 X 300 MM PLATE AND ROD)	1
2	HT TURN BUCKLE	2	NOS	LT TURN BUCKLE	2
3	HT THIMBLES	2	NOS	LT THIMBLES	2
4	POLE CLAMP(TC6)	2	NOS	POLE CLAMP(TC8)	1
5	HT STAY INSULATOR	2	NOS	STAY INSULATOR	2
6	PREFORM TIE FOR STAY WIRE 7/8 SWG	8	NOS	PREFORM TIE FOR STAY WIRE 7/12 SWG	8
7	7/8" SWG STAY WIRE	24	M	7/12" SWG STAY WIRE	20
8	HT EYE BOLT	0	NOS	LT EYE BOLT	0

CONSTRUCTION STANDARDS **HT AND LT – DOUBLE STAY**	**NEPAL ELECTRICITY AUTHORITY**

TYPE C



NOTE:

1. REFER CSG-M1 & CSG-M2 FOR PSC & TTSP POLE RESPECTIVELY FOR B/M.
2. SPAN OF STAY SHALL BE LIMITED TO A MAXIMUM LENGTH OF 50 METERS.
3. REFER FOR CONSTRUCTION STANDARD, SECTION IX-2D.

CSG-10	CONSTRUCTION STANDARDS STAYS AND ANCHORS	NEPAL ELECTRICITY AUTHORITY

NOTES

A. PLOT APPROXIMATE GROUND LINE PROFILE UNDER PROPOSED SAY.

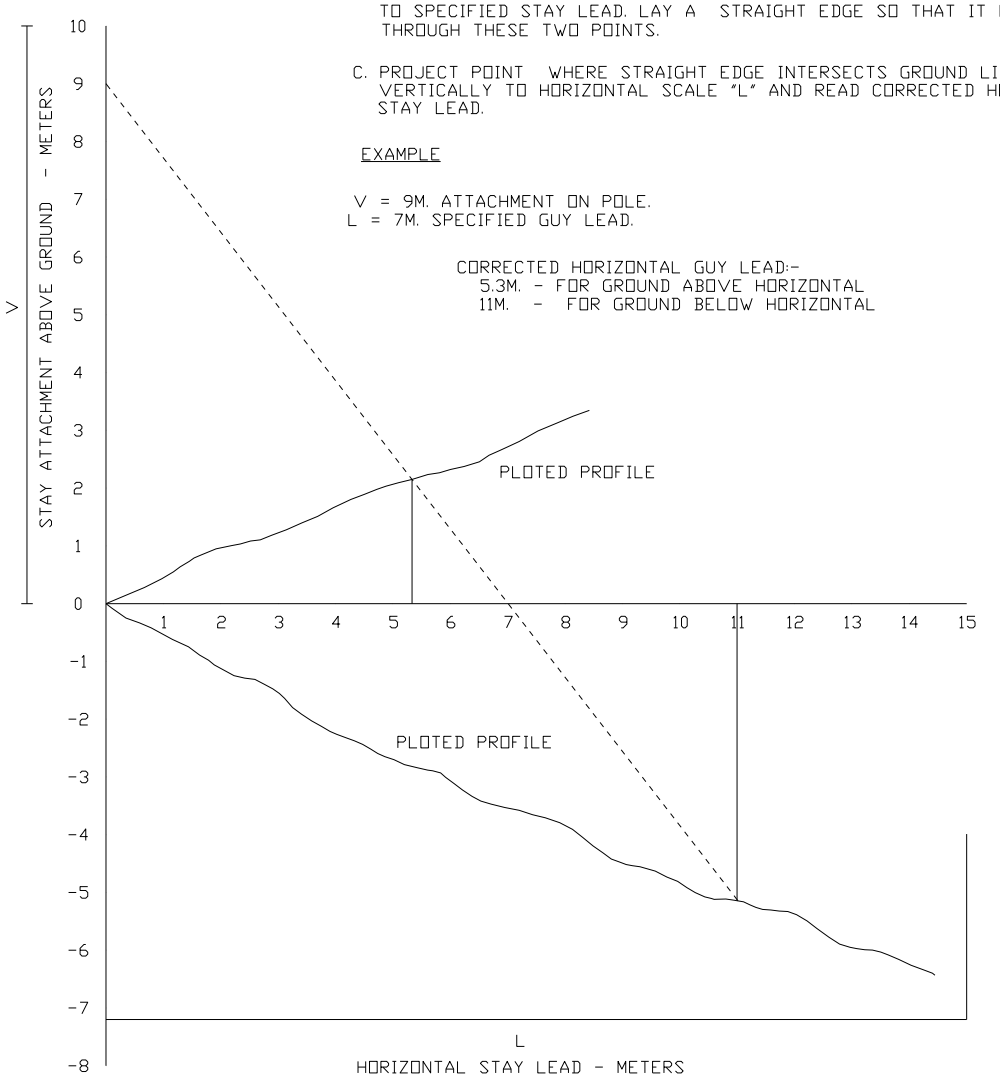
B. SELECT A POINT ON VERTICAL SCALE "V" CORESPONDING TO GUY ATTACHMENT ON POLE , SELECT A POINT ON HORIZONTAL SCALE "L" CORESPONDING TO SPECIFIED STAY LEAD. LAY A STRAIGHT EDGE SO THAT IT PASSES THROUGH THESE TWO POINTS.

C. PROJECT POINT WHERE STRAIGHT EDGE INTERSECTS GROUND LINE PROFILE VERTICALLY TO HORIZONTAL SCALE "L" AND READ CORRECTED HORIZONTAL STAY LEAD.

EXAMPLE

V = 9M. ATTACHMENT ON POLE.
L = 7M. SPECIFIED GUY LEAD.

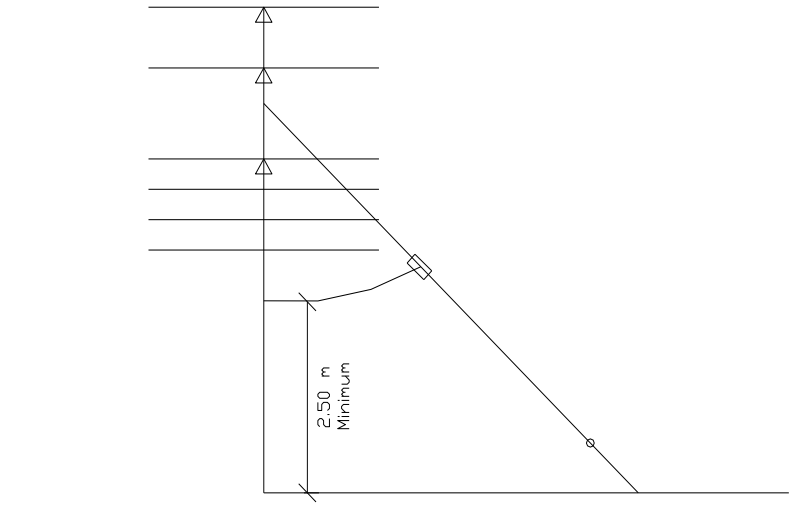
CORRECTED HORIZONTAL GUY LEAD:-
5.3M. - FOR GROUND ABOVE HORIZONTAL
11M. - FOR GROUND BELOW HORIZONTAL

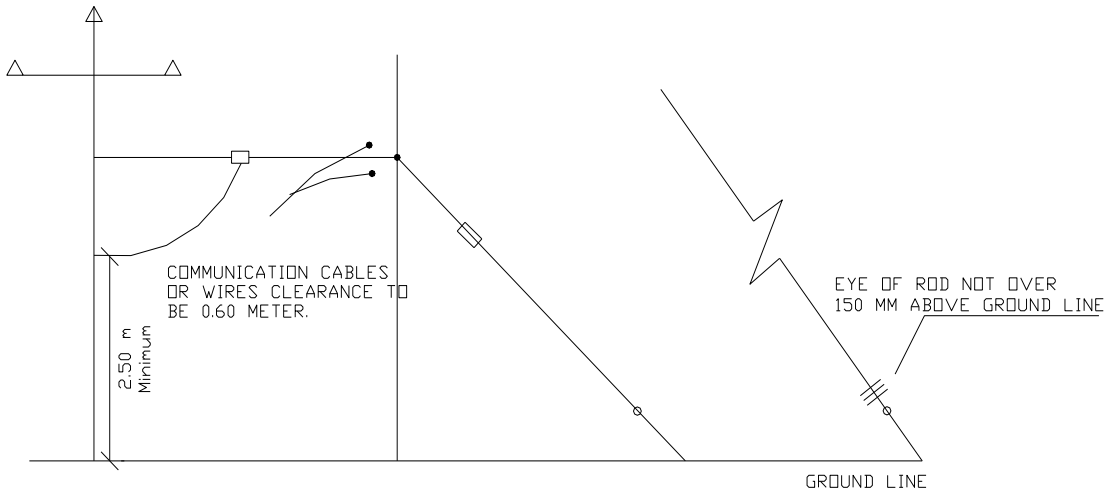


CSG-11	CONSTRUCTION STANDARDS STAYS AND ANCHORS	NEPAL ELECTRICITY AUTHORITY

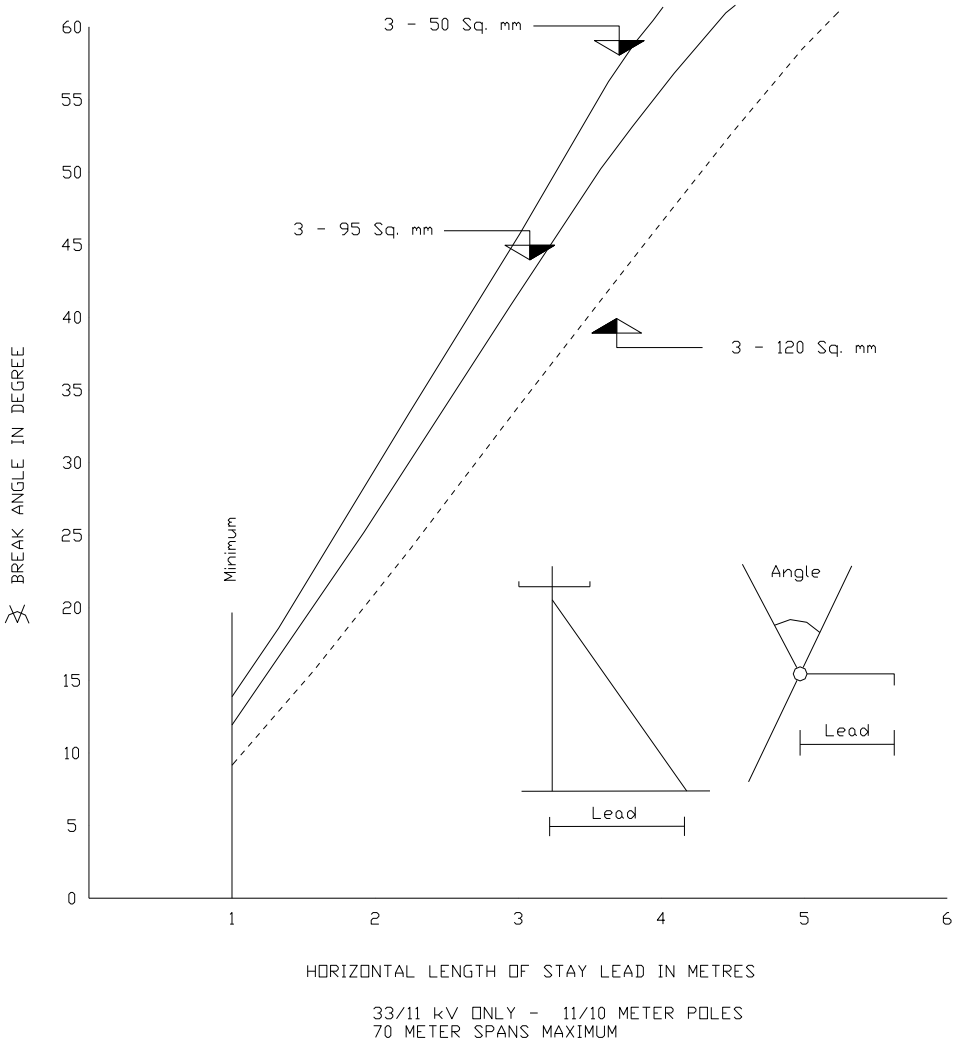
S.No.	MATERIAL (HT-STAY)	QTY.	UNIT	MATERIAL (LT-STAY)	QTY
1	HT STAY SET (600 x 600 MM PLATE AND ROD)	1	NOS	LT STAY SET (300 X 300 MM PLATE AND ROD)	1
2	HT TURN BUCKLE	2	NOS	LT TURN BUCKLE	2
3	HT THIMBLES	1	NOS	LT THIMBLES	1
4	POLE CLAMP(TC6)	1	NOS	POLE CLAMP(TC8)	1
5	POLE CLAMP(TC8)	1	NOS		
6	HT STAY INSULATOR	2	NOS	STAY INSULATOR	2
7	PREFORM TIE FOR STAY WIRE 7/8 SWG	8	NOS	PREFORM TIE FOR STAY WIRE 7/12 SWG	8
8	7/8" SWG STAY WIRE	25	M	7/12" SWG STAY WIRE	20
9	HT EYE BOLT	0	NOS	LT EYE BOLT	0
10	POLE 11M	1	NOS	POLE 9M	1

CONSTRUCTION STANDARDS **HT AND LT – FLYING STAY**	**NEPAL ELECTRICITY AUTHORITY**

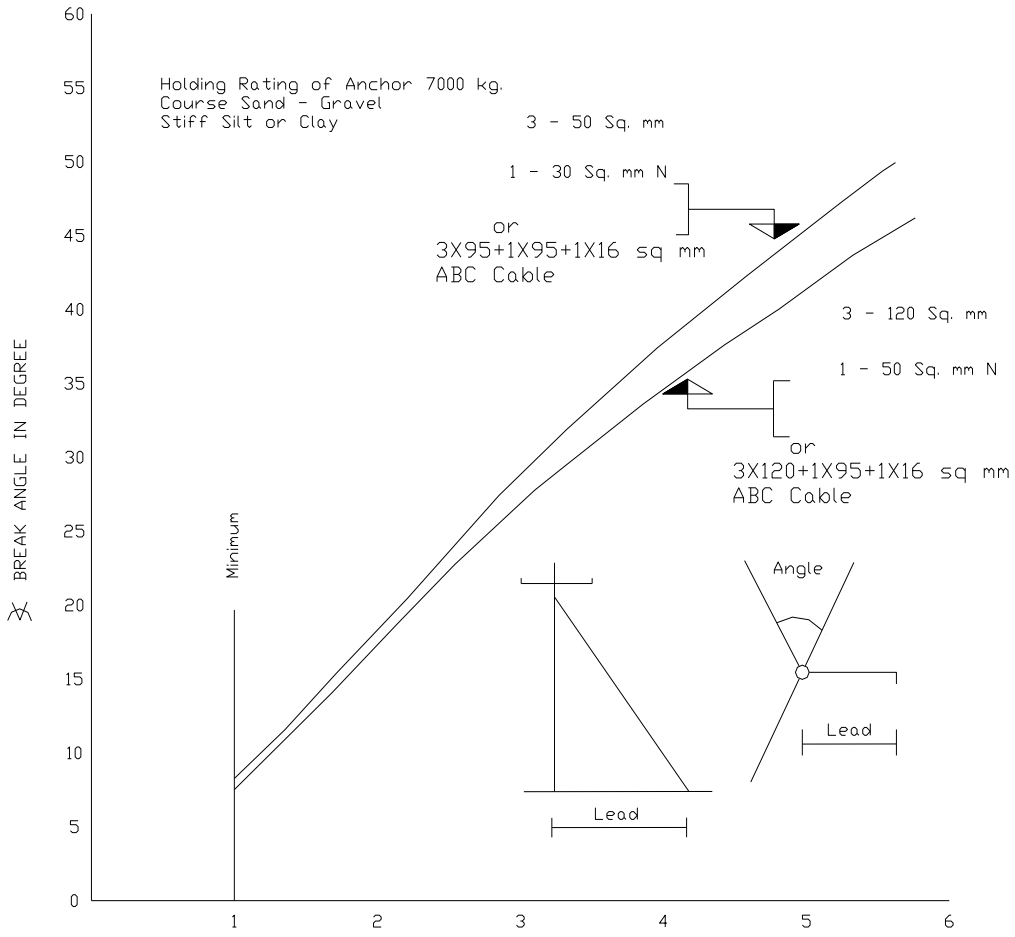




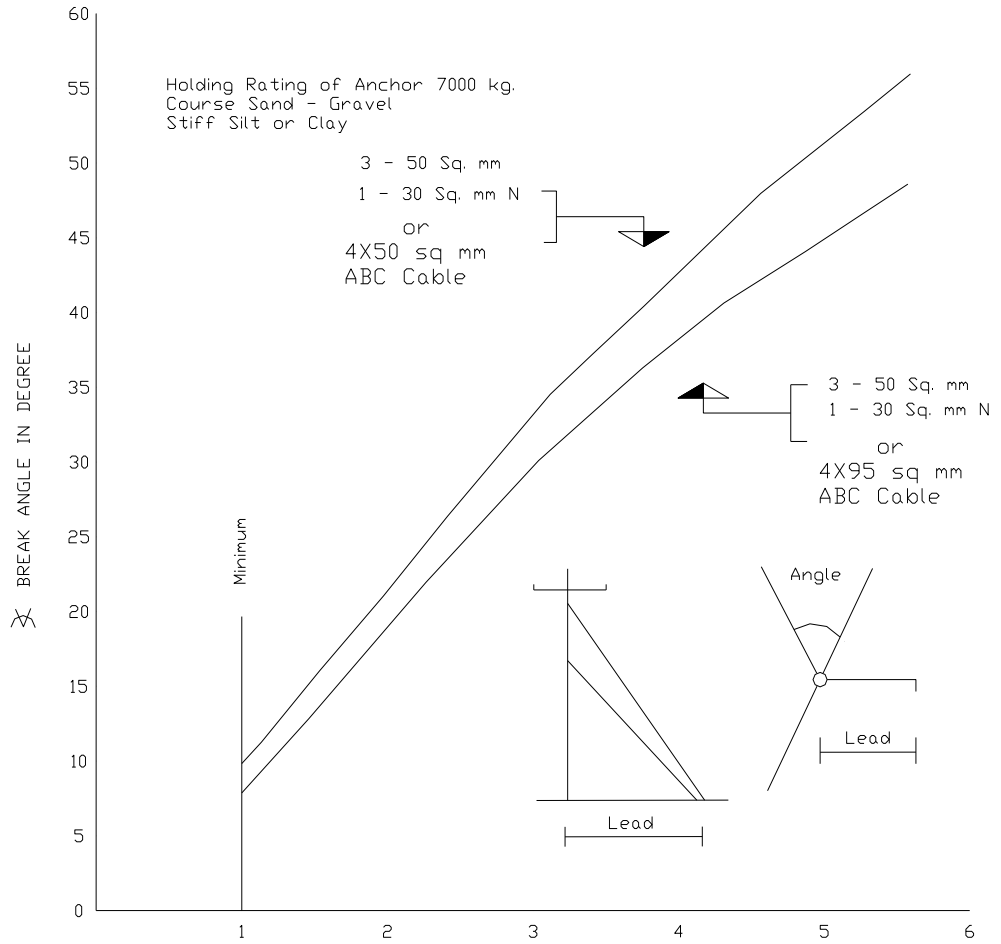
CSG-12	CONSTRUCTION STANDARDS STAYS AND ANCHORS	NEPAL ELECTRICITY AUTHORITY



CSG-13	CONSTRUCTION STANDARDS MINIMUM LEAD FOR SIDE ANGLE STAYS	NEPAL ELECTRICITY AUTHORITY

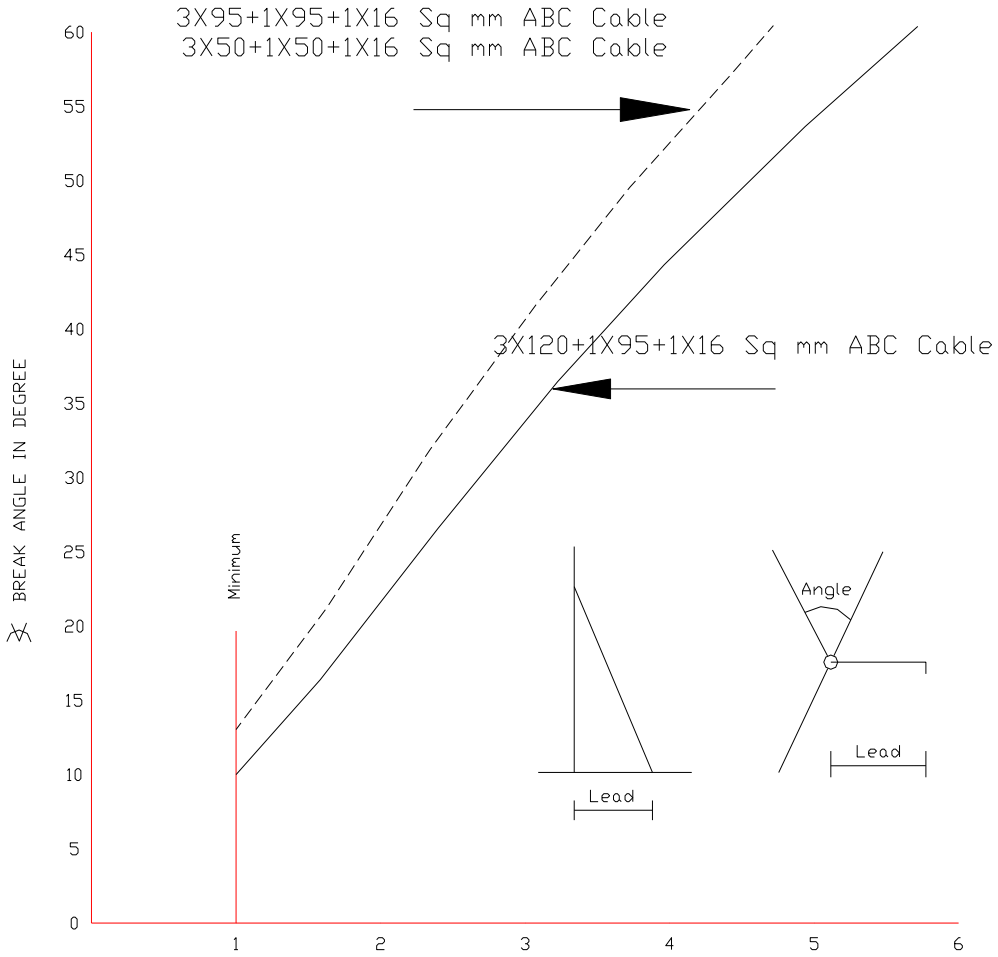


CSG-14	CONSTRUCTION STANDARDS MINIMUM LEAD FOR SIDE ANGLE STAYS	NEPAL ELECTRICITY AUTHORITY



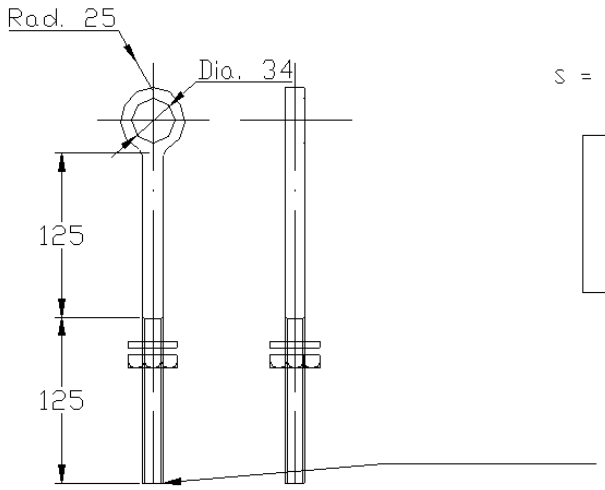
11 AND 0.4 kV -COMPOSITE - 11/10 METER POLE
50 METER SPAN MAXIMUM
3 - 50 S.Q. MM
1 - 30 S.Q. MM

CSG-15	CONSTRUCTION STANDARDS MINIMUM LEAD FOR SIDE ANGLE STAYS	NEPAL ELECTRICITY AUTHORITY

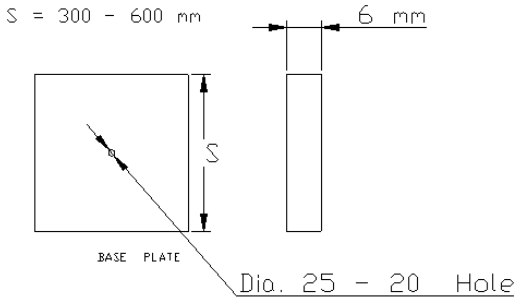


400/230V ONLY - 9 METER POLES
50 METER SPANS MAXIMUM

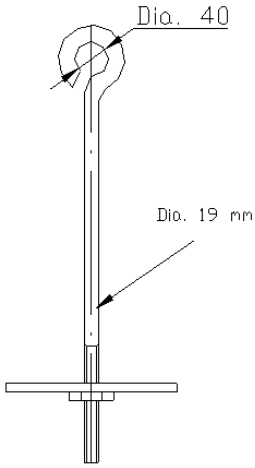
CSG-16	CONSTRUCTION STANDARDS MINIMUM LEAD FOR SIDE ANGLE STAYS	NEPAL ELECTRICITY AUTHORITY



EYE - BOLT.

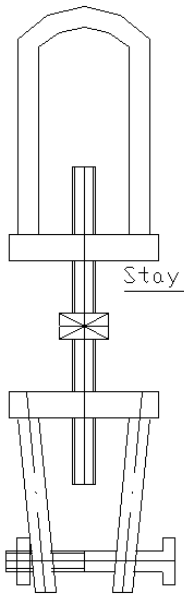


Dia. 16 mm

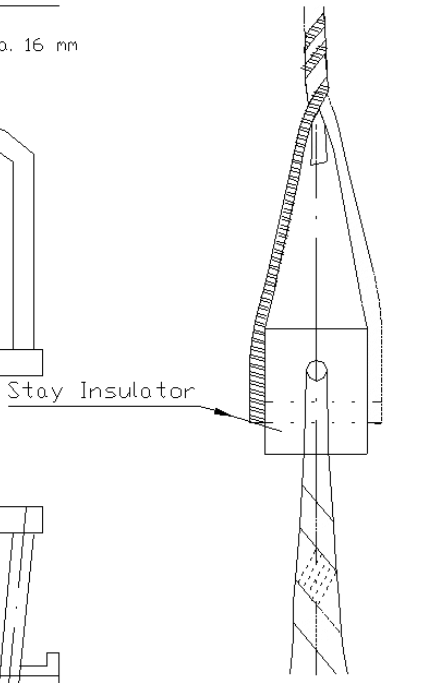


STAY ROD

S. N.	Description	Unit	HT Stay	LT Stay
1	Length of Stay Rod	mm	2440	1800
2	Diameter of Stay Rod	mm	19	16
3	Length of threaded portion	mm	300	

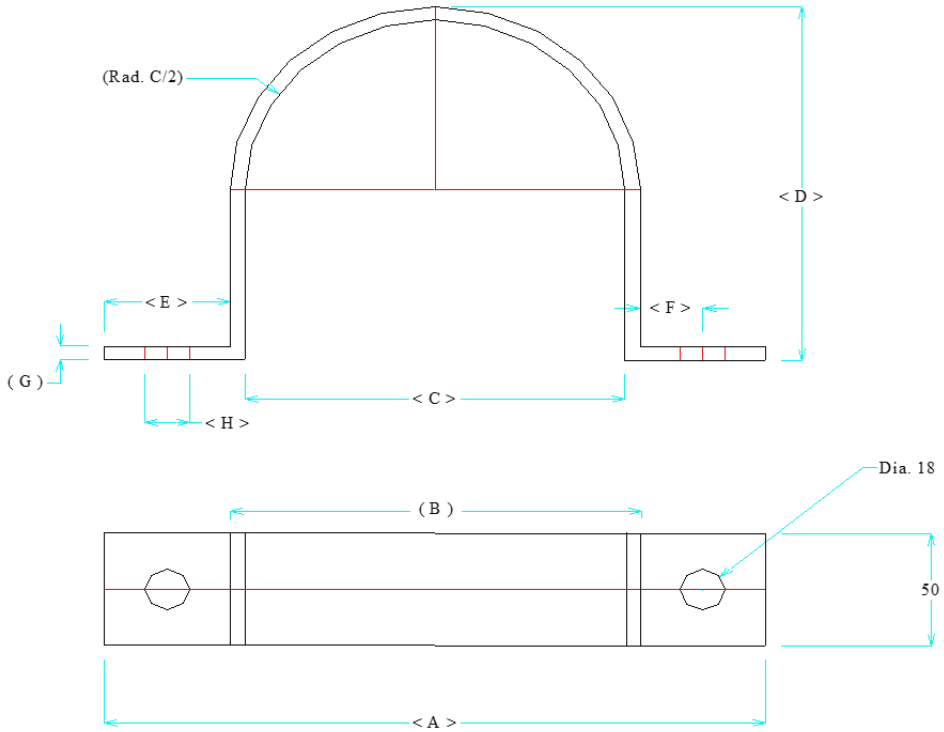


TURN BUCKLE



PREFORMED WIRE ASSEMBLY
WITH STAY INSULATOR

CSG-17	CONSTRUCTION STANDARDS Hardware for Stay Set	NEPAL ELECTRICITY AUTHORITY

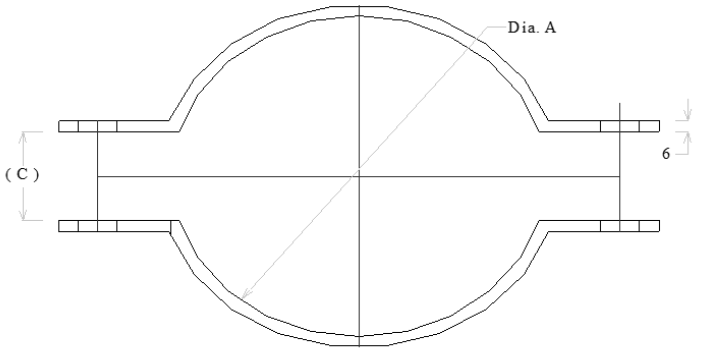


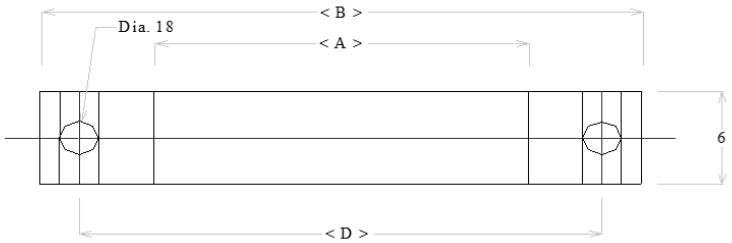
Type	Unit	A	B	C	D	E	F	G	H	Remarks
TC1	mm	285	185	173	179	50	25	6	18	
TC2	mm	297	197	185	191	50	25	6	18	
TC3	mm	307	207	195	201	50	25	6	18	
TC7	mm	334	234	222	228	50	25	6	18	
TC4	mm	347	247	235	241	50	25	6	18	
TC5	mm	397	297	285	291	50	25	6	18	

Note :- Dimensions are subject to approval prior to manufacture.

NEPAL ELETRICITY AUTHORITY

All Dimension in mm	Semicircular Clamp for Tubular pole DWG. 1H	Drawn by		
		Checked by		
		Approved by		





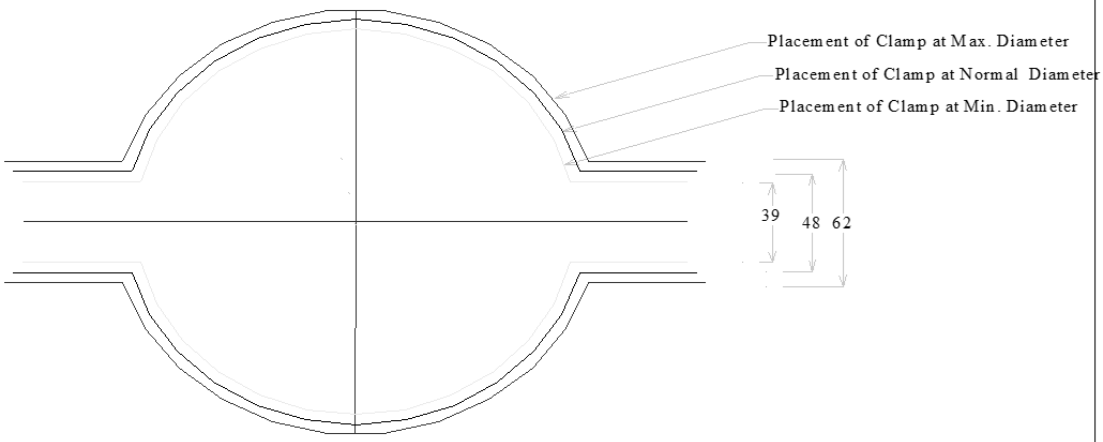
Type	Unit	A	B	C	D	Remarks
TC6	mm	200	302	50	268	
TC8	mm	155	257	50	223	

Note :- Dimensions are subject to approval prior to manufacture.

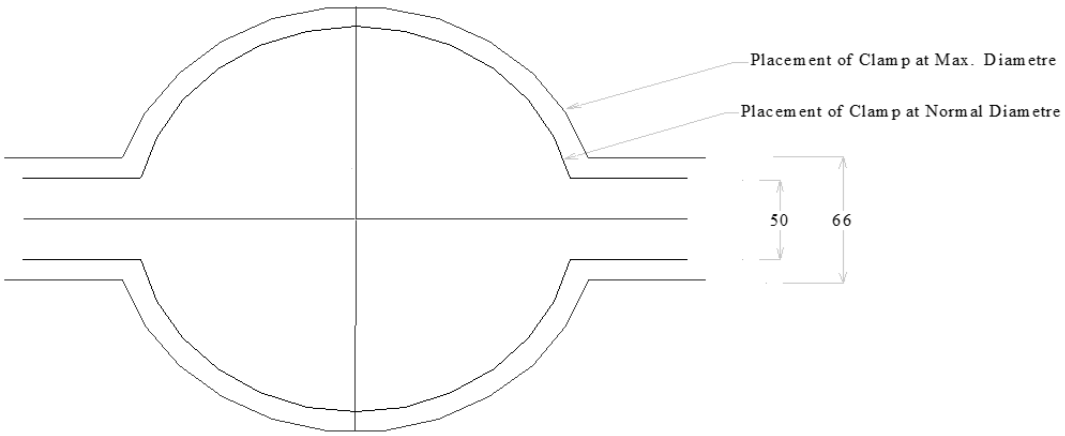
NEPAL ELECTRICITY AUTHORITY

All Dimension in mm	Semicircular Stay Clamp for Tubular Pole DWG. 3H	Drawn by		
		Checked by		
		Approved by		

Clamp for Stay TC6



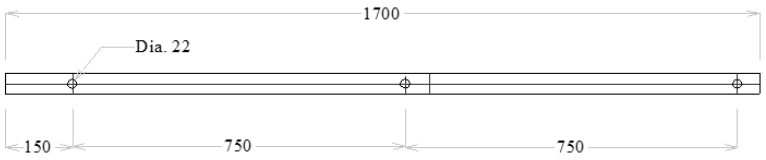
Clamp for Stay TC8



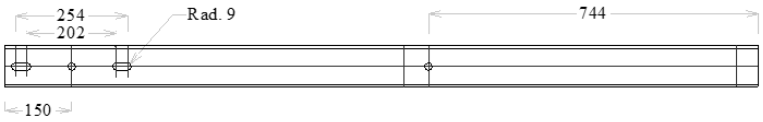
Note :- Dimensions are subject to approval prior to manufacture.

NEPAL ELECTRICITY AUTHORITY				
All Dimension in mm	Placement of Semicircular Stay Clamp for Tubular pole DWG. 4H	Drawn by		
		Checked by		
		Approved by		

Off Set Cross Arm for 11 kV (100 x 50 x 6.4 x 1700 mm)

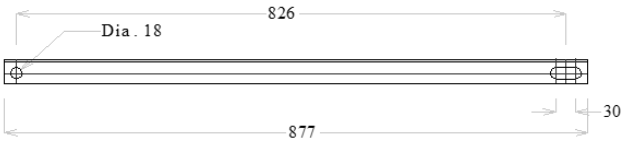


Top View



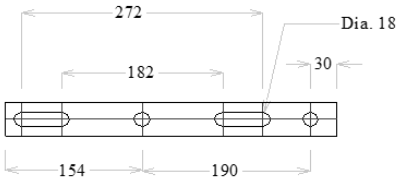
Front View

Bracing Angle For 11kV Off Set
(877 x 40 x 40 x 5 mm)

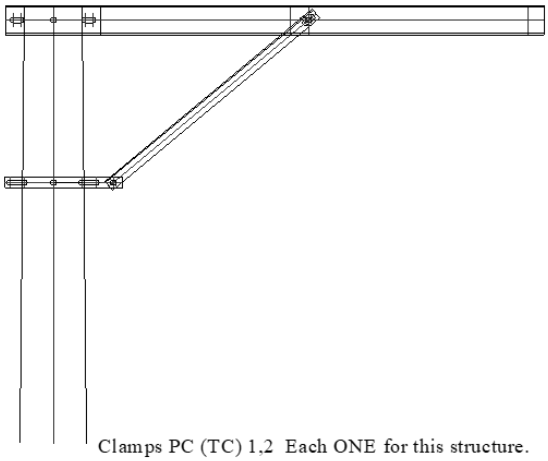


Front View

Flat Brace for 11kV Off Set
(374 x 40 x 6 mm)



Front View

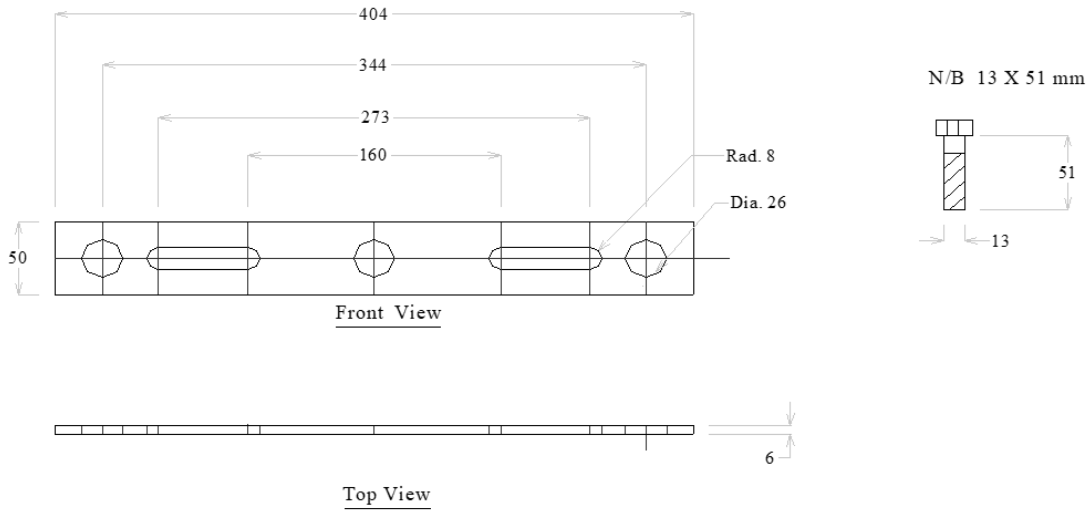


Clamps PC (TC) 1,2 Each ONE for this structure.

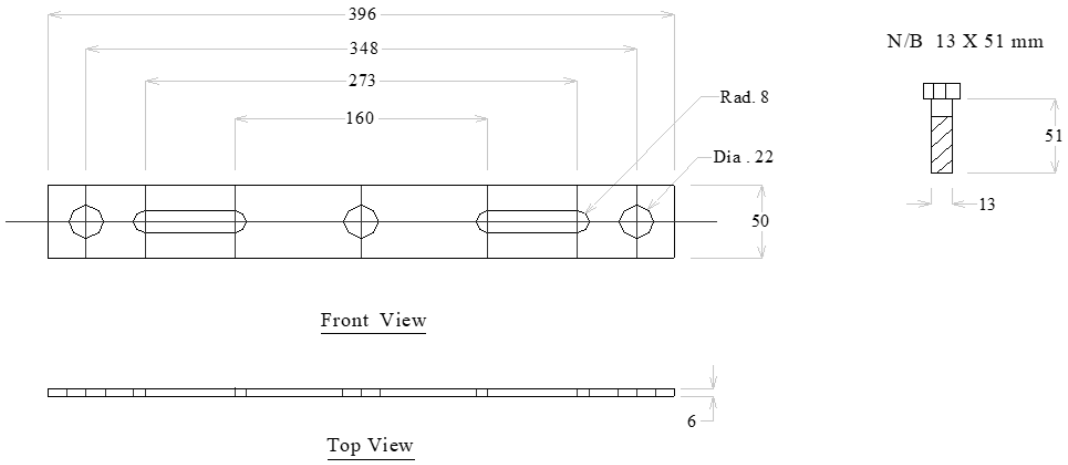
Note :- Dimensions are subject to approval prior to manufacture.

NEPAL ELECTRICITY AUTHORITY				
All Dimension in mm	Off Set Cross Arm Assembly for 11 kV DWG. 5H	Drawn by		
		Checked by		
		Approved by		

Strap for 33 kV Pin Insulator String.(404 x 50 x 6 mm)



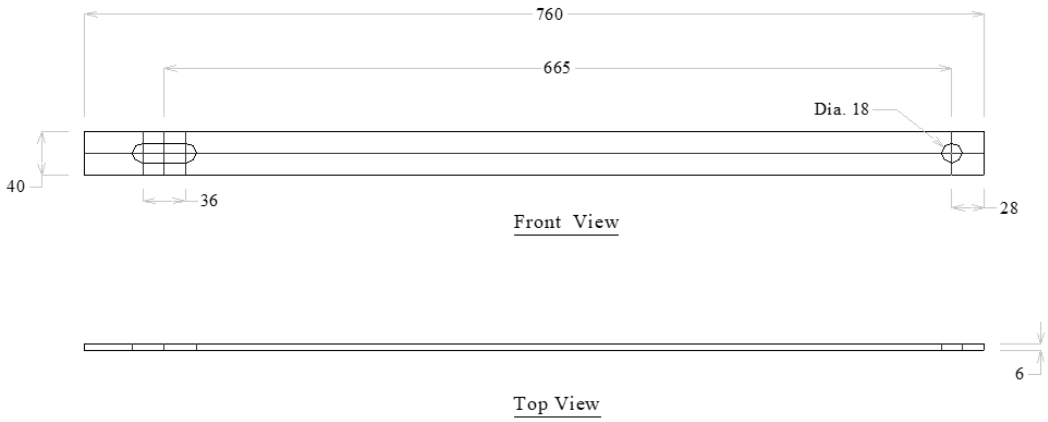
Strap for 11 kV Pin Insulator String (396 x 50 x 6 mm).



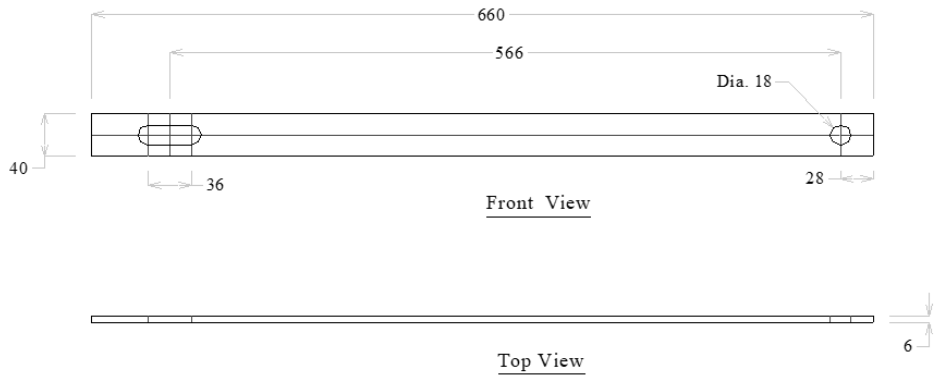
Note :- Dimensions are subject to approval prior to manufacture.

NEPAL ELECTRICITY AUTHORITY				
All Dimension in mm	Strap for Pin Insulator string (11 kV) DWG. 6H	Drawn by		
		Checked by		
		Approved by		

Cross Arm Brace for 33 kV (760 x 40 x 6 mm)



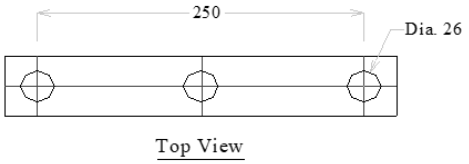
Cross Arm Brace for 11 kV (660 x 40 x 6 mm)



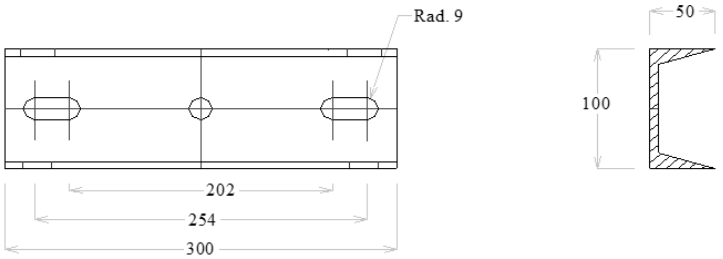
Note :- Dimensions are subject to approval prior to manufacture.

NEPAL ELECTRICITY AUTHORITY				
All Dimension in mm	Cross Arm Brace for 11 kV. DWG. 7H	Drawn by		
		Checked by		
		Approved by		

Cross Arm for 33 kV (300 x100 x 50 x 7.5 mm)

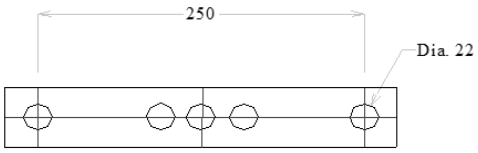


Top View

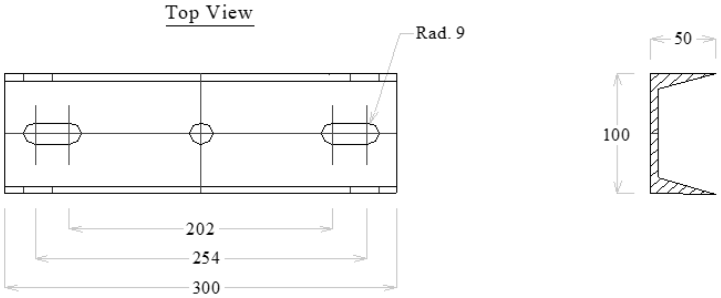


Front View

Cross Arm for 11 kV (300 x 100 x 50 x 6.4 mm)



Top View

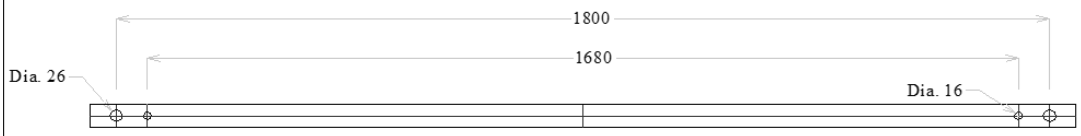


Front View

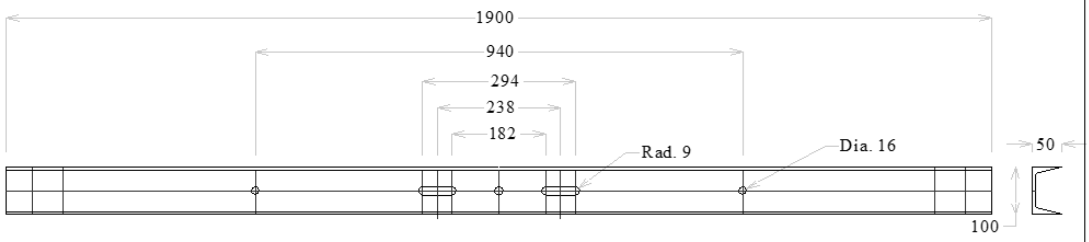
Note :- Dimensions are subject to approval prior to manufacture.

NEPAL ELECTRICITY AUTHORITY				
All Dimension in mm	Cross Arms for 11 kV. DWG. 8H	Drawn by		
		Checked by		
		Approved by		

Cross Arm for 33 kV (1900 x 100 x 50 x 7.5 mm)

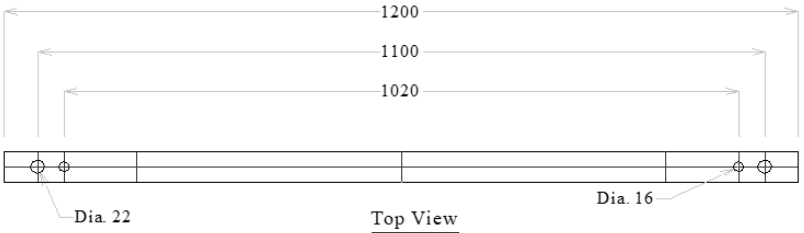


Top View

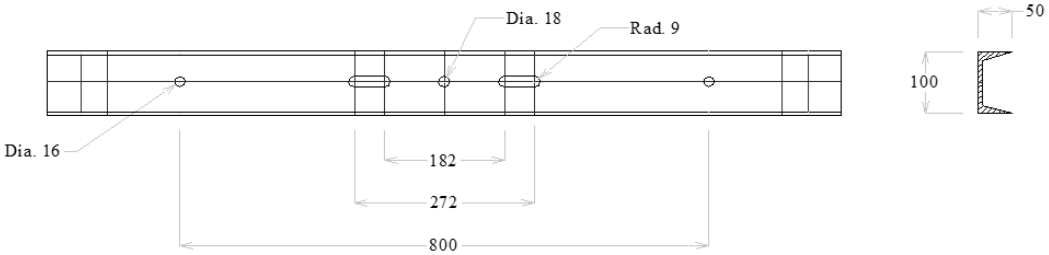


Front View

Cross Arm for 11 kV (1200 x 100 x 50 x 6.4 mm)



Top View

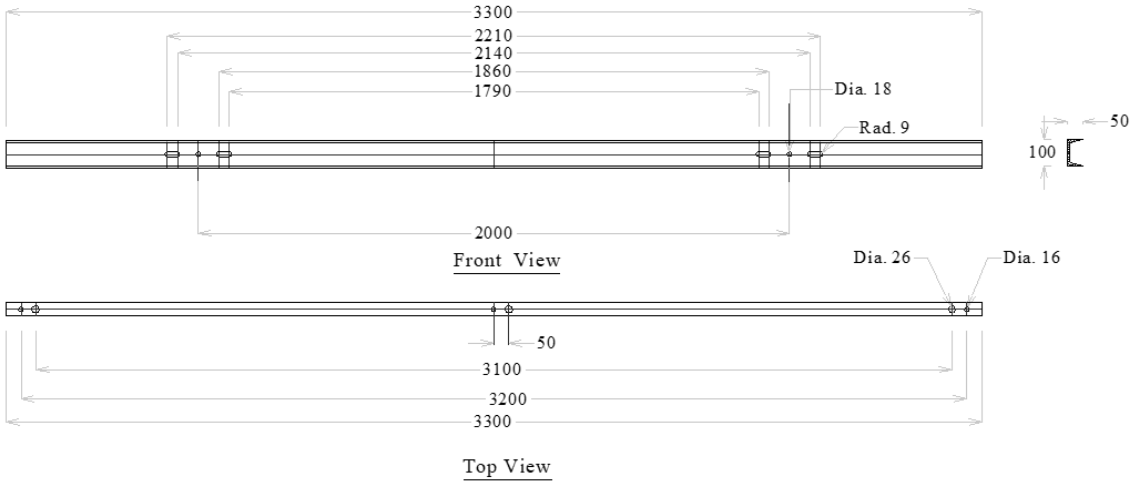


Front View

Note :- Dimensions are subject to approval prior to manufacture.

NEPAL ELECTRICITY AUTHORITY				
All Dimension in mm	Cross Arms for 11 kV. DWG. 9H	Drawn by		
		Checked by		
		Approved by		

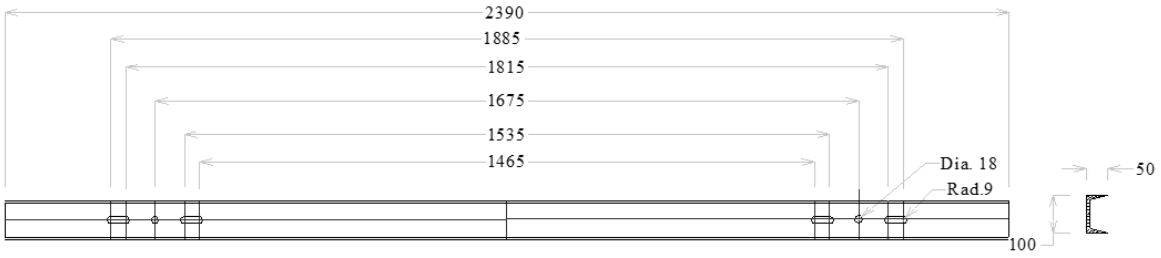
Cross Arm for 33 kV H-Pole (3300 x 100 x 50 x 7.5 mm)



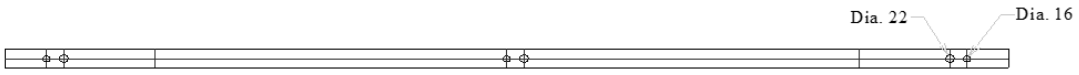
Front View

Top View

Cross Arm for 11 kV H-Pole (2390 x 100 x 50 x 6.4 mm)



Front View

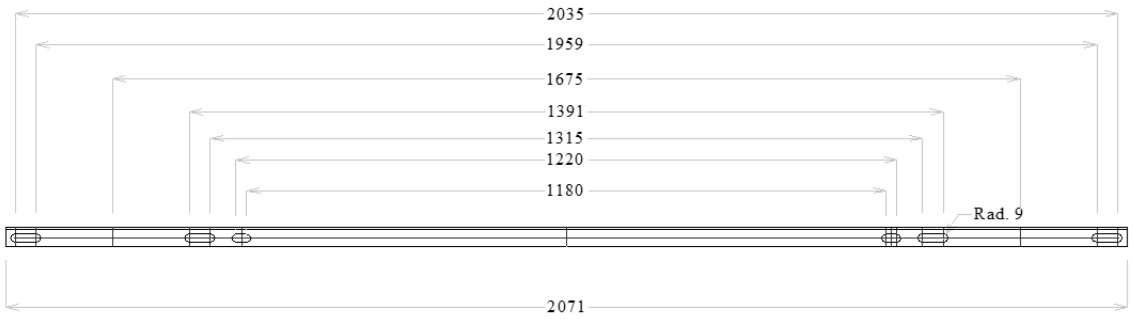


Top View

Note :- Dimensions are subject to approval prior to manufacture.

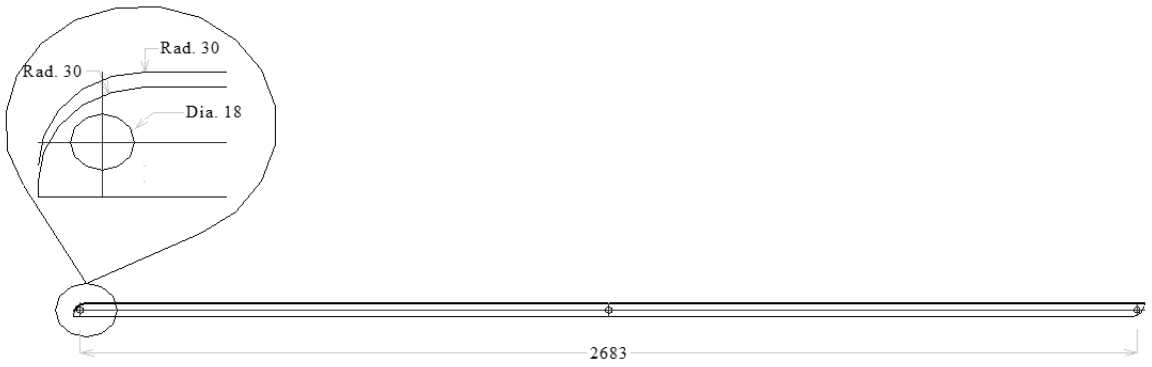
NEPAL ELECTRICITY AUTHORITY				
All Dimension in mm	Cross Arms for 11 kV H - Pole Structure. DWG. 10H	Drawn by		
		Checked by		
		Approved by		

Bracing Angle for 11 kV H-Pole (2071 x 40 x 40 x 5 mm)

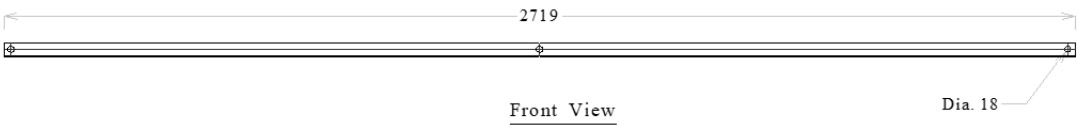


Front View

Bracing Angle for 11 kV H-Pole (2719 x 40 x 40 x 5 mm)



Front View

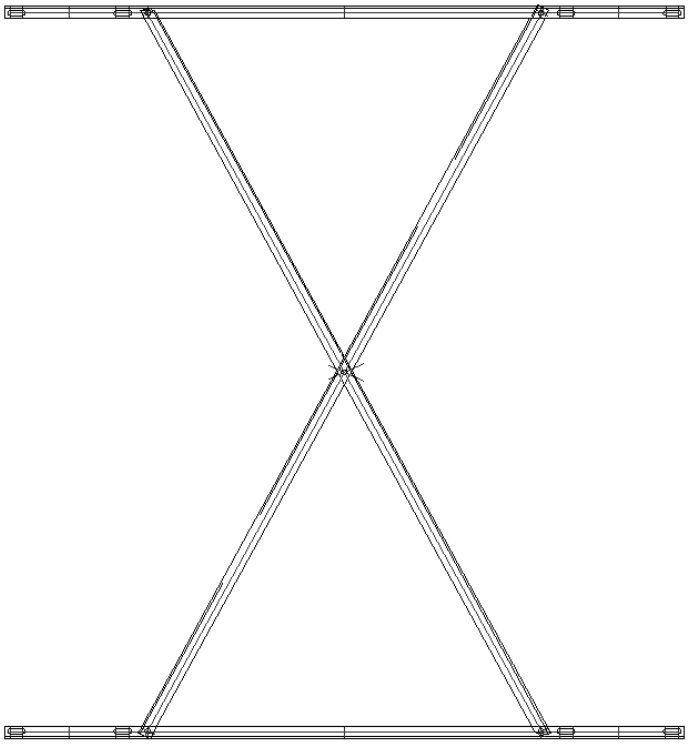


Front View

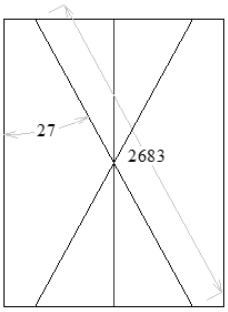
Note :- Dimensions are subject to approval prior to manufacture.

NEPAL ELECTRICITY AUTHORITY				
All Dimension in mm	11 kV Angle Bracing for H - Pole Structure. DWG. 11H	Drawn by		
		Checked by		
		Approved by		

11 kV H- Pole Cross Bracing



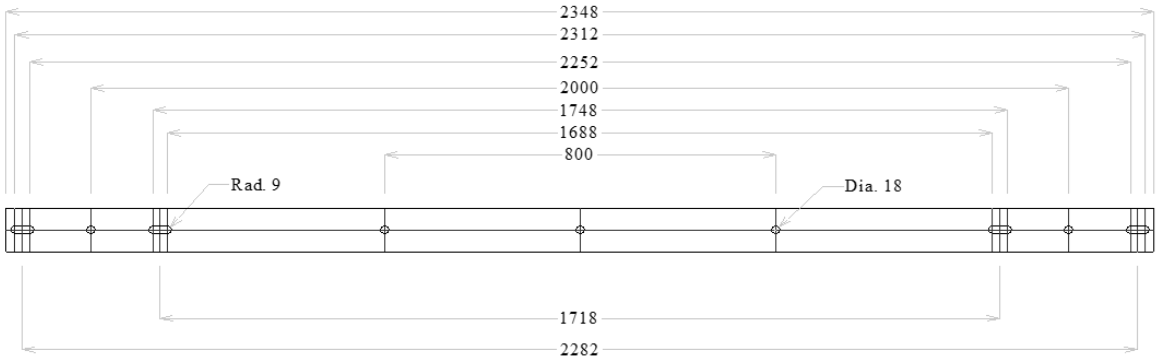
Front View



Note :- Dimensions are subject to approval prior to manufacture.

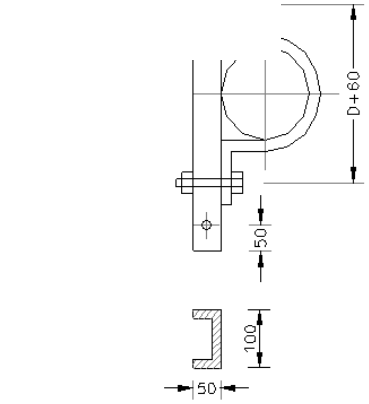
NEPAL ELECTRICITY AUTHORITY				
All Dimension in mm	11 kV Angle Bracing Assembly for H - Pole Structure. DWG. 12H	Drawn by		
		Checked by		
		Approved by		

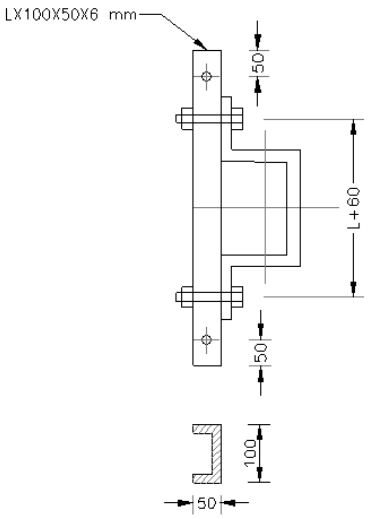
Cross Arm For LA and DO (100 x 50 x 6.4 x 2348 mm)



Note :- Dimensions are subject to approval prior to manufacture.

NEPAL ELECTRICITY AUTHORITY				
All Dimension in mm	Cross Arm For LA and DO 100 x 50 x 6.4 x 2348 mm DWG. 15H	Drawn by		
		Checked by		
		Approved by		





DRAWING NO.	POLE CLAMP	NEPAL ELECTRICITY AUTHORITY